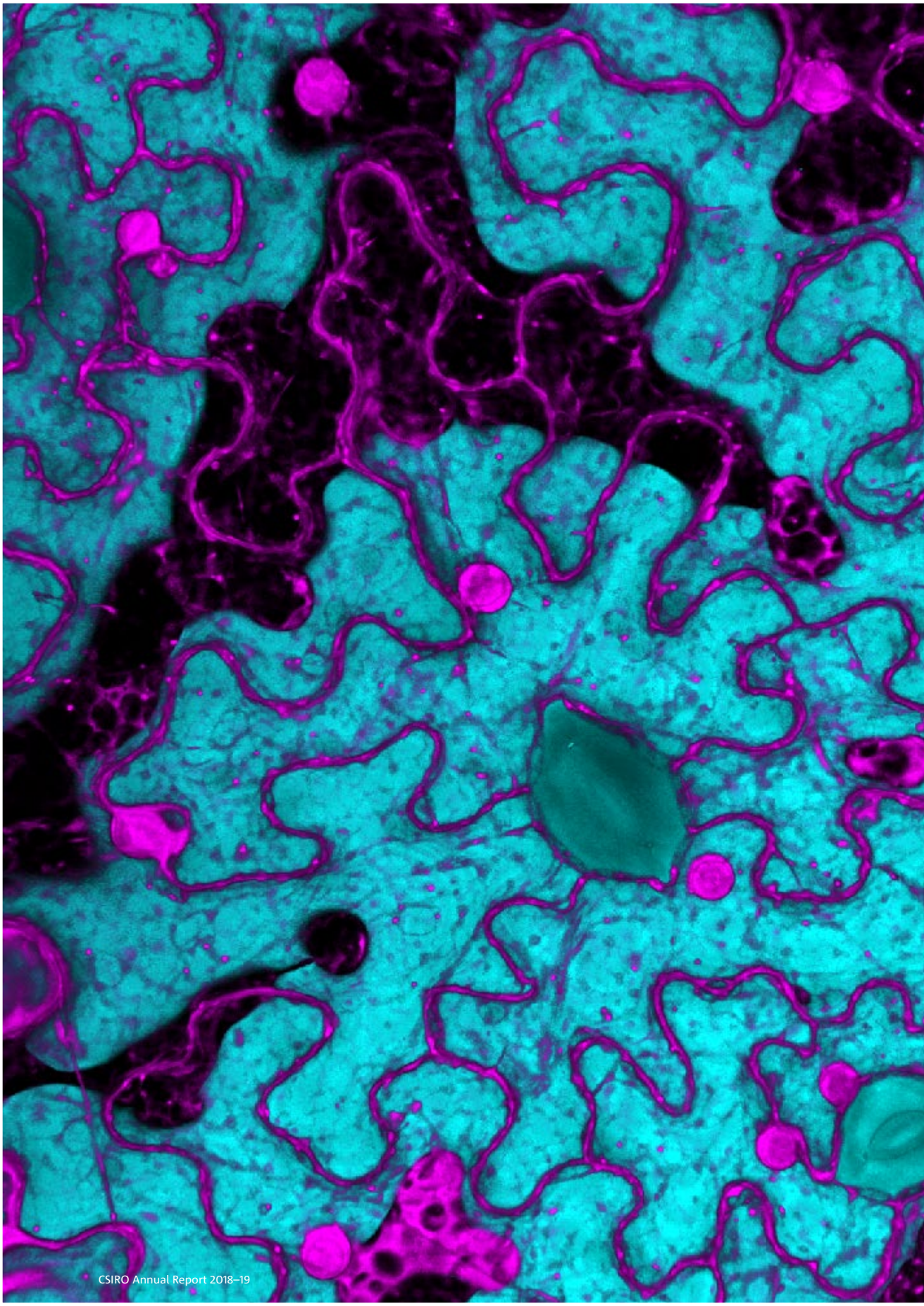
CSIRO

Australia's National
Science Agency

Annual Report 2018–19



Our annual report

This annual report provides a summary of our activities and performance for the financial year ended 30 June 2019 against the planned objectives and outcomes in our Corporate Plan and Portfolio Budget Statements.

Read the annual report online: **csiro.au/annualreport2019**.

CSIRO

We are Australia's national science agency and innovation catalyst. As one of the largest and most multidisciplinary mission-driven research organisations in the world, we unlock a better future for everyone.

Our purpose

We are an Australian Government statutory authority within the industry, innovation and science portfolio, operating under the provisions of the *Science and Industry Research Act 1949* (SIR Act). Our purpose is defined through the functions we undertake as set out in the Act (read more on page 28) and through our Corporate Plan.

To align with our Portfolio Budget Statement outcome statement, we describe our purpose as:

Solving the greatest challenges through innovative science and technology.

Our vision

We are Australia's innovation catalyst, collaborating to boost Australia's innovation performance.

Harnessing the digital revolution.

Our Artificial Intelligence and Machine Learning Future Science Platform is targeting artificial intelligence-driven solutions to build a safer and more efficient future for the next generation.

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30 August 2019

The Hon Karen Andrews MP
Minister for Industry, Science and Technology
Parliament House
CANBERRA ACT 2600

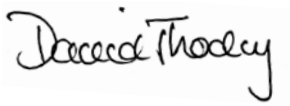
We have pleasure in submitting to you, for presentation to Parliament, the 71st Annual Report of the Commonwealth Scientific and Industrial Research Organisation (CSIRO) for the year ending 30 June 2019. This report has been prepared in accordance with the requirements of the *Science and Industry Research Act 1949*, section 46 of the *Public Governance, Performance and Accountability Act 2013* and the *Public Governance, Performance and Accountability Rule 2014*.

The report was endorsed at the meeting of the CSIRO Board members on 30 August 2019.

Part 6 is a report on the operations of the Science and Industry Endowment Fund (the Fund), which was established under the *Science and Industry Endowment Act 1926*. It also includes a report by the Auditor-General on the accounts of the Fund.

The Corporate Commonwealth Annual Reporting Rule requires CSIRO to report any significant activities and changes that affected the organisation or structure. During the annual reporting period, CSIRO established the role of Chief Scientist as an additional member of the Executive Team.

We are proud of CSIRO's achievements this year.



Mr David Thodey AO
Chairman of the CSIRO Board

Dr Larry Marshall
Chief Executive of the CSIRO

CSIRO
Australia's National Science Agency

Contents

We're monitoring flying foxes in far north Queensland as part of our work in ensuring resilient and valuable environments.

Part 1
Overview

Foreword by the Chairman

There's never been a more important time for Australia to think differently about our future. As Australia's national science agency, CSIRO is building on a century of delivering national benefit to deliver innovative solutions that protect our quality of life, our economic health, our environmental sustainability, and our position in a globally competitive world.

Our cutting-edge science and application of technology, the passion of our diverse people, and our innovative thinking are focused on solving the greatest challenges. I am proud to have experienced the many achievements of CSIRO this year.

We are one of the world's largest mission-driven multidisciplinary science and research organisations. We focus on every aspect of Australia's priorities – from agriculture, to manufacturing, data technology, the environment and much more. Examples highlighted in this annual report include sustainable wheat farming, drought conservation, reducing waste in copper production, protecting precious wildlife species, and applying emerging new technologies like machine learning to amplify the pace and scale of our impact.

In June, we partnered with the National Australia Bank to publish the Australian National Outlook 2019 (ANO), with the participation of more than 50 leaders from over 20 organisations.

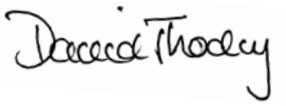
The ANO offers two scenarios – a bleak vision if we don't change our current activities, and a bright vision of the future if we seize the opportunities offered by science and technology to build a future with prosperous and globally competitive industries, inclusive and enabling communities, and sustainable natural endowments. It has started an important and timely conversation in Australia about how we act now to build the future we want.

Our people are committed to unlocking a better future for everyone and are the driving force behind all that we do.

The Board and I were pleased to meet with CSIRO people and partners during our Board visits to sites including Perth, Canberra, Eveleigh, Newcastle and Lindfield over the past 12 months. We were especially pleased to meet with Newcastle-based business and CSIRO partner, Puzzle Precision, whose sophisticated electronic circuit boards are being used inside the world's fastest survey radio telescope, the Australian Square Kilometre Array Pathfinder in Western Australia.

Our more than 3,300 customers this year are critical to our ability to translate science into solutions for Australia.

This annual report tells many stories of the value we're delivering to our partners and customers across industry and business, government and the research community, as well as to every Australian. I want to thank the CSIRO team for their commitment and dedication to fulfilling the purpose of our organisation. I'm honoured to be part of Australia's national science agency as we continue our work to make life better for every Australian.



Mr David Thodey AO
Chairman of the CSIRO Board

Chief Executive's report

For more than 100 years, CSIRO has been solving the greatest challenges through innovative science and technology. Every day, our people get out of bed fuelled by a passion for unlocking a better future for our community, our economy and our planet. As you will see they continue to do an outstanding job of delivering on our purpose.

In this annual report, you'll see some of our world-class science translated into high-impact solutions aligned with the six national challenges we've identified. These challenges leverage the strengths of our strong networks of partners from government, industry, business, academia and the community around common goals to create unique advantages for Australia. They are designed to connect our purpose with the issues that matter most to Australians: food, health, environment, sustainable energy and resources, future industries, and a secure Australia and region.

I'm proud and honoured to look back on all team CSIRO has achieved this year. From extracting ultra-high purity hydrogen from ammonia and powering fuel cell vehicles, to collecting data about the Great Barrier Reef to protect this treasured Australian landmark, to launching the *Future of Health* report so we can keep Australia's health system efficient, equitable and affordable. These are projects that are critical to ensuring Australia's future sustainability, prosperity, and security.

Following our success in digital agriculture, this year we've continued our digital transformation across the full depth and breadth of CSIRO's deep domain expertise, from manufacturing to health and others, to accelerate the pace and scale of our impact. This annual report captures some early examples of the power of combining digital tech with domain expertise, like combatting the impact of drought with the National Drought Map and developing the world's most advanced sensor system for large-scale ore sorting to rapidly determine ore quality. The report also shows progress on the capability programs that are enabling this transformation, including our Digital Academy and our Managed Data Ecosystem.

Importantly, CSIRO doesn't solve any of these challenges alone. We collaborate with every Australian university, government department, across Australia's major industries with businesses of all sizes, and internationally. This year we worked with more than 3,300 customers, including 377 Australian corporations, 375 international corporates, and over 950 small to medium enterprises. Some of our most significant collaborations this year included expanding our 30-year partnership with Boeing into space science, and signing a $20 million partnership with Fortescue to develop hydrogen technologies, both investments in industries of the future.

Australia's future depends on a strong community of STEM professionals and advocates. To inspire the next generation, we delivered programs to more than 190,000 primary and secondary school students, promoting STEM capability, development and education in the classroom. We also lifted our profile by participating in the world-famous Sydney Gay and Lesbian Mardi Gras Parade and promoting our stories through the media to a combined audience of more than 22 million people this year. In a world where trust is still under pressure, CSIRO is one of Australia's most trusted brands, alongside the Australian Red Cross and the Bureau of Meteorology.

Everything we do is driven by our extraordinary and committed 5,500 people around the country. To see our people flourish, we're committed to inclusion and diversity. In line with our Science in Australia Gender Equity (SAGE) Action Plan, we implemented a '50/50 If not, why not?' pledge to call out gender imbalances in teams, committees and around decision-making tables, among other initiatives. We also introduced the Thrive Wellbeing program, and in this year's staff survey, we recorded an all-time high of 92 per cent of our people fully supporting what CSIRO stands for – a testament to our shared commitment.

Solving the greatest challenges has never been more important, and this annual report showcases an adaptive and responsive organisation that will continue to deliver on its purpose and unlock a better future for all Australians.

Dr Larry Marshall
Chief Executive, CSIRO

About us

As Australia's national science agency and innovation catalyst, CSIRO is solving the greatest challenges through innovative science and technology.

We are Australia's most trusted research institution and most connected innovator, working with every Australian university, government department and major Australian industry.

We are one of the largest and most multidisciplinary mission-driven research agencies in the world. Our more than 5,500 people are based across 58 sites in Australia and around the world, and we manage state-of-the-art research facilities for the nation.

Our collaborative research turns science into solutions for food security and quality; clean energy and resources; health and wellbeing; resilient and valuable environments; innovative industries; and a secure Australia and region.

We deliver around $4.5 billion of benefit to the nation each year as a result of our science, securing our future national prosperity as well as environmental and social benefits.

CSIRO. Unlocking a better future for everyone.

Our purpose: solving the greatest challenges through innovative science and technology.

5,500 staff

Committed to delivering the greatest national benefit.

55 sites in Australia and three overseas

Local and international networks collaborated across the globe.

3,300+ customers

1,800+ commercial agreements worth more than $700 million entered into.

$175 million of scientific engagement

Received from more than 200 customers from all levels of Australian government.

67 per cent publication with Australian collaborators*

Everything we do is in collaboration with others – universities, government and industry.

*Analysis of CSIRO's scientific publication output for the period 2014–18 based on WoS Relational database (May 2019), Finch A, Abbott T.

Our strategy

Our strategy directs how we will achieve our purpose and comprises our objectives and outcomes. We are guided by strategic pillars as the key areas for how we deliver our science to meet our purpose and vision.

Our objectives

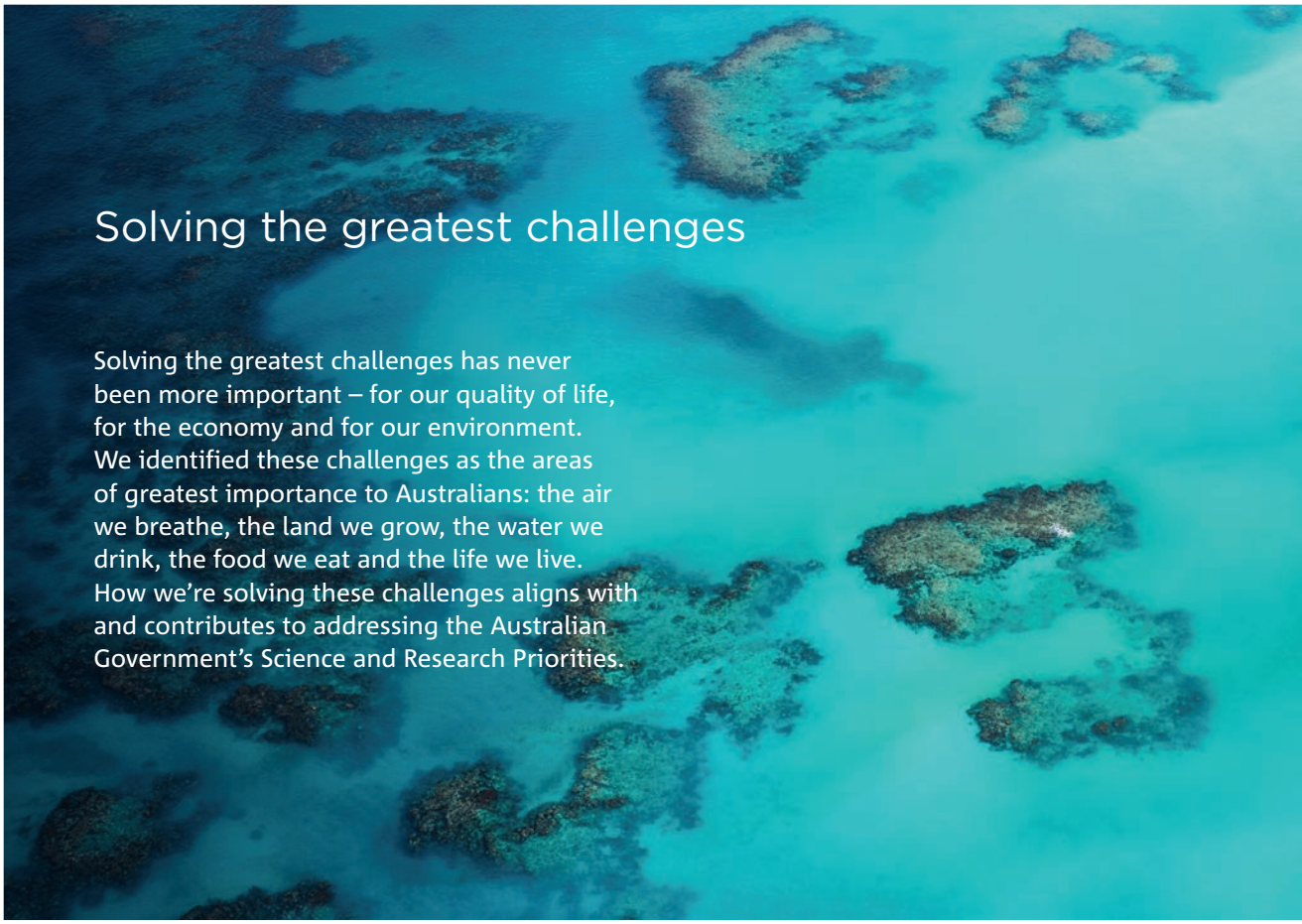
Our objectives are the primary activities to deliver our purpose:

- Conducting and encouraging the uptake of world-class scientific research.
- Mobilising and developing the best talent, for the benefit of Australia.
- Managing national research infrastructure for the nation.
- Ensure the sustainability of CSIRO.

Strategic pillars

These core areas defined in our Corporate Plan 2018–19 guide our operations and bring our purpose, vision and strategy to life:

- **Customer first:** creating deeper innovation relationships with our customers and prioritising the highest impact investments.
- **Collaboration:** integrating the best solutions for our customers, increasing our flexibility, and enhancing Australia's innovation performance.
- **Breakthrough innovation:** increasing our capacity to help reinvent existing industries and create new industries for Australia and deliver public good.
- **Global engagement, national benefit:** delivering connectivity to the global science, technology and innovation frontier as well as accessing new markets for Australian innovation.
- **Excellent science:** creating breakthrough technology and knowledge and being a trusted advisor for Australia.
- **Our people:** enabling and supporting the innovative capacity of our creative people and teams to take risks and deliver to customers.
- **Health, safety and environment:** enhancing staff safety and wellbeing and to further our aspirations towards zero harm.
- **Adaptiveness:** enhancing our agility, financial sustainability and capacity to respond at the speed of business.



Solving the greatest challenges

Solving the greatest challenges has never been more important – for our quality of life, for the economy and for our environment. We identified these challenges as the areas of greatest importance to Australians: the air we breathe, the land we grow, the water we drink, the food we eat and the life we live. How we're solving these challenges aligns with and contributes to addressing the Australian Government's Science and Research Priorities.

1 Food security and quality

Achieving sustainable regional food security and growing Australia's share of premium AgriFood markets.

- We tackled the issue of improving wheat yields and profitability using a multidisciplinary farming systems approach to produce more food sustainably for an increasing population using limited resources.
- We developed the world's first scientifically-tested management procedure for southern bluefin tuna to set global catch limits that reduce the risk of extinction.
- We launched fishIDER (fish Identification Database and Educational Resource), a website and online training tool that helps to identify important food fish species in Indonesia, including tuna, billfish and sharks.

2 Health and wellbeing

Enhancing health for all through preventative, personalised, biomedical and digital health services.

- We launched the *Future of Health* report which details what's needed to keep Australia's health system efficient, equitable and affordable.
- We worked with Australian Plant Proteins Pty Ltd to develop a more advanced and efficient manufacturing process that produces a plant-based protein powder using faba beans.

3 Resilient and valuable environments

Enhancing the resilience, sustainable use and value of our environments.

- We collected data about the Great Barrier Reef's physical and biological processes to sustain and protect this treasured icon.
- We used data science to combat the impact of drought and created the National Drought Map. The map uses Data61's TerriaJS platform, building on our deep strength in mapping and visualising data in 3-D and 4-D.
- Through field studies and desktop analyses, we investigated land suitability in Northern Australia for irrigation and aquaculture, as well as water storage and capture options to understand the scale and nature of future development opportunities.
- As part of the National Rabbit Biocontrol Monitoring Program, we developed and implemented near real-time diagnostic tests to monitor the spread and impact of the different types of virus in the landscape.

4 Sustainable energy and resources

Building regional energy and resource security while lowering emissions.

- We extracted ultra-high purity hydrogen from ammonia and powered two fuel cell vehicles.
- Renewable energy start-up Evergen, in partnership with AMP Capital, was named winner of the CSIRO Entrepreneurship Award for pioneering the concept of a virtual power station, combining predictive control with battery and solar technology with benefits to consumers and electricity system operators.
- We developed the world's most advanced sensor system for large-scale ore sorting to rapidly determine ore quality (grade) in order to reject large volumes of waste rock before it enters the plant for processing.

5 Future industries

Creating Australia's future industries and jobs by collaborating to boost innovation performance and STEM skills.

- We collaborated with the National Gallery of Victoria and used flow chemistry, the latest development in chemical processing, to create a new varnish that will protect paintings from ageing.
- We developed two new Future Science Platforms to plan for Australia's future: Space Technologies, and Artificial Intelligence and Machine Learning.

6 A secure Australia and region

Safeguarding Australia from risks such as war, terrorism, pandemics, disasters and cyber-attacks.

- We released the Australian National Outlook 2019 with the National Australia Bank and our report participants. This second iteration explored how Australia can have a future with prosperous and globally competitive industries.
- We collaborated with international institutions to develop a vaccine and improve our diagnostic testing for African swine fever to help control the disease and ensure Australia is prepared should it reach our shores.

World-class scientific research

We deliver impact to the nation through our Business Units.

Agriculture and Food: improving productivity, profitability and sustainability in Australia's food and fibre industries.

Data61: solving Australia's largest data-driven challenges through CSIRO's specialist data science group.

Energy: delivering science and technology to enable Australia's transition to a net zero emissions energy future.

Health and Biosecurity: understanding human, animal and environmental health and biosecurity.

Land and Water: delivering innovative science and technologies to catalyse the sustainable management of natural, managed and built environments.

Manufacturing: developing industry-driven scientific and engineering innovations to catalyse the transition of Australian manufacturing into a globally connected, economically viable, high-technology sector.

Mineral Resources: supporting efficient exploration and discovery of new mineral resources for the benefit of Australia and the world.

Oceans and Atmosphere: undertaking world-class ocean, atmosphere and climate research that protects the environment and informs sustainable coastal and offshore development.

Using robotics and digital technology, we're creating Australia's future industries and jobs.

The Active Integrated Matter Future Science Platform harnesses digital technology, autonomous systems and materials science to deliver the transdisciplinary scientific breakthroughs needed for Enlightened Industry, or Industry 5.0.

Future Science Platforms

Future Science Platforms are our investment in science areas that will help reinvent and create new industries for Australia.

Active Integrated Matter: ground-breaking advances at the interface of big data, advanced autonomous systems and materials science.

Artificial Intelligence and Machine Learning: targeting artificial intelligence-driven solutions to build a safer and more efficient future for the next generation.

Deep Earth Imaging: imaging subsurface rock properties to unlock the potential of the greater depths in the Earth.

Digiscape: building a common big data infrastructure to support Australian farmers and land managers.

Environomics: reinventing how we measure and monitor ecosystem health, predicting environmental change and finding new resources in nature.

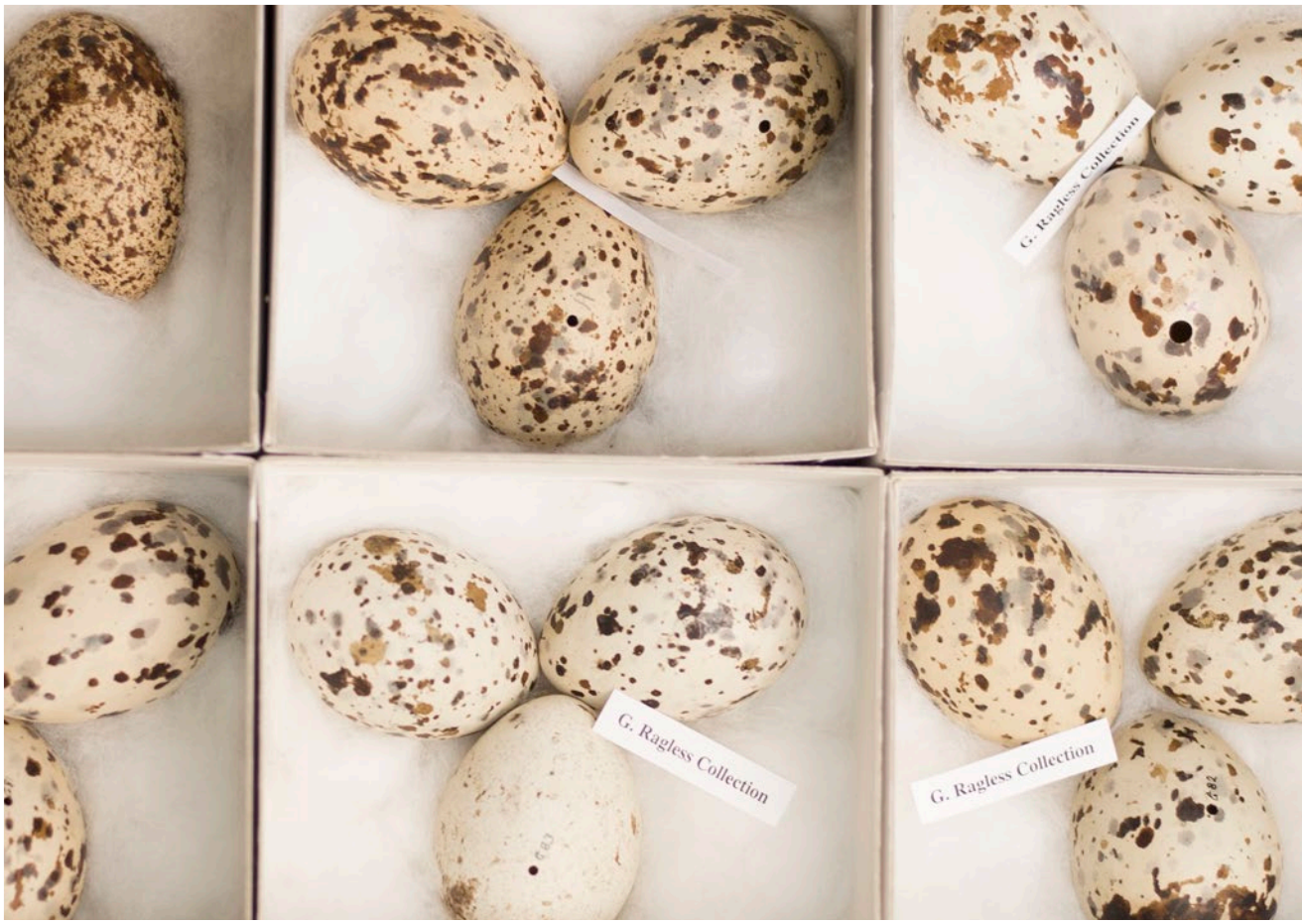
Hydrogen Energy Systems: creating new science, capabilities and technologies across the emerging hydrogen value chain to support new Australian industries and large-scale emissions reduction.

Precision Health: engaging with communities to create an integrated platform to manage a person's health through tailored food, nutrition and lifestyle interventions.

Probing Biosystems: obtaining real-time information from living organisms to provide customised health and medical interventions.

Space Technology: identifying and developing the science to leapfrog traditional technologies and find new areas for Australian industry to work in.

Synthetic Biology: artificial engineering of biological systems.



Managing national research infrastructure for the nation

Through our facilities, we are enabling scientists to deliver world-class research, as well as safeguarding Australia's health and industries.

Australian Animal Health Laboratory: protecting Australia from emerging infectious disease threats.

Australia Telescope National Facility: Australia's premier radio astronomy infrastructure and technical leadership for space activities.

Marine National Facility: supporting, enabling and inspiring marine science.

National Research Collections Australia: securing our biodiversity future.

Pawsey Supercomputing Centre: a world-class high-performance supercomputing facility.

Atlas of Living Australia: making Australia's biological specimen collections available on-line.

The Australian National Wildlife Collection (ANWC), part of the National Research Collections Australia, holds more than 17,000 bird eggs from more than 1,000 species, including the G. Ragless Collection.

Developing the best talent

We promote science, technology, engineering and mathematics (STEM) capability, development and education and facilitate the use of scientific research.

Education and Outreach programs: delivering innovative learning opportunities to schools, teachers and the wider community and training the next generation of STEM professionals.

CSIRO Publishing: building awareness and appreciation through scholarly and general publishing.

SME Connect: facilitating and enabling innovation-driven partnerships through funding, support and resources.

CSIRO Futures: translating science into strategy to help businesses and governments address major opportunities and challenges over the coming decades.

Infrastructure Technologies: providing testing, assessment and consulting services to help develop better building products and systems.

We're looking at solving the challenge of resilient and valuable environments by enhancing the resilience, sustainable use and value of our environments.

Every day, our 5,500 people get out of bed fuelled by a passion for unlocking a better future for our community, our economy and our planet.

Part 2
Our people

Our extraordinary people are critical to CSIRO's success and bring our excellent science to life. We inspire each other, trust each other and collaborate closely to help solve complex problems that will make a real difference to our future.

Staff pride

92 per cent of staff are proud to be associated with CSIRO.

Science in Australia Gender Equity (SAGE) Institutional Bronze Award

We're committed to advancing workplace gender equity.

Thrive Wellbeing program

Helping our people prioritise their health, safety and wellbeing.

Annual CSIRO Awards

Celebrating the hard work and achievements of our people.

Second Reconciliation Action Plan

Investing in Aboriginal and Torres Strait Islander cultural knowledge.

Staff numbers

As at 30 June 2019, we had 5,915 staff, a full time equivalent of 5,359. Of these, 3,685, or 62 per cent, were classified within the research function.

Overall, the number of staff increased by 2.6 per cent (148) this year. The proportion of female staff increased by 0.6 per cent to 42.1 per cent and the proportion of female research science staff has increased slightly to 28.1 per cent. Research science staff increased by one per cent (37). Voluntary staff turnover increased slightly from the previous year but remained relatively low at six per cent.

Table 2.1: Staff numbers (headcount)

FUNCTIONAL AREA	2014–15	2015–16	2016–17	% FEMALE 2016–17	2017–18	% FEMALE 2017–18	2018–19	% FEMALE 2018–19
Research								
Research Scientists/ Engineers	1,520	1,466	1,473	27	1,533	27	1,570	28
Research Project staff	1,669	1,752	1,803	41	1,809	42	1,829	42
Research Management	254	248	246	19	251	22	233	21
Research Consulting	40	54	58	22	55	26	53	25
Non-research								
Senior Specialists	21	20	21	43	19	42	17	47
Technical Services	537	586	621	16	672	17	719	17
Communication and Information Services	201	203	237	78	260	78	281	80
General Services	16	23	20	55	19	53	16	50
Administrative Support	908	909	942	75	999	75	1,046	75
General Management	103	106	144	40	150	45	151	50
Total headcount	**5,269**	**5,367**	**5,565**	**40**	**5,767**	**41**	**5,915**	**42**
Full-time equivalent (FTE)	**4,836**	**4,864**	**4,990**	**38**	**5,190**	**39**	**5,359**	**40**

In 2016–17, the creation of Data61 led to the classification of new roles in General Management and changes in some functions led to an increase in staff reported in that functional area.

Our People Strategy

We strive to attract the best people and develop and engage them in an inclusive and diverse environment. We are committed to fostering individual growth and providing equal opportunities for our staff.

There are four focus areas of our People Strategy: talent; empower; mobility and agility; and diversity and inclusion. This strategy is enhanced through our Cultural Alignment Program – linking our organisational culture and strategy. It focuses on creating a culture of mutual trust, transparency and accountability, collaboration, and inclusion and participation.

Talent

Our staff are critical to the delivery of innovative science and technology for our customers. To ensure we attract the best people, we developed a new approach to assessing and filling our future workforce. A student and early-career staff focus helped us deepen partner relationships with universities and increase engagement in education and training, from school-age to post-doctorate level. This focus is helping to build Australia's future science, technology, engineering and mathematics (STEM) and innovation-capable workforce.
We have started a project to design a new model for talent acquisition, with a focus on the candidate experience (read more about our student programs on page 74).

This year we increased learning opportunities and experiences for our staff by delivering 6,549 days of facilitated development, an increase from 5,824 days in 2017–18. This consolidates significant year-on-year growth, up 34 per cent since 2014–15, as we strive to develop Australia's national science talent.

We focused on supporting and building the wellbeing of our national science talent. Aligning with the release of our Thrive Wellbeing program, we facilitated online learning for more than 1,000 leaders and teams to build emotional wellbeing and resilience. We supported an increasing number of staff to access career development planning and advice to address changing and future work expectations through our Career Development Centre and Intensive Development Centre (for future leaders), with more than 158 participants benefiting from programs in 2018–19.

We expanded the number of programs we offered to build digital literacy and data science capability. Our digital learning offering continues to grow, currently including best-practice skill development in data analysis, visualisation and management, CSIRO's Data School complemented by DataCamp's Online Course Library and Software Carpentries' instructor training. Further expansion is planned for the Digital Academy, including the announcement of our partnership with the Research Data Alliance Plenary, to be held in Australia in 2020.

We continued to enhance learning delivery methods and reach through a digital modernisation program. This included embedding new technology such as a new learning management system, online program nomination and evaluation mechanisms, and virtual collaboration platforms. This technology enabled online social learning in our programs. The ongoing investment in digital modernisation is critical to enabling us to meet future capability needs and continue to build our nation's science leadership and talent at scale.

We supported future science talent through the design and implementation of a bespoke CSIRO development framework for our CSIRO Early Research Career Postdoctoral Fellows. This ensures relevant and focused learning opportunities are available and accessible as part of their CSIRO experience. It supports them to develop the capabilities required to operate as an independent researcher within CSIRO or beyond.

Empower

Our leaders and staff are integral to delivering our strategy – and we empower them to do so. Having staff more fully engaged and taking part in organisational decisions and change is central to their empowerment.

Annual round-table discussions, Leader Change webinars, crowdsourcing ideas and CSIRO Connect all-employee events helped to provide more visibility, transparency and two-way feedback between CSIRO senior leadership and its team (read more about our staff morale and engagement on page 80).

Through extensive engagement, we also defined the CSIRO Experience to differentiate CSIRO as an employer of choice, improve our employee experience to retain and develop critical science capability, and attract new people to world-class science, engineering and digital research for

CSIRO Early Research Career Postdoctoral Fellows

Our CSIRO Early Research Career (CERC) Postdoctoral Fellowship program develops the next generation of leaders in the innovation system. These Fellowships enhance the person's research capability so that they are better able to pursue a career in science at CSIRO or beyond.

We employed 417 CERC Postdoctoral Fellows over the course of the past year.

Table 2.2 provides a point in time comparison with previous years of the number of CERC Postdoctoral Fellows.

Table 2.2: CERC Postdoctoral Fellows as at 31 May 2019

	2015	2016	2017	2018	2019
CERC Postdoctoral Fellows	303	229	248	310	331

Australia's future. It brings together what our research told us makes CSIRO an incredible place to work, from meaningful and impactful work, great people and teams, pay and working conditions, learning and career development, and an inclusive culture and genuine work and life flexibility.

We focused on the delivery of new learning and development initiatives in three key priority areas to enable a more digital and diverse environment. We created a Digital Academy to support our future workplace. This program offers data-focused learning across a range of programming languages, data analysis, curation and cyber security topics, through a selection of learning delivery modes. The second priority area targeted more collaborative and inclusive team practices. Our objective was to enable our people to work together more effectively to solve complex problems and build critical skills, which will support our role as a catalyst in the innovation system. The programs included an Inclusive Leader Program for mid-level leaders and a First-Responder training program to support victims of Family and Domestic Abuse. Finally, in our continued focus on leadership, we successfully piloted the Productive Collaborations program, the Leadership Shadow program for senior leaders, and the Executive 360 Feedback and Coaching Program for the Executive and CSIRO Leadership teams, to develop self-awareness, personal insight and build their leadership capability and effectiveness.

Investment in leadership development across all levels increased again this year by nearly 20 per cent, with more than 1,500 days of leadership development accessed by CSIRO leaders. Highlights included participation in our Ready to Lead program growing by more than 400 per cent. This program achieved 'highly commended' in the Best Implementation of Blended Learning Solution (Large Enterprise) category at the Australian Institute of Training and Development's 2018 Excellence Awards.

Across all leadership programs we reached 48 per cent female participation, which significantly exceeded our 30 per cent minimum requirement. In addition, more than 400 leaders accessed 360-degree feedback, communication and collaboration style inventories, psychometric tools and coaching.

Mobility and agility

CSIRO continued its secondment and mobility program, Switch, where we quickly appoint staff to areas where they are most needed. Now in its second year, there were 20 Switch secondments, increasing the exchange of people and know-how between research, industry and government (read more about our staff morale and engagement on page 80).

Diversity and inclusion

To deliver on our purpose, we need a diverse and inclusive team. One of our key priorities is to increase the diversity of our employees and to embed diversity and inclusion into the entire organisation. This year, we launched the 2019–22 Diversity and Inclusion Strategy. We're committed to creating an environment where each individual is included and supported and can realise their full potential. We're achieving this through a workplace culture that accepts, values and enables difference (read more about diversity in leadership on page 81).

For the first time, we marched in the annual Sydney Gay and Lesbian Mardi Gras Parade to demonstrate and celebrate that we are diverse, inclusive and a great place to work, for everyone. We introduced the inaugural CSIRO Diversity and Inclusion Award and completed the gender pay equity model, using insights from this initiative to address gaps in pay and inform future salary decisions.

Indigenous engagement

We recognise that Aboriginal and Torres Strait Islander peoples have made and will continue to make extraordinary contributions to all aspects of Australian life, including culture, the economy and science.

The new Introduction to Aboriginal and Torres Strait Islander Cultural Awareness at CSIRO program was launched, which won a Platinum Award in the Best eLearning Design category at the LearnX 2019 Awards. At 30 June 2019, 36 per cent of staff had completed the online learning module.

Events were held at seven national sites to acknowledge the anniversary of the National Apology and to celebrate National Reconciliation Week.

Our Chief Executive, senior leaders and more than 20 Aboriginal and Torres Strait Islander staff attended the GARMA 2018 Festival, Australia's largest Aboriginal-led cultural exchange. Eight members of our Education and Outreach team also led STEM-based workshops at the Youth Forum.

We sought advice and developed CSIRO activities that better meet the needs of Aboriginal and Torres Strait Islander communities through our representative councils and committees, including the Indigenous Strategic Advisory Council, Independent Indigenous Reference Group, Indigenous Innovation Alliance, Health and Biosecurity Advisory Committee and the Indigenous STEM Education Project Steering Committee.

We were also awarded the Indigenous Girls' STEM Academy program, in collaboration with CareerTrackers Indigenous Internship Program (read more about the Academy on page 74). The CSIRO Medal for Aboriginal and Torres Strait Islander Engagement was awarded for the successful joint management at Arakwal National Park.

Celebrating our people's achievements

Order of Australia

Companion of the Order (AC)

Dr Elizabeth Dennis, for eminent service to science as a researcher and academic in the area of genomics and plant development, and to professional organisations.

Officer of the Order of Australia (AO)

Professor Calum Drummond, for distinguished service to chemistry and materials science research, to commercialisation initiatives, and as a mentor.

Dr Ronald Ekers, for distinguished service to science as a radio astronomer, to scientific education, and to international astronomical organisations.

Ms Kathryn Fagg, for distinguished service to business and finance, to the central banking, logistics and manufacturing sectors, and to women.

Professor Elaine Sadler, for distinguished service to science as an astrophysicist in the field of galaxy evolution, and to gender equality.

Professor Frances Separovic, for distinguished service to science education, particularly to biophysical chemistry, as an academic, and to young women scientists.

Reconciliation Action Plan 2018–20

In November, we launched our second Reconciliation Action Plan. This builds on our previous plan and the significant work undertaken since our Indigenous Engagement Strategy was implemented in 2007. Aligned to our organisational strategy, our Reconciliation Action Plan aims to increase partnerships, education, engagement, employment and procurement opportunities for Aboriginal and Torres Strait Islander peoples.

We continued to make progress to achieve the plan's commitments. In September, we invested in an Indigenous Capability Development Program, an initiative aimed to attract, recruit, retain and build future pathways for Aboriginal and Torres Strait Islander peoples. Through our Cultural Capability Framework, we increased our staff's awareness of Aboriginal and Torres Strait Islander culture and history.

We made progress towards achieving a three per cent representation of Aboriginal and Torres Strait Islander peoples in our workforce. Currently, two per cent of our employees identify as Aboriginal or Torres Strait Islander, including 19 cadets and 16 trainees, along with 85 research, technical, administrative and management staff.

To enable greater support, engagement and visibility of career opportunities for Indigenous staff at CSIRO, we implemented a staff network, talent management database, and social media platforms.

We also developed relationships with 13 universities nationwide and established up to 25 Indigenous STEM scholarships, invested in 20 Indigenous staff and provided support to retain 34 Indigenous CSIRO staff.

Australian Academy of Science Fellowship

Professor David Karoly, a leading environmentalist scientist, for major contributions in climate dynamics and climate change science including increased understanding of climate anomalies across the globe.

Dr Surinder Singh, for cutting edge plant oil engineering research that produces large amounts of long-chain omega-3 oils from canola seeds. Previously such oils came from unsustainable marine sources.

Australian Academy of Science Matthew Flinders medal and lecture

Dr Dick Manchester, for his world-leading research into pulsars.

Australian Academy of Technology, Science and Engineering Fellowship

Dr Anna Koltunow, for achievements in plant reproduction and seedless fruit formation understanding used for developing crops with transformational productivity gains.

Australian Museum Eureka Prizes

The Smart Infrastructure Team in Data61 took home the University of Technology Sydney Eureka Prize for Excellence in Data Science. The team worked to address the problem of assessing the condition of water pipes by developing an analytical tool that can make intelligent predictions about water pipe failures.

Web of Science Highly Cited Researchers 2018

Dr Josep Canadell, Dr Peter Dodds, Dr Simon Ferrier, Dr Elizabeth Fulton, Dr Kemal Kazan, Dr John Kirkegaard, Dr Evans Lagudah, Dr John Manners, Dr Craig Moritz, Professor Rana Munns, Dr Mark Peoples, Dr Alan Richardson, Professor Anthony Richardson, Dr Raphael Viscarra Rossel and Dr Yingping Wang among the most cited authors in their respective fields of study. The Highly Cited Researchers list recognises leading researchers in the sciences and social sciences through the publications indexed in the Web of Science core collection that rank in the top one per cent by citations for their field and year.

Boeing 2018 Supplier of the Year

CSIRO's Manufacturing Team received the 2018 Environment Award as the supplier with demonstrated leadership, outstanding performance or successful partnerships in a formal, measurable environmental program and culture of environmental leadership.

The Chairman's Medal for Science Excellence

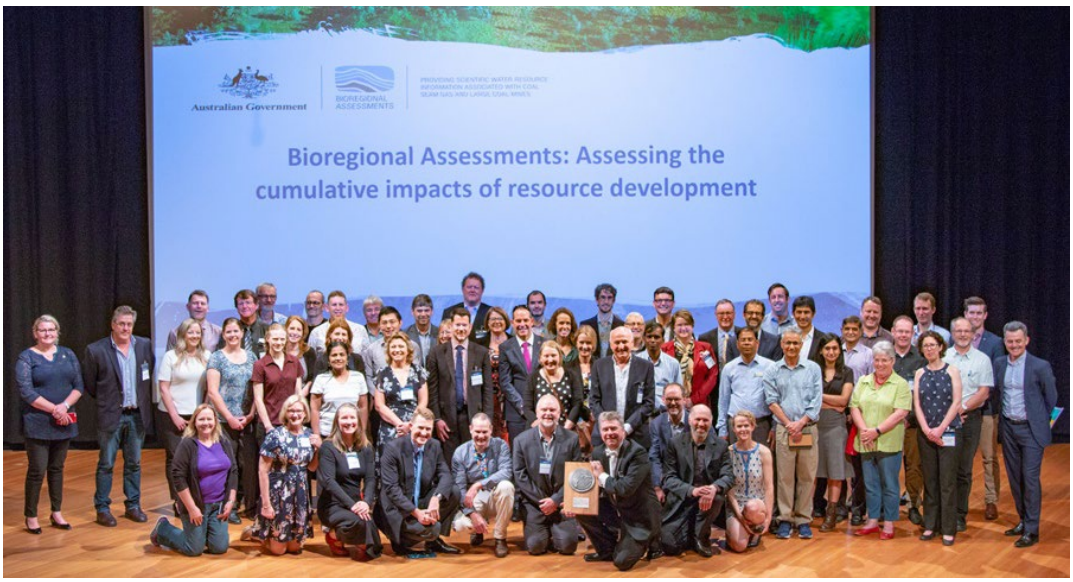
This award recognises teams who have made significant scientific or technological advances that create value for our customers via innovation that delivers positive impact for Australia.

The Bioregional Assessments Team were awarded the medal for their world-first integrated assessment of the potential impacts of $2.5 trillion of future coal seam gas and coal mine developments in eastern Australia on water resources and water-dependent ecological, economic and sociocultural assets.

The CSIRO Medal for Impact from Science

This award recognises exceptional individuals or research teams who have created value for customers through innovation that delivers impact for Australia.

The Southern Bluefin Tuna Monitoring and Management Team were awarded the medal for improving the economic returns, community benefits and stock status of the southern bluefin tuna fishery. They achieved this by delivering a scientifically tested management system in combination with the development of ground-breaking genomic assessment methods (read more about southern bluefin tuna monitoring on page 43).



The Chairman's Medal for Science Excellence winners: Bioregional Assessments, in partnership with Department of Environment and Energy.

CSIRO Medal for Lifetime Achievement

This award recognises individuals who have a record of sustained and meritorious achievements in science, technology and innovation or the support of science, technology and innovation.

Dr John La Salle was an internationally recognised insect taxonomist, renowned for his contribution to science as well as his energy, passion and humour. Dr La Salle joined CSIRO in 2000 and soon became Director of the Australian National Insect Collection. His main research area was Hymenoptera (wasps, bees, ants) and the systematics of parasitic wasps (particularly Chalcidoidea). Dr La Salle identified early on that taxonomy and collection management needed to embrace new technologies in order to contribute significantly to sustaining and conserving biodiversity. He was instrumental in establishing the Atlas of Living Australia and became its Director in 2012.

Dr La Salle passed away in 2018. His two sons, Alex and Sam La Salle along with Toni Moate, Director National Collections and Marine Infrastructure, accepted the award on Dr La Salle's behalf.

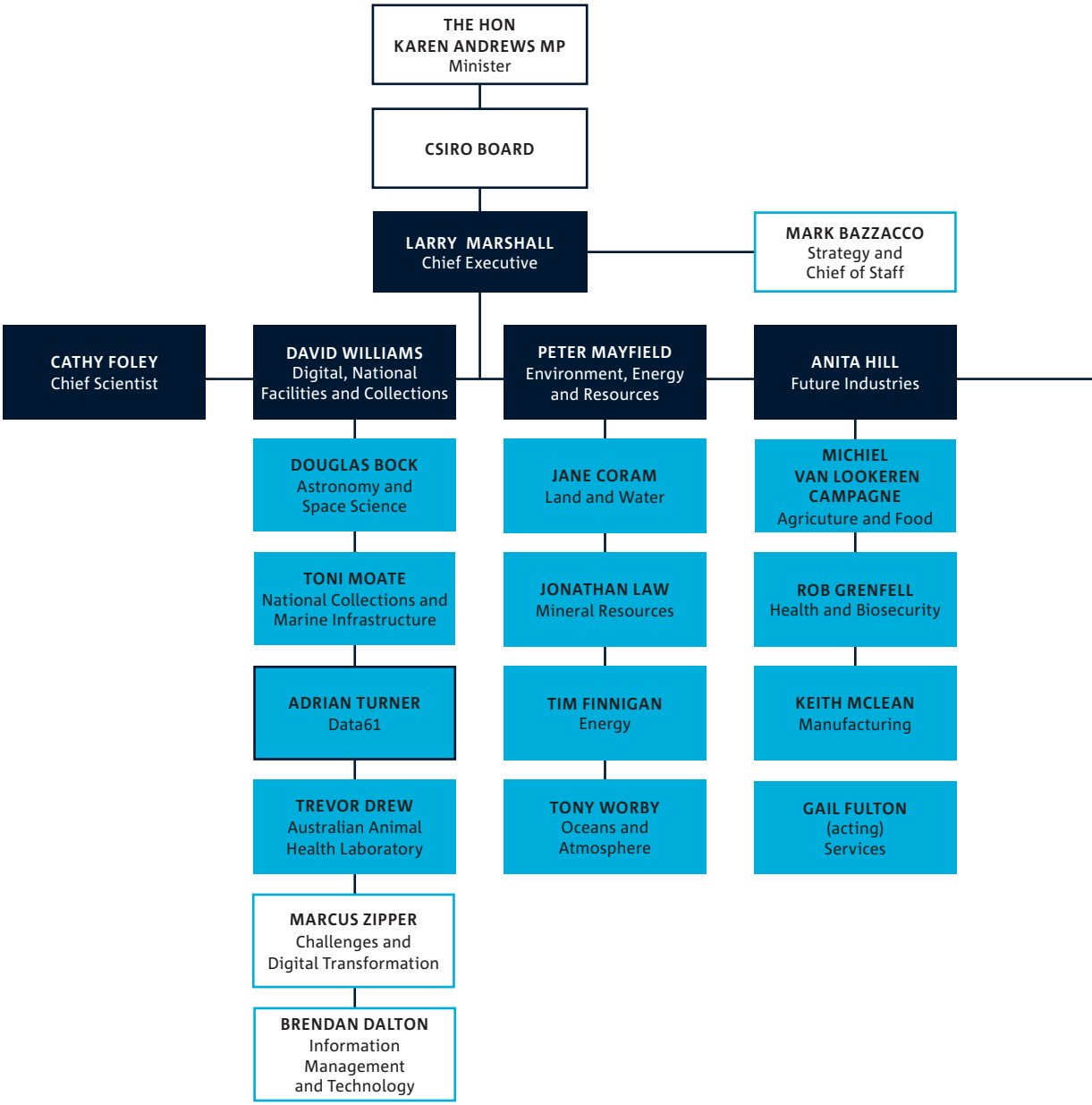
Professor Manny Noakes is an eminent scientific leader, a key thought leader and trusted advisor in nutrition and health. She has improved the health of Australians by translating complex science into high-impact communications that in turn produce life-changing health benefits for the public. Professor Noakes was one of the key driving forces behind CSIRO's first Total Wellbeing Diet, and the subsequent development and release of a further five editions. Under Professor Noakes' guidance, the Total Wellbeing Diet has become a brand synonymous with CSIRO and this has helped increase the community's broader awareness of our organisation.

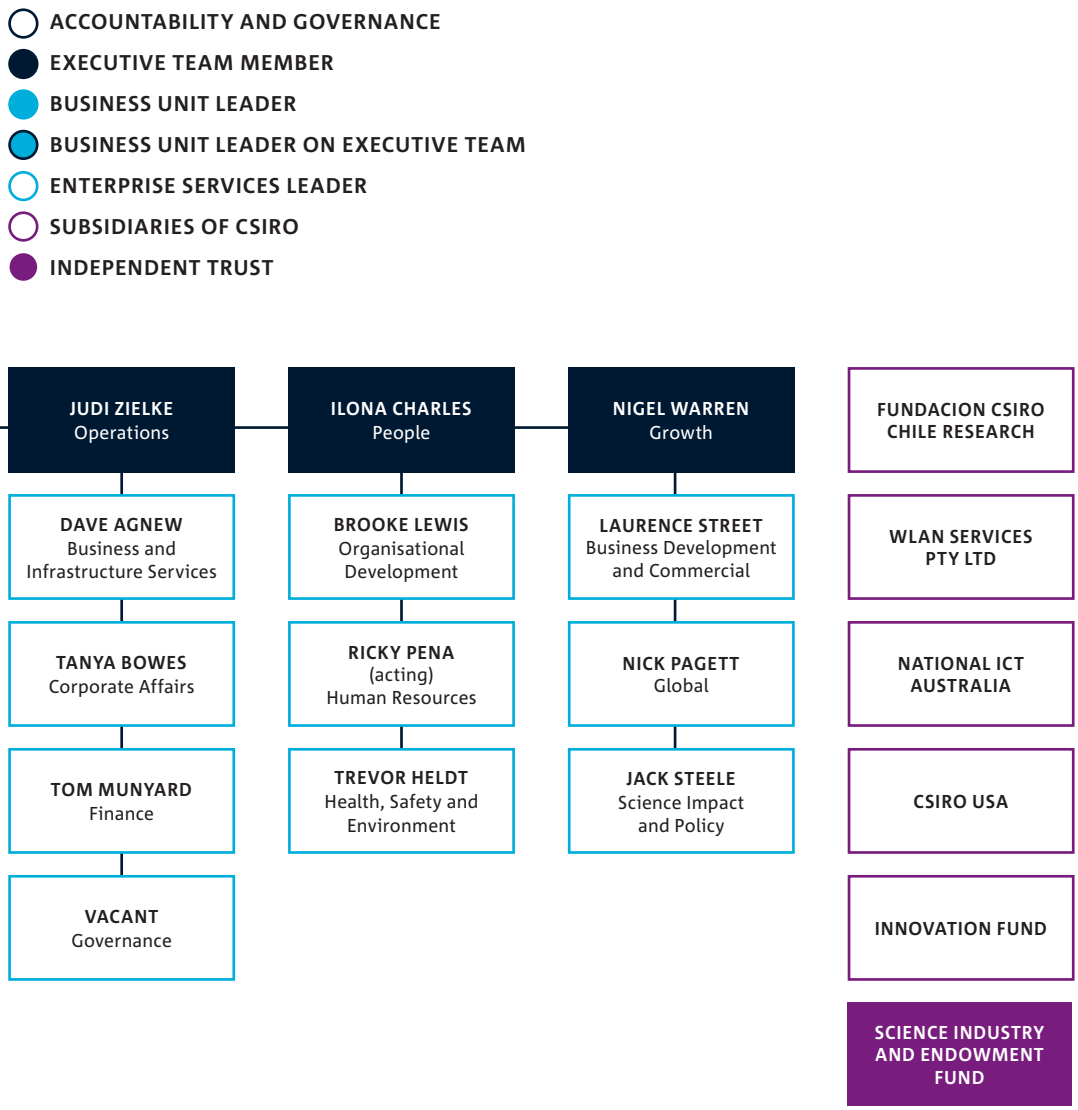
The CSIRO Medal for Lifetime Achievement: Sam La Salle, Larry Marshall, Cigdem La Salle and Alex La Salle.

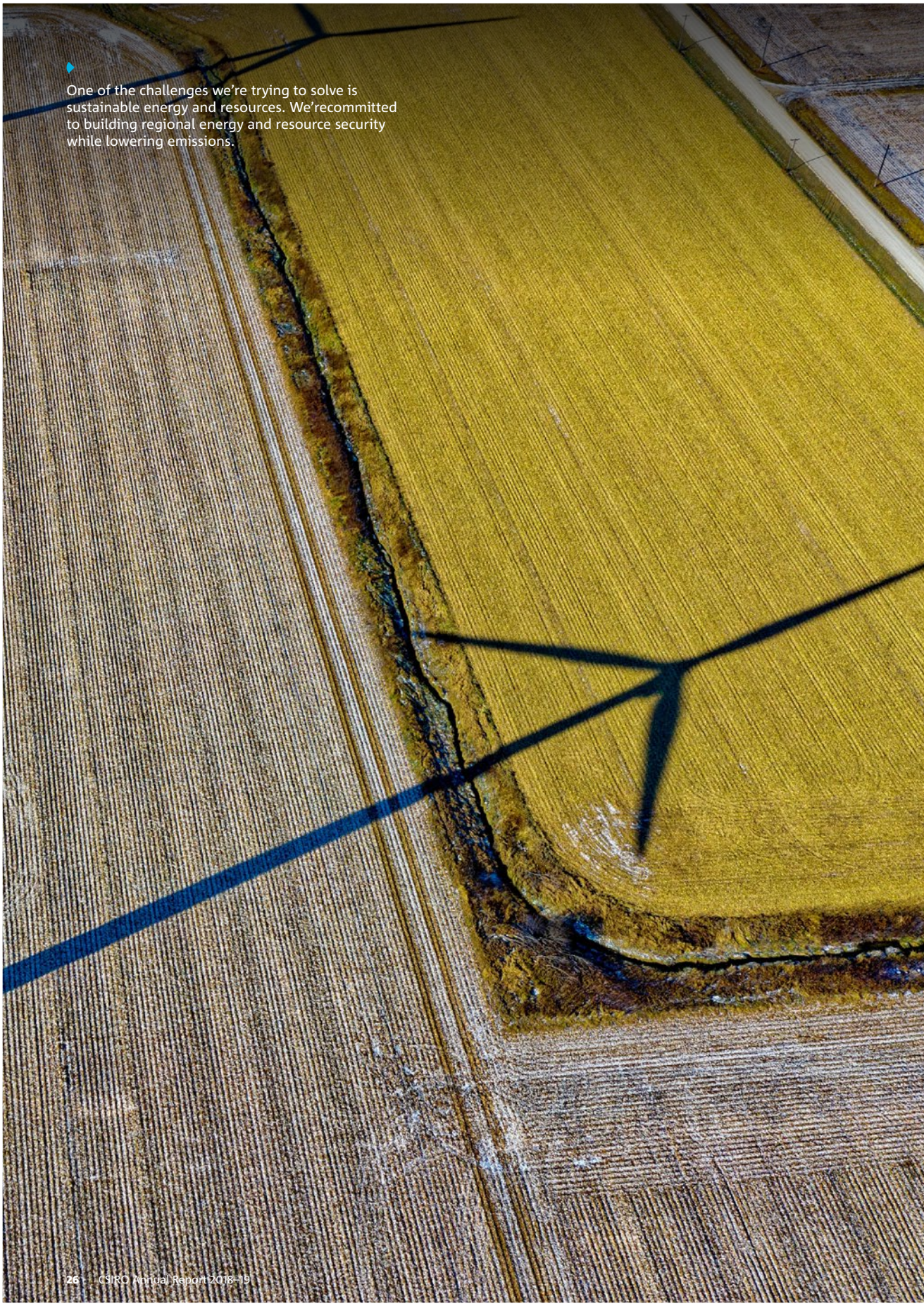
The CSIRO Medal for Lifetime Achievement: Larry Marshall and Manny Noakes.

Our organisational structure

(as at 30 June 2019)




ACCOUNTABILITY AND GOVERNANCE
EXECUTIVE TEAM MEMBER
BUSINESS UNIT LEADER
BUSINESS UNIT LEADER ON EXECUTIVE TEAM
ENTERPRISE SERVICES LEADER
SUBSIDIARIES OF CSIRO
INDEPENDENT TRUST
JUDI ZIELKE
Operations
DAVE AGNEW
Business and Infrastructure Services
TANYA BOWES
Corporate Affairs
TOM MUNYARD
Finance
VACANT
Governance
ILONA CHARLES
People
BROOKE LEWIS
Organisational Development
RICKY PENA
(acting)
Human Resources
TREVOR HELDT
Health, Safety and Environment
NIGEL WARREN
Growth
LAURENCE STREET
Business Development and Commercial
NICK PAGETT
Global
JACK STEELE
Science Impact and Policy
FUNDACION CSIRO CHILE RESEARCH
WLAN SERVICES PTY LTD
NATIONAL ICT AUSTRALIA
CSIRO USA
INNOVATION FUND
SCIENCE INDUSTRY AND ENDOWMENT FUND



One of the challenges we're trying to solve is sustainable energy and resources. We'recommitted to building regional energy and resource security while lowering emissions.

Part 3
Annual performance statement

Introductory statement

The CSIRO Board, as the accountable authority of CSIRO, presents the 2018–19 annual performance statements as required under s39 (1) (b) of the *Public Governance, Performance and Accountability Act 2013* (PGPA Act). These annual performance statements are based on properly maintained records, and accurately present CSIRO's performance in accordance with s39 (2) of the PGPA Act.

Purpose

CSIRO's purpose is to provide innovative scientific and technology solutions to national challenges and opportunities to benefit industry, the environment and the community, through scientific research and capability development, services and advice.

To deliver our purpose we:

- Conduct, and encourage the uptake of world-class scientific research
- Mobilise and develop the best talent, for the benefit of Australia
- Manage research infrastructure on behalf of the nation.

Results

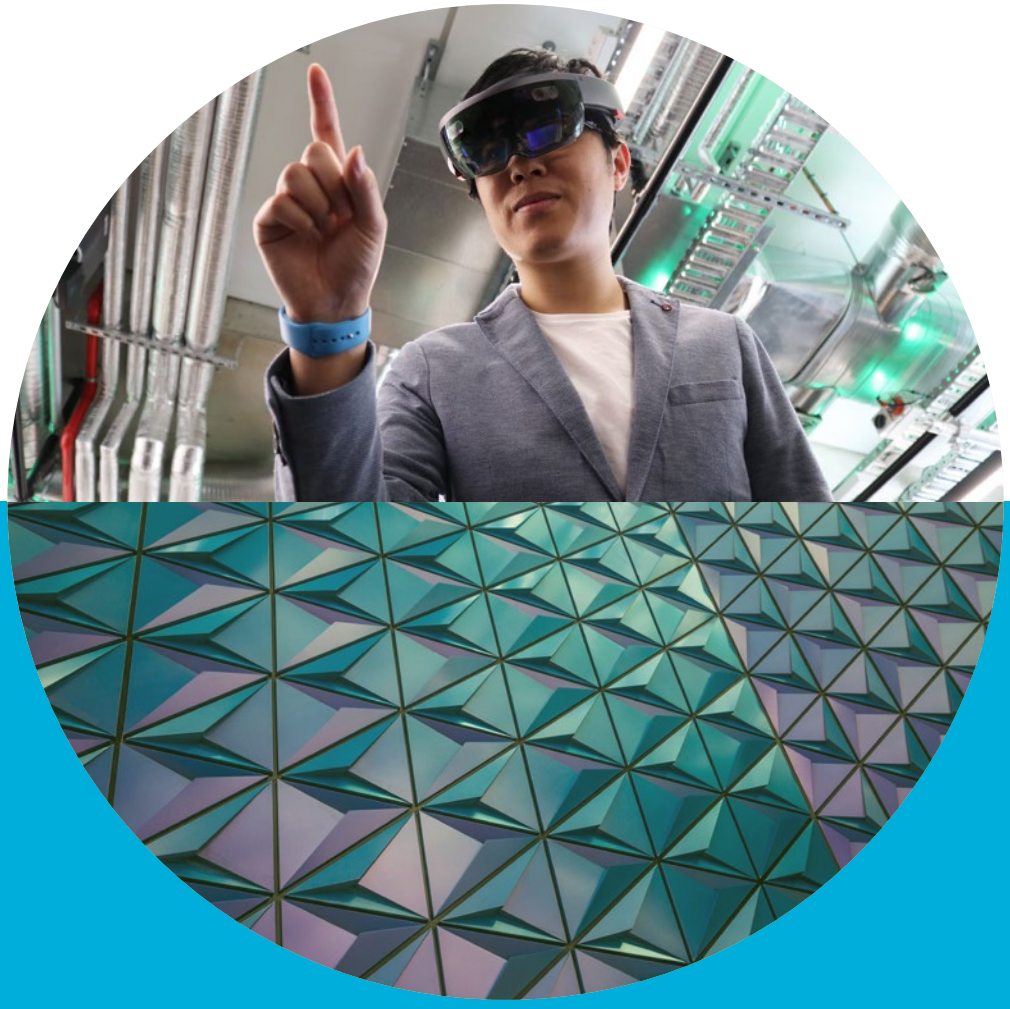
This section of our annual report provides evidence of our results against the activities and performance measures set out in our Corporate Plan 2018–19[1] and the Portfolio Budget Statements 2018–19.[2]

Read our performance statements:

- mission-directed research and development
- managing national research infrastructure
- developing national science talent
- enabling a healthy and sustainable organisation.

1 CSIRO's Corporate Plan is available at www.csiro.au/en/About/Strategy-structure/Corporate-plan.
2 CSIRO's Portfolio Budget Statement is available at www.industry.gov.au/about-us/finance-reporting/budget-statements.

Mission-directed research and development



Our Digiscape Future Science Platform is building a common big data infrastructure that will support next generation decision-making and transform agricultural industries and environmental action (read more on pages 11 and 48).

We deliver science in collaboration with our research and industry partners and through strategic investments to help translate scientific discoveries into practical applications for Australia and the world (Table 3.1). We work to achieve this through three functions:

- Conduct and facilitate the uptake of excellent scientific and technology solutions to deliver impact to the nation.
- Connect to global science, technology and innovation to access new opportunities for Australian innovation.
- Manage funding for industrial scientific research activities and assist industry through research collaboration and capacity building.

Table 3.1: Mission-directed research and development performance

Our delivery of mission-directed research and development is measured in these ways.

KPI AND METRIC	TARGET	RESULT	
Demonstrate triple bottom line impacts through: • externally validated impact case studies • assessment of impact in independent Business Unit reviews • a biennial external 'Value of CSIRO' impact assessment (not due in 18–19)	Demonstrate impact with a minimum of 6 externally validated impact case studies	G	Substantial triple bottom line benefits have resulted from our work and are demonstrated by 31 impact case studies completed across the CSIRO portfolio, also including an industry and government research alliance.
	At least 80% of programs are rated in the top two categories, benchmark or strong, on the impact criteria, in external reviews of Business Units	G	The external panels assessed the impact of the research programs in external reviews of three of our Business Units. 94% were assessed in the top two rating categories, strong and benchmark, indicating exceeding and leading international standards.
Science excellence: Normalised Citation Impact relative to global average performance	Top quartile of Australian universities & >50% global average	P	CSIRO is ranked in the second quartile compared to Australian universities, at 13 of 41 institutions. The Normalised Citation Impact of 1.49 is 49% above the global average and materially consistent with recent years' results.
Strategic innovation investment: direct science investment including Future Science Platforms, capability development and centrally competitive funds	$62m invested in Future Science Platforms, capability development and internally competitive funds	P	The growth of direct investment was constrained to $51.2m for 2018–19. This was the result of a prudent approach to growing funding of the program, while investing in other enabling platforms like digital, and the temporary suspension of the Science Leaders Program while it was being reviewed.
Pipeline of investable propositions for the "*CSIRO Innovation Fund 1, LP*" from publicly funded research institutions (Function 1.3 in our Corporate Plan)	At least 5 investable propositions pursued	G	Investments in 14 deep technology companies linked to the publicly funded research sector have been made across all focus areas for the Fund in 2018–19 to a total of 19 since September 2017.
Evidence of triple-bottom line impacts from global activities, with demonstrated benefits to Australia (Function 1.2 in our Corporate Plan)	Minimum of 6 externally validated impact case studies	G	Our global activities and engagements have generated national benefits, as demonstrated with nine impact case studies.
Establishing new, significant and strategic level Memoranda of Understanding (MoU) (Function 1.2 in our Corporate Plan)	8 negotiated per year	G	Strategic MoU have been established to facilitate collaboration and enable the research business with 26 organisations from 19 countries.
University engagement: feedback from the universities involved in the ON program – willingness to recommend (4 or higher on 5-point scale)	80% of university participants highly recommend the program	G	Universities have engaged with CSIRO through the ON program, with 96% of participants in university-led teams recommending the ON program, demonstrating its continuing relevance and effectiveness and an improvement on the previous result of 93%.
Public perception of CSIRO	Increase positive public perception of CSIRO to 80%	G	Public awareness of CSIRO at 87% remains high and consistent with recent years. Perceptions also remains consistent with last year, as 64% of Australians view CSIRO positively.
Customer and user satisfaction: Customer Net Promoter Score (NPS)	Net Promotor Score: +18	G	The NPS of +45 improves on the +40 achieved last year on a 10% increased base of survey responses.
Additional KPIs relating to Science and Industry Endowment Fund (SIEF) are found in the SIEF Annual Report Part 6.			

Green shading indicates positive progress for the year and the target has been achieved.
Purple shading indicates progress through the year was less than anticipated and continues to be closely monitored.

Triple bottom line impacts

The triple bottom line impact we deliver for Australia is evaluated in several ways. We conduct several externally validated impact case studies each year; engage external reviews of our Business Units every three to five years; and commission a biennial 'Value of CSIRO' impact assessment. The last assessment by ACIL Allen Consulting in 2018 quantified the aggregate benefits of impact case studies and determined that we provide more than $3.2 billion per year in benefits to the nation.

In addition, it is recognised that we provide value through our 'standing capabilities' such as the ability to quickly respond to new or urgent demands for scientific information and our national infrastructure and facilities. Value is also derived from our training, education and advisory services, support for STEM talent development, innovation system investments and through options and royalties generated by our research. While it is difficult to quantify, these benefits were assessed as representing considerable additional value to the nation.

External reviews

The regular external reviews of our Business Units employ a panel of scientific and industry experts from Australia and overseas to assess performance against three dimensions: impact, science excellence and innovation capacity. In 2018–19, we undertook external reviews of the Agriculture and Food, Data61 and Oceans and Atmosphere Business Units. Across these reviews, 94 per cent of research programs achieved a rating on the impact criteria in the top two categories of strong to benchmark, indicating exceeding and leading international standards.

The panels recognised our unique role and value in addressing Australia's national challenges. They highlighted the excellence of our science, that our people are passionate and talented, and that the capacity to integrate across disciplines enables innovations of national importance for Australia.

The external panel was impressed by Agriculture and Food's scientific achievements and the positive impact that the focus on innovation and impact has had on staff morale and performance, and its interaction with key stakeholders. This was achieved through the committed leadership team, which has provided outstanding support to the staff while maintaining high-quality, interdisciplinary research programs.

The panel reviewing Data61 recognised it as a leading data science and innovation group in Australia that is positioned to contribute substantially to the nation's future. The panel acknowledged the success of integrating the previous NICTA organisation into CSIRO with strong leadership. The overall assessment ratings were strong on all three dimensions, with the impact of each program rated from strong to benchmark.

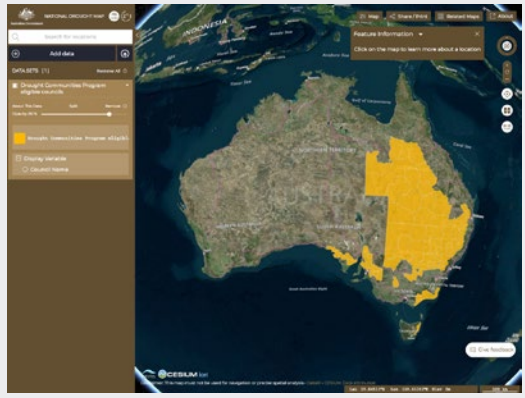
Oceans and Atmosphere was praised by the external panel for delivering its science with innovation and impact. In every respect, the assessment of performance is at least at the strong to benchmark level. The panel was impressed with the effective leadership of the Business Unit and the programs, and appreciated the relevance of the research to the environmental, societal and economic triple bottom line.

CASE STUDY

Tackling drought with data visualisation

Droughts put farming communities under devastating pressure, push up food prices and hurt Australia's economic growth. They are a constant threat for farmers, with climate and weather experts across the globe predicting that droughts will become longer and more severe in parts of the country.

Problems associated with droughts – adapting to the impacts of climate change, the sustainable use and value of our environments, and food security – go to the heart of our purpose; to solve the greatest challenges through innovative science and technology.



The National Drought Map found at https://map.drought.gov.au/ brings together disparate information to help government deliver support to drought-affected areas that need it most.

A key obstacle to combating drought impacts is gathering and interpreting disparate data to give a detailed picture. With this information, we can mobilise the most effective drought response, offering help where it will have the biggest impact.

CSIRO's Data61, a specialist group of data scientists, used data science to combat the impact of drought, we worked with the Joint Agency Drought Taskforce and the Department of the Prime Minister and Cabinet's Central Analytics Hub to create the National Drought Map.

The map uses Data61's TerriaJS platform, building on our deep strength in mapping and visualising data in 3-D and 4-D. Terria also powers world-leading platforms, including Australia's National Map and the United States Geological Survey's Protected Areas Database of the United States Map, and will be a key component of our forthcoming innovative 'Digital Twins' virtual city models.

The National Drought Map is an online tool that integrates curated climatic, socioeconomic, program and service delivery data. It draws on data from more than 20 Commonwealth, state and territory, local government and non-government agencies. The map has an invitation-only interface for governments and other officially sanctioned groups, and a general website open to all on FarmHub, an Australian Government initiative administered by the National Farmers' Federation. The National Drought Map received additional funding in the federal budget.

The National Drought Map demonstrates the myriad ways sophisticated use of data can tell a story of what's happening in a local area. It gives unprecedented capability for informed decisions based on unique data combinations in an accessible format. The map facilitates response coordination: with understanding of conditions in regional communities, governments can direct information sessions and services, such as the Department of Human Services' Mobile Services Centres, where most needed.

The National Drought Map also offers a new approach to collaboration among agencies, facilitating close relationships and bringing together decentralised data in an innovative data-sharing model. The federated data model used allows data custodians to maintain data ownership, hosted locally with their required security levels. This is an ideal solution given most data held by government is subject to legislative controls. This shift in the collection and curation of data has shown agencies a new way to share information while retaining control.

Now there are significantly changed expectations about the use of government data, with cultural changes in agencies partnering in the project. The Central Analytics Hub has received interest from areas across government keen to apply learning from the National Drought Map to projects, especially those using rich geographical data sets.

CASE STUDY

Metal membrane to power renewable hydrogen exports

As the transition towards clean energy accelerates and as one of the six challenges we are working on solving, there is an opportunity to assess how Australia's vast renewable energy resources may be integrated into the domestic energy mix, and also exported.

One such avenue is hydrogen, created with renewable energy or through the application of low emissions technologies such as carbon capture and storage. CSIRO's National Hydrogen Roadmap, released in 2018, noted that Australia has the resources and skills to build an economically sustainable domestic and export hydrogen industry, which can help meet agreed emissions targets and address concerns around energy security.

Recent advances in solar and electrochemical technologies mean renewable hydrogen production is expected to become competitive with fossil fuel-based production, providing an opportunity to decarbonise both the energy and transport sectors while creating new export opportunities.

Due to its low density, hydrogen is notoriously difficult to store and transport. Similar issues were faced with natural gas, before solutions were found to liquefy, store, gasify and use it commercially. Australia is now among the world's largest LNG exporters.

One way to overcome the limitations of hydrogen is to convert it to ammonia for transportation and storage, piggybacking existing transport infrastructure, then convert it back to high-purity hydrogen at or near the point of use. Our research – receiving initial Science and Industry Endowment Fund funding – has made this process possible by developing a metal membrane that allows hydrogen to pass through while blocking all other gases.

This technology has the potential to fill the gap in the value chain to supply fuel cell vehicles and power vehicles around the world with low-emissions hydrogen sourced from Australia.

In August, we collaborated with BOC, Toyota and Hyundai to successfully demonstrate this metal membrane technology by extracting ultra-high purity hydrogen from ammonia and powering two fuel cell vehicles.

In November, we announced a $20 million partnership with Fortescue Metals Group (Fortescue) on hydrogen technologies to help to develop new industries, create jobs and pave the way for low emissions export opportunities. The centrepiece of the partnership is an investment in our metal membrane technology. We will work with Fortescue to identify, develop and commercialise technologies to help create of an Australian hydrogen industry and future global uptake.

We are continuing our own investment in hydrogen research and development, chiefly through the Hydrogen Energy Systems Future Science Platform, and will work with Fortescue to commercialise technologies that support new energy markets, including in the chemicals and transportation sectors.

The Hon Keith Pitt MP and CSIRO Chief Executive Dr Larry Marshall fuel a Toyota Mirai fuel cell vehicle with ultra-high purity hydrogen.

Impact case studies

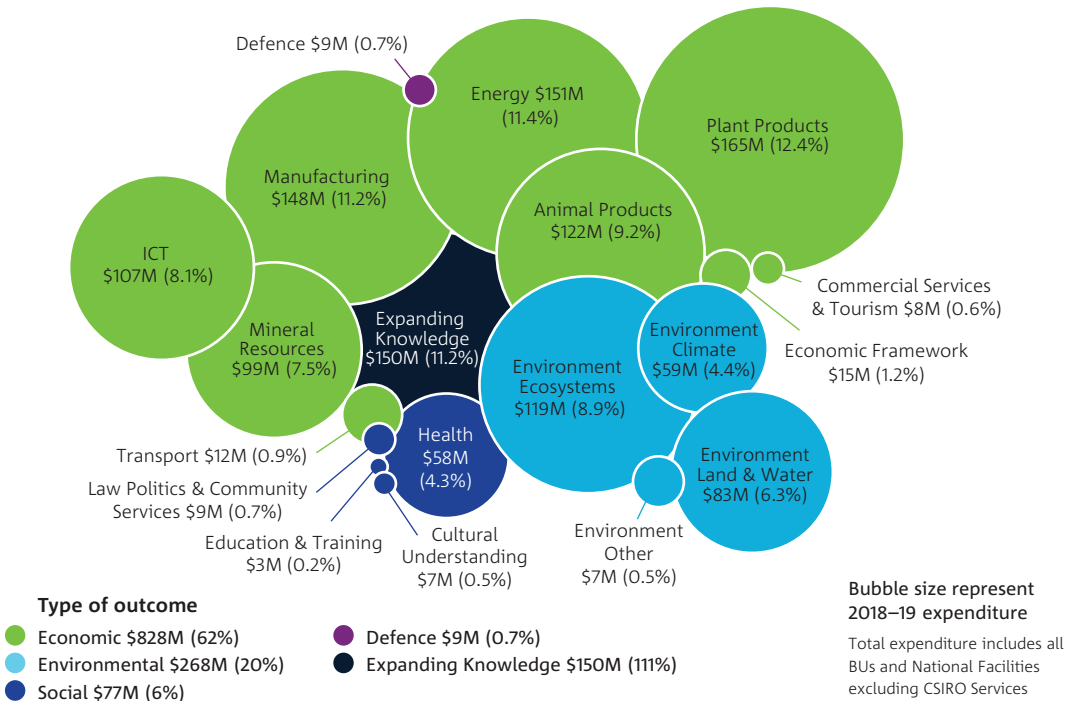
Externally validated case studies are conducted every year[3] to evaluate and demonstrate the impact value resulting from individual projects. With 31 case studies completed and published[4] during 2018–19, we demonstrated substantial benefits from our research.

A portfolio of case studies from across CSIRO are included in this section. Some highlights include the following:

- The research conducted by Oceans and Atmosphere on the conservation management of southern bluefin tuna demonstrated the value we provided in improving the security of the fishing industry in Australia, New Zealand and worldwide. The benefit of this research to 2025 was calculated at $616.5 million in 2018–19, with a benefit-cost ratio of over 28:1 (read more about this impact on page 43).
- The measurable, directly attributable benefits of Data61's TerriaJS include time-saving efficiencies delivered through ease of accessing government geospatial data, analysis of data, and dissemination of findings. These benefits alone deliver net benefits of more than $47.5 million over the 10-year period to 2028, representing a benefit-cost ratio of 6.64 (read more about this impact on page 33).
- The combined research of the Pacific Climate Change science program has informed policy development and adaptation/disaster risk management planning in Australia and surrounding Pacific nations. The combined net present value of the two projects is therefore projected to be $691 million in 2018–19 dollars, while the benefit-cost ratio is estimated to be 15.19.

Figure 3.1 shows the balance of research efforts to a diverse range of socioeconomic benefits.

Figure 3.1: CSIRO research investment by socioeconomic objectives in 2018–19



3 Each case study is assessed within the context of a common framework, as outlined in the CSIRO Impact Evaluation Guide. See: https://www.csiro.au/en/About/Our-impact/Evaluating-our-impact.

4 Each case study is published, once completed and reviewed to exclude confidential or commercial details. See: https://www.csiro.au/en/About/Our-impact/Our-impact-in-action/Latest-impact-case-studies.

CASE STUDY

Wheat advances – feeding Australia and beyond

Ensuring a secure food supply while maintaining the integrity of our environment are two of the six challenges we are focused on solving through our multidisciplinary science. Australia's $60 billion agricultural sector[5] is on the frontline, grappling with these challenges on two fronts.

We are helping agriculture and food industries simultaneously produce more food sustainably for an increasing population using limited resources, while building resilience in the face of increasingly adverse growing conditions due to warmer conditions and reduced rainfall.

Over the past decade, our advanced wheat research into more efficient use of water, strategic sowing, better adapted varieties and improved farm management techniques has generated significant benefits, with one project alone delivering a benefit of $143 million, according to our investment partner Grains Research and Development Corporation (GRDC).

Efforts to grow and protect Australia's $7 billion wheat industry – Australia's second most valuable agricultural product (behind beef)[6] – are vital from economic and food security standpoints. We've approached the issue of improving wheat yields and profitability using a multidisciplinary farming systems approach.

The National Water Use Efficiency (WUE) Initiative revealed that a more than 20 per cent[7] increase in WUE could be achieved using early sowing practices, which take advantage of soil moisture retained from summer rainfall. Importantly, it was the combination of improved management – no-till farming systems, improved rotations, and good summer fallow weed control – prior to the planting of the wheat crop that ensured the summer rainfall was captured and stored.

Further research into early sowing practices found additional benefits when integrated into mixed-farming systems (cropping and livestock), because the early-sown crops can be grazed during the vegetative stage without impacts on grain yield. Research conducted with GRDC and Meat and Livestock Australia found farm profitability improved by around $100/ha due to provision of forage during the winter feed gap. Dual-purpose crops also reduce risk as the climate becomes more variable by providing options to graze, cut for hay or silage, or to grow through to grain depending on seasonal conditions.

Our research has seen guidelines and recommendations adopted by agronomists and their clients across Australia's cropping regions. These practices have been critical in securing Australia's ability to export 10 per cent of the world's wheat.

Our research has also highlighted the problems faced by Australian wheat farmers, with long-term reductions of in-season rainfall, compounded by increased temperatures between 1990 and 2015. With climate modelling predicting even more adverse conditions, research efforts continue to futureproof the Australian wheat and broader grains industry.

In early 2019, research published in *Nature Climate Change* demonstrated how genetic gains for fast winter wheat varieties and adopting further practices to early sowing systems developed by CSIRO could increase Australian wheat yields by as much as 25 per cent. That would equate to an additional 7.1 million tonnes of wheat harvested each year, worth approximately $1.8 billion to the national economy.

Agriculture has been at the heart of our research success for the past century. In order to feed and clothe the world into the future, our efforts will continue to build, maintain and improve Australia's critically important agricultural systems.

Our work is improving farm profitability for wheat growers and helping to feed the nation.

5 http://www.agriculture.gov.au/abares/research-topics/agricultural-commodities/dec-2018/agriculture-overview.
6 http://www.agriculture.gov.au/about/commitment/portfolio-facts/grains.
7 https://grdc.com.au/resources-and-publications/groundcover/ground-cover-supplements/gcs103/benchmarking-the-key-to-improving-productivity-and-wue.

CASE STUDY

Flow chemistry, refining our art

Chemicals are an integral part of our modern way of life. Whether it's a treatment for cancer, paint thinner or herbicides, the chemical has to be made using a particular process. Until now, these chemical processes have used a manufacturing method called batch chemistry. But flow chemistry is having a huge impact in helping us to solve the greatest challenges and create future industries for Australia.

A batch process involves chemicals being produced in large containers, batch reactors. Because of the underlying physics associated with large batch reactors, it is difficult to adequately control the temperature and the mix of the ingredients.

Getting the batch chemistry process right can take significant amounts of tweaking, often resulting in high levels of unwanted products, and costly and time-consuming purification. Batch chemistry can also be quite risky for operators as they need to check, adjust and re-check the processes, which can expose them to dangerous liquids and fumes and, at worst, runaway reactions that can lead to explosions.

Unlike batch chemistry where the reactants are combined in one go, the new process, flow chemistry, involves combining reactants continuously in a flowing tube. Flow chemistry processes can be used for small and large volumes and are controlled using advanced technology, which saves time, cuts energy costs and reduces waste. It also circumvents the need for operators to intervene between reactions, which keeps them safe.

Boron Molecular has adopted flow chemistry to improve operations across its business, including pharmaceuticals, electronics and a range of industrial chemicals.

Working with Boron Molecular on several projects, we helped to develop some impressive new processes, including one that will save the masterpieces of the world. Together we used flow chemistry to create a new resin that is used to coat and protect paintings from the ravages of time.

We collaborated with the National Gallery of Victoria and used flow chemistry to create a new varnish that will protect paintings from ageing.
Image courtesy of National Gallery of Victoria.

The team is now working with the National Gallery of Victoria to refine the new resin that, once ready, will be available to conservators across the world. The resin is reversible, does not yellow as it ages and is completely clear. It can safely be used on priceless masterpieces to preserve them for future generations.

We're continuing to develop our flow chemistry capability and capacity through the commissioning of FloWorks, supported by funding from the Science and Industry Endowment Fund (SIEF). FloWorks is a lab in Melbourne that will make it easier for chemical manufacturers to use flow chemistry for their chemical manufacturing needs. We will also continue to explore new horizons that could benefit from the exacting control that flow chemistry brings to chemical manufacturing.

CASE STUDY

Protecting Australia's valuable environment from rampant rabbit populations

Since the 1800s Australia has fought an ongoing battle against rabbits, a destructive pest introduced by European settlers. Thriving in Australian conditions – perfect for all year-round breeding – rabbits spread across 70 per cent of Australia, causing devastation to Australia's environment, native species and agricultural lands.

In modern Australia, the overall economic losses in the agriculture and horticulture industries caused by rabbits are estimated to be more than $200 million every year, and more than 320 native flora and fauna species are now threatened as a result of invasive rabbit populations. We have been focused on this challenge of ensuring we have a resilient and valuable environment for more than a century.

Over the years, biological controls have shown to be the most cost-effective, large-scale solution in keeping rabbit numbers low. Australia first turned to biocontrol measures to reduce rabbit population numbers in the 1950s with the release of the Myxoma virus, followed in the 1990s by the Rabbit Haemorrhagic Disease Virus (RHDV), commonly known as Calicivirus.

While these biocontrol measures are still having a major impact on controlling rabbit numbers ($70 billion of agricultural benefit over the last 60 years), their effectiveness has declined due to the inevitable development of genetic resistance to viral biocontrol agents.

In 2017, in the ongoing effort to stop rabbits from further damaging Australia's agricultural and natural environment and reaching the plague numbers seen in the early 1900s, we played a key role in the nationwide release of a new strain of RHDV, termed K5.

The Centre for Invasive Species Solutions brought together the New South Wales Department of Primary Industries, CSIRO, federal and all state governments along with industry bodies, to develop the project. Members of the community including farmers, land management groups and volunteers, also played a pivotal role in the project, helping to release and then monitor the impact of K5 over 300 sites across Australia. Through this citizen-science approach, researchers were able to collect more data than would have been possible without community support, with participants involved in releasing the virus, monitoring, and collecting and submitting tissue samples for analysis.

As part of the project, the National Rabbit Biocontrol Monitoring Program was developed to help track the spread and record the effects of the K5 release.

Our team developed and implemented near real-time diagnostic tests that enabled the project to monitor the spread and impact of the different types of virus in the landscape before, during and after the K5 release. The project reported an average reduction in rabbit numbers of 34 per cent one month post release at the release sites.

Ongoing monitoring by our team continues to provide critical data, which is fed into a publicly available rabbit calicivirus map of Australia, and provides information about which viruses are circulating and where. This map helps land managers in the development, coordination and timing of tailored rabbit management strategies, and aids veterinarians and pet rabbit owners in implementing biosecurity measures and, where available, vaccination strategies to protect non-target domestic rabbits.

The program will have a lasting impact on rabbit control measures by helping governments, researchers, industry and land owners to better understand the continued effects of biocontrol measures on rabbit populations, while informing the planning, implementation and tracking of future biocontrol release programs.

In 2019, the project received the Industry Award in the Australian Government's Australian Biosecurity Awards, which recognises significant outcomes for Australia's biosecurity system.

The K5 rabbit team receiving its Australian Biosecurity Award from Minister David Littleproud.

Equity portfolio

Another representation of our impact value is the valuation of and investment in the companies that use our research outputs and intellectual property (IP). We partner with companies, large and small, that we believe are best placed to take new technologies to market and deliver positive outcomes for Australia.

In many instances, we license our technology to third party companies, where licensing represents the pathway most likely to maximise the impact of CSIRO-developed IP. In other instances, an impact assessment might lead to us assigning CSIRO-developed IP to newly created, high-technology small and medium-sized enterprises (SMEs). Under many of our commercialisation pathways, we retain an equity holding in the underlying commercialisation vehicle.

At 30 June 2019, we held interests in eight listed companies, 26 unlisted companies, four special purpose vehicles and three investment funds (including the CSIRO Innovation Fund). The value of these holdings at 30 June 2019 totalled $125.3 million (up from $98.7 million at 30 June 2018), and we believe that the portfolio of companies has a collective total market capitalisation in excess of $2 billion.

The value of our portfolio has grown significantly in recent years with an ongoing focus on creating impact with CSIRO IP via our commercialisation pathways, bolstered by the significant investment we've made in the CSIRO Innovation Fund. Notable transactions in 2018–19 include new investments in CANN Group, MecRX, Renerve, Rhythm Biosciences, Vivazome Therapeutics and Medical Devices International under the various research-for-equity arrangements that we have in place with these groups.

Investment holdings were initiated in four newly formed companies – Emesent, RapidAIM, V2Food and Reflexivity, follow-on investments were made in two existing portfolio companies – NextOre and Arista Cereal Technologies – and a further $10 million investment was made in the CSIRO Innovation Fund. Finally, a significant holding was acquired in NGH Holdings Pty Ltd as a result of a merger that involved an existing CSIRO portfolio company called GeoSLAM. The last of our shares in the ASX-listed Carbon Energy were sold in 2018–19.

Table 3.2: Change in the value of CSIRO's equity holdings

	2015–16	2016–17	2017–18	2018–19
Listed and unlisted companies	$8,930,281	$19,541,035	$37,948,573	$55,387,191
Unlisted special purpose vehicles (SPV), CSIRO Fund of Funds, LP, CSIRO Holding Trust and Unlisted Unit Trust	$40,515,560	$50,279,196	$60,766,039	$69,948,314
Total	**$49,445,841**	**$69,820,231**	**$98,714,613**	**$125,335,505**

CASE STUDY

Science underpins future decisions on development in Northern Australia

The climate and soils in Australia's north could support a wide range of agriculture, aquaculture and horticulture, and potentially more integrated, efficient and higher-yielding farming systems. It presents a possible solution to the challenge of increasing pressure on ensuring we have a resilient and valuable environment.

But despite long-term interest in developing Northern Australia, there has been little data and insights to support policy and investment decisions. Enter the Northern Australia Water Resource Assessment (NAWRA).

We conducted this assessment, which was commissioned as an initiative of the Australian Government's White Paper on Developing Northern Australia and the Agricultural Competitiveness White Paper. The assessment delivered detailed region-wide, finer-scale data not previously available and focused on three study areas: the Fitzroy River catchment in Western Australia; the Finniss, Adelaide, Mary and Wildman river catchments in the Northern Territory; and the Mitchell River catchment in Queensland.

Through extensive field studies and desktop analyses, the assessment investigated land suitability for irrigation or aquaculture, water storage and capture options, and potential impacts of those development options on regional economic outcomes and ecological impacts.

When landscape suitability outcomes were linked to water availability and economic viability, several messages emerged:

- Diversification, such as adding forages into the existing cattle production, is a way to improve productivity.
- Rethinking the scale of irrigated agriculture could open new opportunities. This could mean multiple, smaller irrigated developments.
- Double cropping can increase revenue from each hectare developed.

The assessment engaged Indigenous people in the catchments, who hold water values, rights and development objectives, to better understand their perspectives on development.

This research required strong collaboration with multiple jurisdictions and agencies, involving more than 140 scientists across many disciplines, and 20 external organisations. The work required new scientific methods to be developed to assess such large areas quickly.

The assessment has produced web-based applications, including the NAWRA-explorer, which makes data publicly available, discoverable, and able to be updated.

The result of the assessment is publicly available data to allow an informed discussion on what is possible, desirable and achievable.

This has already translated to action, including a $3.5 million assessment of soil and water resources in the Northern Territory's Roper River catchment and a water resource assessment in Norfolk Island. It has also provided technical information to inform the development of water and catchment plans by state and territory governments, as well as federal government investment initiatives such as the Northern Australia Infrastructure Facility and the National Water Infrastructure Development Fund.

Investigating the Fitzroy River catchment in Western Australia to understand the scale and nature of future development opportunities.

Science excellence

Science excellence is intrinsic to CSIRO and measured in several ways. One measure is the frequency with which our publications are cited by other research, normalised for subject patterns and the age of the material. This Normalised Citation Impact (NCI) is a standard indicator and allows for global comparison.

Our science excellence metrics show citation levels that are significantly higher than the global average, although we are observing a gentle downward trend in our NCI value. This is despite our productivity increasing, with more papers published per scientist than in previous years. We have strategies in place for addressing science excellence and quality, including establishing the Future Science Platforms (read more on page 48).

Our NCI of 1.49 is 49 per cent higher than the global average, based on publications produced from 2014 to 2018, compared to NCI results of 50 per cent higher than global average for publications from 2013 to 2017 and 51 per cent higher for the prior cycle. We are currently ranked 13th against universities in Australia, a decrease on our ranking of joint eighth last year, attributable to a rapid increase in the NCI of some universities in recent years.

The number of refereed CSIRO journal articles and reviews published remains at more than 3,000 per year although it has been trending downwards slightly since 2015 (see Figure 3.2). The decline is attributable to the decrease in our research staff count from 2013 onwards, a lagging effect because of the time it takes to conduct and publish research. However, productivity has not fallen – the total number of refereed papers is still greater than earlier years when staff numbers were higher. For example, in 2018 there were 3,101 papers at a rate of 0.517 per staff member, compared to 3,067 publications at a rate of 0.474 per staff member in 2012.

The number of refereed conference papers recorded in our internal record system increased from 500 in 2017 to 784 in 2018, with the effect that refereed publication output overall is stable. Journal articles are our main type of research publication, followed by conference papers and client reports (see Figure 3.3). In 2018, we produced 663 client reports and 270 technical reports. This was 19 fewer client reports and eight fewer technical reports than last year (see Figure 3.3).

Figure 3.2 CSIRO journal publication output by year 2012–2018

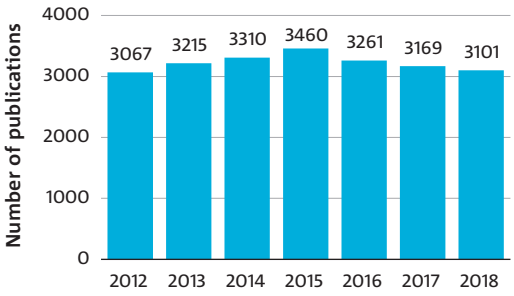
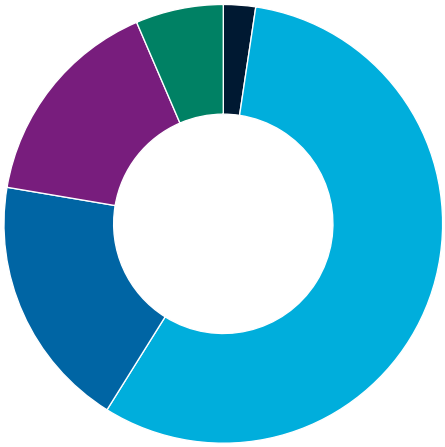


Figure 3.3: Percentage of CSIRO publications by type in 2018



Book/Book Chapter | 99

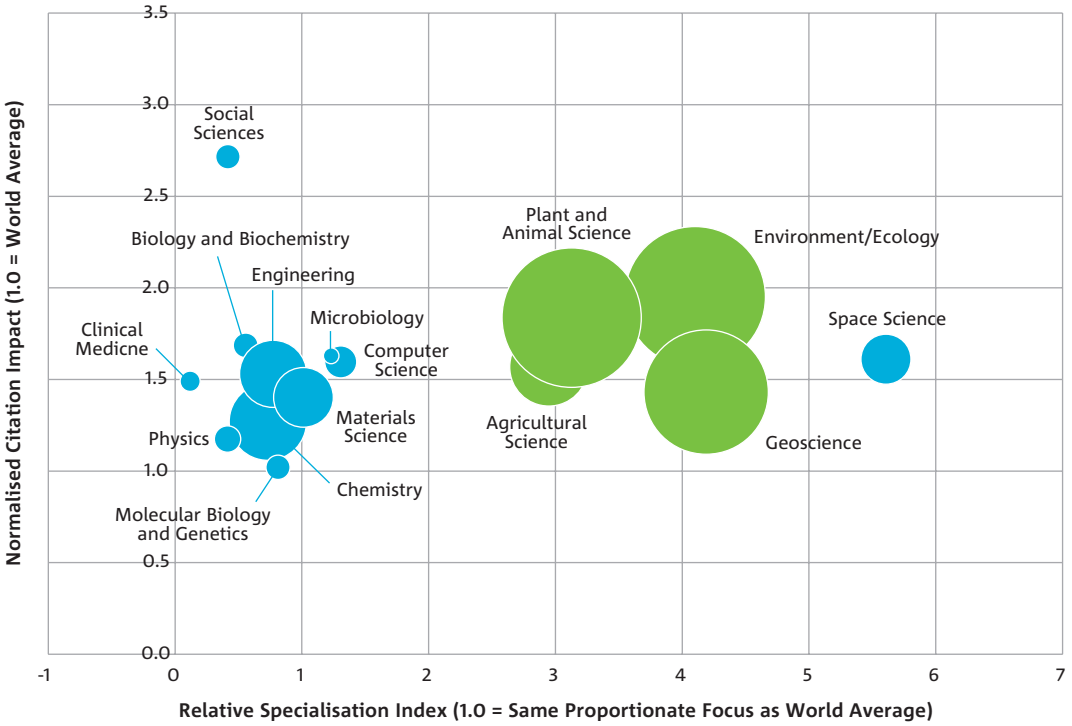
Journal Article | 2361

Conference Paper | 784

Client Report | 663

Technical Report | 270

Figure 3.4 CSIRO specialisation and citation impact by research field 2014–18



We produce publications in a range of research fields. Figure 3.4 shows our focus on, and strength in, each of our 15 largest fields. To interpret the chart, a result of 2 on the vertical axis would represent our publications being cited twice as strongly as the global average of publications in this research field. On the horizontal axis, a value of 2 would show that our volume of output of publications in this research field as a proportion of our total output, is twice the proportion of that field in global research output.

Fifty-one per cent of our publications are in the four research fields for which we are most strongly ranked for total citations, appearing in the top 0.1 per cent of institutions globally, which are marked in green. We have held this position in these four fields for the 14 years since we have tracked this performance.

CASE STUDY

Transformative science for valuable southern bluefin tuna fishery

Australia's large and valuable southern bluefin tuna (SBT) fishery, operating predominantly out of Port Lincoln in South Australia, is part of the internationally managed fishery estimated to be worth more than $800 million. Australia is a founding member of the Commission for the Conservation of Southern Bluefin Tuna (CCSBT) and its national allocation is 35 per cent of the global catch level set by the CCSBT.

Historical overfishing of SBT saw the stock decline to around three per cent of the unfished level and led the species to be listed as 'critically endangered' by the International Union of Conservation of Nature and 'conservation dependent' under Australian environment legislation. Furthermore, historical under-reporting of longline catches meant that key data for assessing the stock status and management are unreliable.

To address the challenge of maintaining a resilient and valuable environment, we delivered excellence in science-based management advice for setting global catch limits and two new methods to accurately monitor challenging species, such as the highly migratory SBT.

CSIRO and collaborators developed the world's first scientifically tested management procedure for tuna to set global catch limits that reduce the risk of further declines and associated extinction risk for this iconic stock. This has enabled Australia's nationally significant fishery to continue operation while rebuilding the stock from dangerously low levels. The economic benefits from the management procedure include greater certainty, transparency and stability for stakeholders, an 85 per cent increase in catch valued at $80 million for the Australian fishery, and many hundreds of millions in direct revenue for the global fishery.

Two new techniques for monitoring abundance of juvenile and adult SBT have also been developed. A gene-tagging program monitors the numbers of juvenile SBT by collecting a DNA 'fingerprint' from biopsies of individual fish, which acts as an invisible, lifelong 'tag'. Abundance is estimated from matching the DNA fingerprint from fish that are 'tagged' and released with fish sampled 18 months later. The program, funded by the CCSBT, Australian Government and European Union, provides reliable information on juvenile SBT abundance, and it does not rely on data from commercial fishers detecting and returning traditional plastic tags. These juvenile abundance estimates will be included in new management procedures for setting the global catches of SBT in the future.

We're providing robust management advice to help rebuild the southern bluefin tuna fishery to sustainable levels, and innovative monitoring programs using genetics and statistics to estimate the abundance of juvenile and adult SBT.

Close-kin Mark Recapture (CKMR), the second new technique, is used to monitor the abundance of adult fish and other demographic parameters, such as survival, without relying on fishery catch and effort data. Like gene-tagging, it uses DNA as a natural tag to match closely related kin (parent-offspring and sibling pairs) from tissue samples of adults and juveniles. The frequency of kin matches is combined with knowledge of the biology and elegant maths to provide an accurate estimate of the number of adults in the SBT population.

These award-winning[8] research achievements are world firsts and have played a critical role in delivering scientific excellence and robust advice to support the SBT industry and Australian community. The future impacts are wide-reaching, as the technologies are transferrable to other fish, wildlife species and conservation management globally.

8 The CSIRO SBT team received the 2018 CSIRO Medal for Impact from Science and the 2018 Sir Ian McLennan Achievement for Industry Award.

CSIRO Publishing

CSIRO Publishing facilitates scholarly communication between scientists and the wider community, to grow awareness of the role of science in addressing areas of national and international importance. The publishing services provided enhance the quality of research through managing rigorous peer review processes. The impact of our work is in improved decision-making, contribution to the growth of STEM-enabled innovation and lives enriched through access to knowledge, positioning Australia to solve its greatest challenges through innovative science and technology.

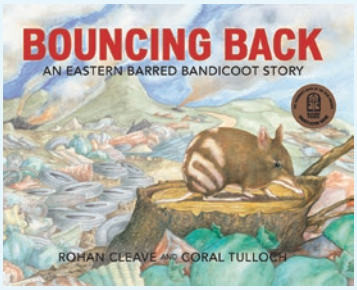
CSIRO Publishing operates as an editorially independent science publisher within CSIRO on behalf of authors and customers in Australia and overseas, covering a wide range of scientific disciplines. We are Australia's only endemic, scholarly science publisher with a significant digital capability. We provide a viable, local publishing option for authors, CSIRO and for learned and professional societies to publish scholarly content that champions Australian research.

During 2018–19, we published 27 journal titles, including 13 titles in partnership with the Australian Academy of Science, a successful relationship dating back to 1948. Fourteen journals were produced under agreements with Australian and international societies or institutions while special issues of journals were published in connection with societies and international conferences.

Online journal readership was measured as downloads of more than 2.8 million articles. The journals are available free to developing countries through the United Nations program Research4Life, fostering scientific understanding and education in developing nations.

Awards

During 2018–19, CSIRO Publishing released 33 book titles in print and electronic formats with approximately 11 per cent of sales in digital books. Our program spans picture books to scholarly reference, and our publications communicate the impact of science in our lives and inform professionals in their work. The developing children's program has been a highlight this year with engaging and vibrant books that ignite curiosity in our future generation of scientists and science champions.



We received industry and professional recognition from the Children's Book Council of Australia, which shortlisted *Bouncing Back: An Eastern Barred Bandicoot Story* for the Eva Pownall Award. At the other end of the reading spectrum, *Australian Echinoderms: Biology, Ecology and Evolution* won the 2018 Whitley Medal.

Accreditation and developments

CSIRO Publishing recognises the importance of high standards of ethical behaviour throughout the publication process. In 2018, CSIRO Publishing was awarded membership to the Committee on Publication Ethics (COPE) and supports the recommendations of the COPE Core Practices in our policies and procedures. Our journal editors are expected to work within the framework of the Core Practices.

We also acknowledge that peer review is the cornerstone of scientific publishing. To recognise and reward our peer reviewers for their commitment, CSIRO Publishing has partnered with Publons to support them to record, verify and display their contributions for reviewing our journal articles. This service can help researchers to demonstrate their service to the research community and expertise in the field for use in their performance reviews, funding and promotion applications, and more.

Table 3.3: CSIRO Publishing readership

	2015–16	2016–17	2017–18	2018–19
CSIRO Publishing journals* (downloads)	2,901,602	4,224,132	2,780,877	2,842,670
Double Helix magazine (subscribers)	7,216	6,687	6,521	6,441
Double Helix Extra (email subscribers)**	43,029	42,017	40,000	45,026

*Downloads in 2016–17 were artificially inflated by robotic crawlers that were filtered out from 2017–18.
**Previously named Science by Email.

Intellectual property

Excellent science generates intellectual property (IP). While it is often published as a contribution to global knowledge and in support of further research, at times it is more appropriate to retain control of the IP. Novel developments, designs and inventions can be defined and registered so that they are recognised as CSIRO property, to be made available for use by others on appropriate terms. This enables our industry partners operating in competitive markets to invest in the application of our IP in their businesses, while potentially returning some of the benefits of their use to CSIRO for re-investment in further research.

Our registered IP at the end of June 2019 included 679 patent families, 325 trademarks and 79 plant breeder's rights. The number of patent applications filed for new inventions (priority applications) decreased slightly compared to the previous financial year. In contrast, our overall number of patent applications experienced significant growth. This is the result of an increase in overseas patent filings (mainly national phase entries) based on a priority application during the financial year, which is a good indicator of investment into existing technology making its way through the pipeline. An increase in overseas trademark filings indicates focus on our Global Strategy.

Technology licences are a method of making IP available for use by others, often on commercial terms. The number of them is used as a key indicator of the uptake and adoption of research and development outputs by customers and collaborators. A total of 446 licences were recorded as active at 30 June 2019, of which 277 have generated revenue returns to CSIRO. There has been a decrease in the total number of active licences since last year, predominantly due to expiration and termination of copyright licences that did not have revenue returns.

Total revenue attributable to IP (excluding revenue from WLAN and including IP-related equity transactions) increased seven per cent this year, and 63 per cent since financial year 2016. This demonstrates that our intellectual assets underpin increased year-on-year commercial activity in industry.

Figure 3.5: CSIRO's standard patent cases by geographic region

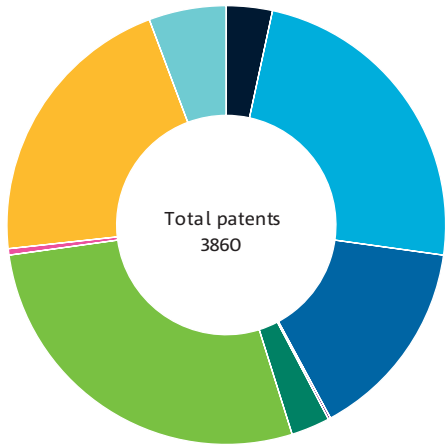


Table 3.4: CSIRO intellectual property portfolio (including NICTA IP)

IP CATEGORY	SUB CATEGORY	2014–15	2015–16	2016–17	2017–18	2018–19
Patents	Current Cooperation Treaty (PCT) applications	78	75	59	53	37
	Granted	1,854	1,959	2,122	2,140	2,244
	Live cases	3,430	3,544	3,773	3,876	4,065
Inventions	Patent families	578	595	692	686	679
	New provisional and direct filings	63	70	79	67	58
Trademarks	Australian	250	251	238	264	273
	Foreign	63	62	94	156	52
Plant Breeder's Rights	Australian	89	89	90	61	59
	Foreign	25	25	26	25	20
Registered designs	Australian	2	2	2	2	2
	Foreign	6	6	6	3	5

Patent filings in Asia, North America and Australia remain at the forefront of our IP Strategy, with these three regions accounting for 66 per cent of our patent portfolio. The total number of live patent cases in Asia has increased steadily over recent years, with approximately 25 per cent in Japan, China, India, South Korea, Hong Kong, Malaysia, Indonesia, Singapore, Vietnam, Taiwan, Thailand and the Philippines. Notably, there was a significant increase in South American filing during 2018–19, while there was a slight decrease in the number of filings in regions such as Africa, which represent a relatively small portion of our patent portfolio.

CASE STUDY

Reducing waste in copper production

The world's high-grade mineral ore deposits are depleting and new mineral ores are increasingly lower in quality. Compared to 20 years ago, a pound of copper produced today generates more than 60 per cent more tailings waste and uses nearly the same in extra electricity, fuel and water. This trend will continue into the future unless we innovate.

New technologies to selectively mine and sort ore, which identify high-value ore and separate it from waste in real time, can make these low-grade ore deposits more economically and environmentally viable to mine.

In response, we developed the world's most advanced sensor system for large-scale ore sorting to rapidly determine ore quality (grade) in order to reject large volumes of waste rock before it enters the plant for processing. We could solve the challenge of an industry in decline by creating a new future industry.

The advanced sensor system applies magnetic resonance technology, which detects signatures from many minerals and is particularly effective for copper, iron, arsenic and gold-bearing ores, among others.

As ore on a conveyor passes through the analyser at a rate of up to 5,000 tonnes per hour, it illuminates batches of ore with short pulses of radio waves. By penetrating through ores – much like medical magnetic resonance imaging 'sees into' human bodies – the analyser rapidly and accurately detects ore grade.

In July, in partnership with RFC Ambrian and Advisian Digital, we launched a new company called NextOre to take the analyser to the international mining market.

In its first year, NextOre targeted copper miners with a focus on engaging local and international markets. The company estimates that 35 per cent of global copper mines are suitable for the application of magnetic resonance technology – where the analyser could be applied to increase productivity, extend mine life and reduce the environmental footprint.

The benefits for producers vary depending on the orebody being mined but have the potential to more than double the average ore quality. This could represent as much as a 20 per cent reduction in processing costs in some copper mines.

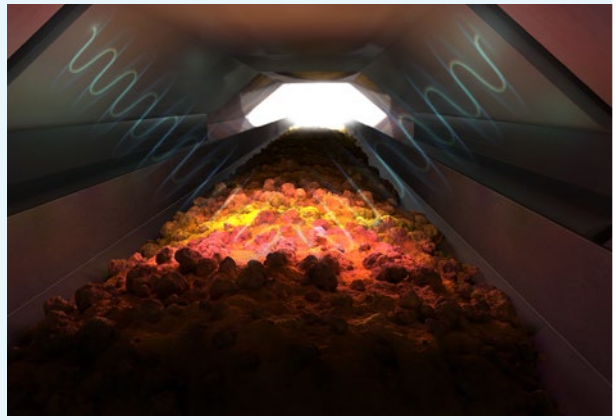
Since NextOre was launched, three magnetic resonance analysers have been sent to mine sites where site-specific trials are being undertaken. This includes two top-tier producers. Another two to three analysers are to be delivered before the end of the year.

Early results from a NextOre trial at a mine site in Latin America have demonstrated the analyser is capable of accurately measuring ore grade in two seconds. This allows rapid separation of low- and high-grade ore with a high degree of confidence.

Meanwhile, in Australia, we are trialling a magnetic resonance analyser at Newcrest. Mine site trials at Cadia East mine are proving successful in regard to accurate monitoring of ore grades at feed rates up to 4,800 tonnes per hour. This is an important result, validating the potential for improved processing options in emerging mine sites, and is relevant for many large-scale applications worldwide.

NextOre is another recent commercialisation success story for CSIRO and RFC Ambrian, which together established Chrysos Corporation in late 2016 to market an X-ray-based gold analysis solution.

NextOre has been acknowledged by industry leaders, achieving first place in the METS to Miners and Engineers' Pitch Battle award at the International Mining and Resources Conference 2018.



An impression of ore going through the analyser sensors.

Strategic innovation investment

Future Science Platforms (FSPs), the CSIRO Innovation Fund and other programs help us to reinvent existing industries, create new industries for Australia and deliver public good. A key mechanism to achieving this is our investment in cutting-edge, potentially transformative science.

To develop our researchers, we provide funding for CSIRO Early Research Career (CERC) Postdoctoral Fellowships, professional development of our early- to mid-career researchers, postgraduate scholarships and support for symposia and visiting distinguished researchers. Our Science Leaders program resumed in 2019 after a pause for review of the program, resulting in a lower than anticipated level of spending.

Future Science Platforms

Our investment in future science continues to grow, with centrally funded direct investment allocations into FSPs increasing to $34.9 million in 2018–19. This investment was less than the original target of $42 million, as a prudent approach was taken to the allocation of funding in the early stages of new FSPs established during the year. The central funding is supplemented by investment from the Business Units involved, resulting in an overall direct investment in 2018–19 in excess of $48 million.

The newly approved FSPs that began this year were Space Technologies, and Artificial Intelligence and Machine Learning. They are aligned with government direction as key fields for scientific focus and investment. Several established FSPs received slight increases in budget for specific purposes. Furthermore, seed funding was provided to undertake initial scoping work on projects in three new proposals that may develop into new FSPs or other forms of strategic investment.

Table 3.5: Progress in Future Science Platforms 2018–19

PROGRESS IN OUR FUTURE SCIENCE PLATFORMS THIS YEAR	
Probing Biosystems	We are partnering with GenesisCare, the largest private provider of cancer care services in Australia, to improve outcomes for patients with difficult-to-treat cancers. This $5 million partnership will drive the development of a new theranostics industry for Australia.
Digiscape	We've built our big data infrastructure platform, Senaps-LAND, and through it we have four decision tools to support farmers and agribusiness. Our Graincast™ tool, released in 2018, combines satellite and weather data with CSIRO's forecasting technologies and simple user-provided data to forecast national annual grain harvest. Our 1622™ app will help protect the Great Barrier Reef by enabling sugarcane growers to make better nitrogen fertiliser decisions. WaterWise helps reduce the footprint of high-value crops through sensor-model-data fusion, and LOOC-C will enable farmers to participate profitably in greenhouse gas mitigation and maximise benefits to the land from carbon markets.
Synthetic Biology	This platform has grown to an R&D portfolio supporting a large collaborative community of practice with national and international partners. We have established and are now commissioning a DNA Foundry – a high throughput robotic DNA assembly and organism engineering facility with test and quality control capabilities – and are developing protocols and training programs to help drive the conceptual shift in the community that is required to effectively engage with this scientific paradigm.
Environomics	We are working at the interface of environmental science and genomics, creating tools to enhance the management of Australia's natural resources. Our teams have developed new ways to remotely monitor biodiversity in Australia's marine parks with eDNA, and to determine the age and lifespan of long-lived ocean fish species to enable sustainable harvest. We are also pioneering ways to culture deep-earth microbes using electricity, which will open up a new age of exploration of biochemical products for medicine and industry.

PROGRESS IN OUR FUTURE SCIENCE PLATFORMS THIS YEAR	
Deep Earth Imaging	Deep Earth Imaging is developing new technologies to secure Australia's ongoing prosperity from resources (energy, minerals and water). We're focusing on the advancement of inversion and Earth imaging algorithms in collaboration with the Australian National University and Geoscience Australia through the new Industrial Inversion Laboratory (InLab). Our science employs indirect observations through geophysics allied with inference processes to see what is hidden from view beneath the surface. To more precisely image subsurface rock properties we will help to develop a common framework for inference, inversion and machine learning which will simplify the testing and development of new algorithms.
Active Integrated Matter	Active Integrated Matter brings together scientists and engineers from materials, sensors, robotics, physical processing, informatics and autonomous systems. We're collaborating to produce impact in smart and personalised food supply, versatile robotics for extreme scenarios, next generation 3-D printing and chemical processing, and future environment security. More than 15 novel technologies or prototypes have been developed, including a new stabilisation and production method for broccoli powder and a stochastic algorithm for food loss mapping. Commercial discussions are underway with potential end users.
Hydrogen Energy Systems	Hydrogen Energy Systems continues to build on the early impacts from its National Hydrogen Roadmap, and is now delivering new science from a range of cross-Business Unit projects. This work, supported by strong collaborations with local and international groups, is laying the foundation for new technologies and industry capabilities supporting a future hydrogen energy value chain, including a new renewable energy export industry for Australia.
Precision Health	In September, we launched the *Future of Health* report which details what's needed to keep Australia's health system efficient, equitable and affordable. This report is now being used to inform policy discussions across the health sector. We have active research projects with international partners such as Nanyang Technological University, A*Star and the Centre for Astrophysics and Computing and have engaged 12 new CSIRO-based Postdoctoral Fellows, with projects focused on extending our current patent portfolio. We have secured an additional $2.2 million in a joint A*Star/ Department of Industry, Innovation and Science Innovations in Food for Precision Health program.
Space Technologies	This new platform was launched in November to grow capability and catalyse research targeting opportunities in support of the Australian Space Agency's goal of tripling the size of the Australian space industry by 2030. The Space Technologies FSP has been in rapid start-up phase, initiating 11 novel projects in February in Earth observation, satellite technologies, space tracking technologies, space biomedicine and off-Earth resource utilisation. These have been supported by industry and research sector collaborators. The program will expand to 18 projects in July 2019–20, incorporating additional new research in space missions, robotics and communications.
Artificial Intelligence and Machine Learning	This new FSP, which began detailed planning in December, is targeting artificial intelligence-driven solutions to build a safer and more efficient future for the next generation. We established an advisory and leadership group with representation across the organisation. We prioritised artificial intelligence and machine learning needs and opportunities across CSIRO and held a series of workshops to consolidate organisational priorities into coordinated activities.

Responsible Innovation

Our Responsible Innovation (RI) initiative was established from within a Future Science Platform for application across the FSP program. It is now nationally and internationally recognised as a key presence in this emergent field. We have established a community of practice in Australia through strategic partnerships and collaborative research projects, including work with international agencies on gene drive, and short-course development on RI and digital disruption. Our applied focus on operationalising RI has emerged as a particular and unique advantage for the organisation.

CSIRO Innovation Fund

The CSIRO Innovation Fund, operated by CSIRO subsidiary Main Sequence Ventures, aims to improve the translation of publicly funded research into commercial outcomes and stimulate innovation in Australia. In 2018–19, the Fund focused on finalising the commitment of private sector investment, building the portfolio of investments and engaging with the Australian innovation sector. More than $140 million in private sector investment was secured for the Fund, representing large superannuation funds, international sovereign wealth funds, strategic corporate investors, an Australian university and high-net-worth individuals.

Between September 2017 and June 2019, the Fund has invested almost $60 million in 19 companies. These represent all of the Fund's priority areas, being health, food and agriculture, software as a service, space, cybersecurity, energy and resources.

In support of the innovation investments, Main Sequence Ventures also drives a Venture on Campus program that includes six key modules. It delivered venture mindset, skills and opportunity, which were custom designed for five Australian universities: University of Technology Sydney, the University of New South Wales, the University of Melbourne, the University of Western Australia and Monash University.

Impact from global activities

Our Global Strategy aims to create strategic and high-value global partners to deliver national benefit, and the importance of global partnerships is increasingly evident throughout CSIRO. The level of global engagements and activity across CSIRO has consistently grown; a reflection of the focus on our Global Strategy. These have demonstrated benefits to Australia through four key factors: enhancing our global scientific standing through global partnerships; connecting the domestic innovation system to the global innovation system; attracting foreign investment to Australia; and supporting Australia's foreign policy agenda.

The benefits accruing to Australia from our international activities are well demonstrated through case studies, with nine studies completed in 2018–19 providing a snapshot of our global engagements. For example, we now have a better capability to support the Tasmanian salmon industry as a result of our experience with a project in Chile. The *Sistema Integrado de Manejo para la Acuícultura* (SIMA) project increased our global scientific standing in the global aquaculture industry. The breadth, scale and complexity of the issues faced by Chilean aquaculture offered a unique opportunity for our scientific expertise and capability to evolve to a world-class level.

To facilitate further international collaboration with global partners, to address significant scientific issues and enable the research business, we established 26 international Memoranda of Understanding across 19 countries during 2018–19. For example, our Memorandum of Understanding with the Vietnamese Ministry of Science and Technology in 2018 has enabled Aus4Innovation, a $10 million development assistance program funded by the Department of Foreign Affairs and Trade. This program aims to strengthen the region's innovation system, connectivity with Australia in opportunities associated with Industry 4.0, and Australian and Vietnamese research and partnerships.

Powering the quest for self-driving cars

Baraja, a start-up based at our Lindfield Collaboration Hub, develops light detection and ranging (LiDAR) systems for autonomous vehicles, and demonstrates how our CSIRO Innovation Fund is helping to amplify our role as Australia's innovation catalyst.

Baraja has used mature telecommunications to revolutionise how driverless cars map the environment around them through the Baraja Spectrum-Scan™ LiDAR.

Spectrum-Scan™ LiDAR connects a wavelength-tuneable laser (engine) to prism-like optics (sensorheads) in a configurable suite. The engine, housing all the delicate optics, is stored within the vehicle, giving it protection and robustness from temperature, shock and vibration. This produces a highly accurate picture of the distance and reflectivity of surrounding objects – the laser can be automatically tuned to change resolution and focal points as required.

The sensorheads, mounted on top of the vehicle, provide up to 360-degree visibility. These are manufactured with off-the-shelf components, due to the LiDAR being built using mature components sourced from the telecommunications and automotive industry supply chains. This results in an already industrialised and scalable system at lower cost.

Baraja's LiDAR is versatile and able to adapt to changing environments. Baraja has been delivering prototypes of its system to autonomous car manufacturers for the last 12 months and has the opportunity to become the standard for the entire industry.

In January, Baraja announced its successful US $32 million Series A funding round, led by Sequoia China and our CSIRO Innovation Fund, and including repeat investment from Blackbird Ventures. With a strong research and development focus, Baraja will use the funds to invest in prototypes, tools and equipment, and hire staff members. Baraja arrived at our Lindfield site in 2015 with only two staff members. It now employs more than 95 staff members, expected to grow in number to 200 at the end of 2019. The company has offices in China and the United States, and is looking at the European market.

Baraja is a great example of how incubation, investment and collaboration can unlock the potential of a deep technology start-up with a global vision.

Production of the Baraja engine in the CSIRO laboratories.

University engagement

We partner with universities to boost innovation and ensure the best available research is used to deliver outcomes for Australia and the world. This year, we engaged with universities through collaborative research and co-publication, student supervision, Cooperative Research Centres and partnering with 30 Australian universities through the ON program.

Cooperative Research Centres

The Cooperative Research Centres (CRCs) program supports collaborations between researchers, industry and the community to foster high-quality research and development. The Australian Government has funded 225, with 30 CRCs active in 2018–19. We have contributed to more than 150 CRCs over time and participated in 14 during 2018–19.

We also participated in 13 CRC Projects (CRC-Ps) during 2018–19. These are smaller collaborations that operate on project timelines of up to three years and grants of up to $3 million.

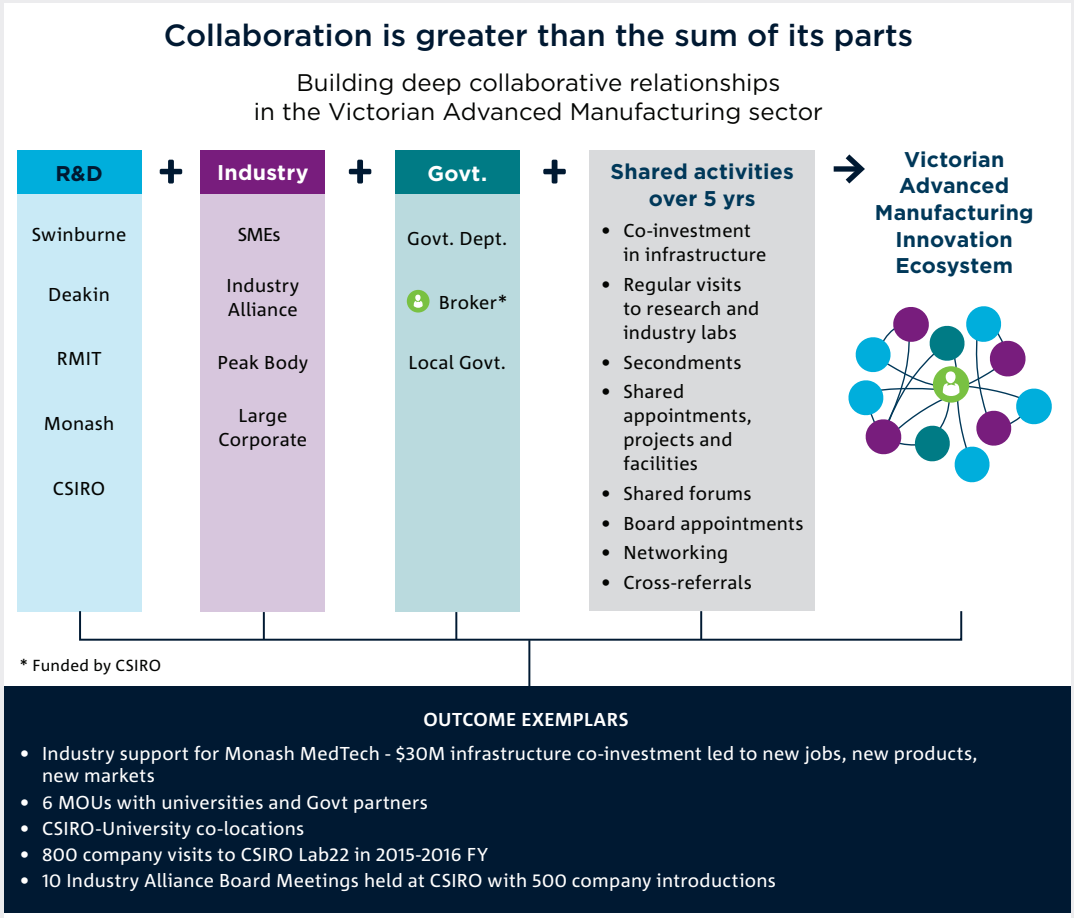
2018–19 highlights

We participated in 14 CRCs and 13 CRC-Ps with total cash and in-kind contribution to CRCs and CRC-Ps of $19 million.

- We became a member of MinEx CRC, which is modelled on the previous Deep Exploration CRC, in which we were a key research participant. Officially launched in late 2018, the $218 million MinEx CRC brings together CSIRO, Geoscience Australia, six universities, all state and territory geological surveys, industry and government. MinEx CRC will tackle the industry's main issue – the decline in the discovery of major new mineral deposits that are required to deliver a pipeline of mineral resource projects. Its work to improve the effectiveness of drilling, while at the same time collecting data, will drive down the time and cost of mineral discovery and deposit 'drill-outs' and bring forward production.
- In April, the Minister for Industry, Science and Technology, the Hon Karen Andrews MP, announced the outcomes of CRC Round 20. We will participate in an additional two CRCs, with funding to start in early 2019–20:
  - Blue Economy CRC: This CRC will bring together national and international expertise in aquaculture to develop innovative and sustainable offshore industries to increase Australian seafood and marine renewable energy production (read more about this CRC on page 56).
  - SmartSat CRC: This CRC will aim to foster the creation of next generation space technologies and make Australia more competitive in the global space economy by supporting the next wave of growth in critical industries including agriculture, transport, logistics, communications and mining.

Advanced Victorian manufacturing

The advanced manufacturing ecosystem in Victoria is a network of research, industry and government organisations working together to boost manufacturing in the region. A CSIRO broker was appointed under the CSIRO Precinct Strategy to work with other local R&D providers to find a mutual path for working together in a more coordinated fashion. The broker acted as a neutral agent working across existing collaborations to bring the organisations together into a larger, more cohesive ecosystem. Working together increased the visibility and access to research capability of industry. It also enabled opportunities to access funding from multiple players. For example, the Monash MedTech Facility benefited from a $30 million investment ($10 million each from CSIRO and Monash University to leverage $10 million from the Science and Industry Endowment Fund) to provide a broad range of equipment and technical expertise. Key infrastructure includes a magnetic resonance and position emission tomography (MR-PET) scanner, materials synthesis and processing equipment, and a cell therapies and regenerative medicine platform. This improved research capability helps companies meet the translational issues of the medical technologies industry.



The Victorian Advanced Manufacturing innovation ecosystem.

ON program

ON, powered by CSIRO, is Australia's sci-tech accelerator that helps researchers from all fields of science and technology to discover their impact pathways and then take their research from the lab into the world.

ON conducted three formal programs and associated activities throughout the year, and additionally supported runway and ecosystem services. These programs are designed to support teams from across CSIRO, the university sector and other publicly funded research agencies. We delivered one ON Accelerate program (44 per cent university teams, 56 per cent CSIRO teams) and two ON Prime pre-accelerator programs: Prime5, which was delivered to 156 participants; and Prime6 was delivered to 281 participants.

More than 300 participants were from Australian universities. More than 96 per cent of participant survey respondents from university led teams reported a willingness to recommend ON programs to their colleagues and other prospective participants. This demonstrates the demand for science accelerator programs in the research sector and the proficiency and effectiveness of the delivery of our programs. The program offerings continue to be developed and expanded in response to the needs of Australian researchers.

Since its formation in 2015, ON has supported 398 teams with deep tech ideas, coaching more than 1,440 people from 31 universities, five publicly funded research agencies, five medical research institutions and CSIRO. There have been 43 new companies formed, 14 of which have raised more than $36 million in investment capital. ON program participants have (post program) attracted more than $29.2 million in commercial grants.

RapidAIM

RapidAIM was founded by CSIRO researchers, Dr Nancy Schellhorn, Darren Moore and Laura Jones.

Its technology offers pest detection and monitoring through a series of smart sensor networks, sending data to farmers in real time on the presence of fruit flies on crops. Fruit flies cost Australia more than $300 million every year – the RapidAIM solution will have an enormous impact on agricultural markets here and overseas.

In November, Dr Schellhorn attended an event at Parliament House to unveil her new start-up, announcing an injection of $1.25 million funding from the CSIRO Innovation Fund, managed by Main Sequence Ventures.

With the help of CSIRO and ON mentors, the team has experimented in Silicon Valley, held successful field trials, gained real customers with product sales, and opened new premises in Brisbane's Fortitude Valley.

ON Executive Manager, David Burt and Dr Nancy Schellhorn.

RapidAIM aims to remain an Australian-made and operated company as the team works to expand their product and explore new markets. Dr Schellhorn, who has worked for CSIRO for 14 years, said her involvement in ON helped shift her mindset.

"We entered the ON program two years ago thinking that we might have an interesting piece of technology," Dr Schellhorn said. "By the time we exited the program 13 weeks later we had a pathway to market."

Customer and user satisfaction

Creating deeper, more innovative relationships with our customers help us to focus on delivering science that solves the biggest challenges facing our nation.

During 2018–19, we again used the industry benchmark Net Promoter Score (NPS) methodology as a measure of customer satisfaction. The NPS for 2018–19 was +45, based on a 10 per cent larger sample of customer responses. This shows a consistent upward trend in customer advocacy – our NPS in 2017–18 was +40 and +34 in 2016–17.

We continue to provide excellent scientific services to our customers, whose overall satisfaction with our price, quality and service (at 73 per cent favourable) has increased over the last four years. They like the way they are treated (89 per cent), that we value their opinion (85 per cent) and that we have their best interests at heart (81 per cent). More customers noted that our research is good value for money and an effective investment for them. Customers are experiencing the positive outcomes of our customer-focused initiatives in recent years: our internal Customer Experience Program training, strategic account management, focused business development, commercialisation pathways, targeted market analysis, and insights and improved systems.

Customers rate our responsiveness higher than in previous years, while their feedback also indicates room for further improvement in the timeliness of project delivery. Although we have become more commercially realistic over the last few years, we can still improve our communication, resourcing and complexity of contracting processes.

In response to this feedback, we conducted a review of our website's business section to clearly articulate our services to industry no matter where they are in their innovation efforts – from strategic planning to commercialisation. Our new Commercialisation Marketplace helps customers explore our pipeline of investment and partnership opportunities as well as licensing options to catalyse innovation and create competitive advantage. It ensures we are more transparent with our research, intellectual property, technology and capabilities.

In 2018–19, we engaged with 3,300 customers, generating $433 million of revenue from research, consultancy and testing services, and earning more than $45 million in licence, equity and royalty revenue from applied technology. We entered into more than 1,800 new commercial agreements totalling $708 million. The average contract value was more than 80 per cent higher than the previous six-year average. Our top 10 contracts in 2018–19 were valued at $191 million, representing 27 per cent of the total of all commercial contracts signed this year.

Government partnerships

In 2018–19, we worked with 207 customers from all levels of Australian government, federal, state and local, representing $175 million of scientific engagement. One example is working with the Therapeutic Goods Administration to develop guidance on the regulation of software as medical device and cyber security for medical devices.

Strategic agreement with South Australian Government

In May, we signed a strategic agreement with the South Australian government to develop capabilities in key sectors such as space, defence, health, energy and resources. Building on this partnership, we will expand our local innovation efforts through investments aimed at improving and up-scaling facilities as well as developing new ones. This will encourage collaboration with the South Australian research sector including universities, research institutes, industry and state government agencies. The agreement will help to create new industries and jobs aligned with the state's agenda of impacting local and national economic growth.

Blue Economy

The Blue Economy focuses on working with a range of industry and government partners for the sustainable use of ocean resources for economic growth, improved livelihoods and jobs, while preserving the health of the ocean ecosystem. In the recently announced Blue Economy Cooperative Research Centre (CRC), we are a core partner through our Oceans and Atmosphere and Energy Business Units. This is a $329 million 10-year research collaboration between 45 national and international partners from industry, research and government, underpinned by a $70 million cash investment from the Federal Government. The CRC seeks to create integrated seafood and energy production systems in the offshore environment.

Bureau of Meteorology

CSIRO and the Bureau of Meteorology have successfully collaborated for more than 40 years, delivering scientific impact of mutual and national benefit. In 2018, we signed a new relationship agreement to increase the strategic and national benefit from our collaborative endeavours. One of the key projects, BLUELink, has been running since 2002 in conjunction with Defence through the Royal Australian Navy (RAN). It is proposed this be extended an additional six years, bringing the lifetime value of the project to $13 million to ensure RAN can take advantage of the improved performance of global and regional ocean models and forecast services, and maintain its world-class position.

Industry partnerships

Applying our research directly to industry is central to our purpose. In 2018–19, we worked with more than 3,300 customers including 377 Australian large corporates, 375 international corporates and more than 950 small and medium-sized enterprises.

2018–19 highlights

Australian National Outlook: In June, we released the Australian National Outlook 2019 in partnership with the National Australia Bank and more than 20 non-government organisations. This second iteration explores how Australia can have a future with prosperous and globally competitive industries.

Fortescue: In November, we partnered with Fortescue to determine whether our metal membrane technology can be developed on a commercial scale to meet the growing global demand for clean hydrogen fuel (read more about Fortescue on page 34).

Australian Plant Proteins Pty Ltd: After we helped Australian Plant Proteins improve its manufacturing process of extracting protein from faba beans, Australian Plant Proteins invested in a $20 million facility, which will create 20 jobs and produce more than 2,500 tonnes of protein powder each year. A further $15 million is planned for the facility, which will double its annual production by 2021 and create additional jobs (read more about Australian Plant Proteins on page 57).

SME Connect

Another way we support collaboration between industry and research institutions is through our SME Connect programs, designed to bring together small to medium-sized enterprises (SMEs) with Australia's best researchers and facilities. Our SME Connect team works with SMEs across Australia to support and enable innovation through funding, expertise and resources. SME Connect delivers three programs; Innovation Connections, funded by the Australian Government as an element of the Department of Industry, Innovation and Science Entrepreneurs' Program; STEM+ Business Fellowship program, funded by the Science and Industry Endowment Fund; and CSIRO Kick-Start. In 2018–19, SME Connect facilitated 222 research projects nationally for 202 companies, injecting more than $24 million into the research and development of these projects. Of these projects, 189 SMEs were delivered by 32 Australian research organisations, including 22 universities and CSIRO, and 33 were grants for recent graduates to work on in-house research projects for SMEs.

Kick-Start

Kick-Start is one of three programs offered through SME Connect. It helps Australian start-ups and SMEs access dollar-matched funding for research, development, or testing activities with CSIRO. This program forms part of our strategic commitment to deepen our direct support for Australian technology start-ups and SMEs in areas of national growth priorities.

In 2017–18, Australian Plant Proteins Pty Ltd approached us for help to improve its manufacturing process that produces a plant-based protein powder using faba beans. As a start-up, the company required financial support and expertise to help develop its product from its testing phase to commercial production.

Working with us over several trials the company was able to create a more advanced protein extraction method, which has increased the protein level in the final faba bean powder to 80 per cent. Under our guidance, the company was also able to make its manufacturing process more efficient, reducing the time and resources needed to produce the protein powder.

The success of this research phase has seen Australian Plant Proteins Pty Ltd invest in a $20 million facility, which will be built in Horsham, Victoria.

The facility, which is expected to be operational in the first half of 2020, will create 20 jobs and produce 2,500 tonnes of protein powder each year.

A further $15 million investment is planned for this facility, doubling its annual production to 5,000 tonnes by early 2021. This will create a further 15 jobs to support the increased production.

Significant demand for plant-based protein powders already exists in overseas markets. As a product that is virtually odourless, colourless and neutral in taste, it can be used across a range of food categories, including snack food, pasta and breakfast cereals, and as a meal replacement. As a result, the protein powder produced at this facility has the potential to create new opportunities for the Australian agricultural industry.

The CSIRO Food and Innovation Centre, Werribee, where the faba bean project work was undertaken.

Space, it's getting bigger

A national spotlight was shone on the space sector this year with the creation of the Australian Space Agency, which has been tasked with growing the local industry three-fold by 2030. We are a key partner to the new agency and this year we built on our 75 years in the sector with several new initiatives.

In September, we launched our Space Industry Roadmap that sets out three main pathways for unlocking future growth across Australian industry in space-derived services, space object tracking and space exploration and use. Our roadmap informed the Australian Space Agency's strategic direction and its priority areas highlighted in the Civil Space Decadal Plan 2018–28.

In November, we announced a $16 million investment into breakthrough innovation via a new Space Technology Future Science Platform. This will focus on building world-leading capability and driving research within CSIRO to support the strategic priorities identified by the Australian Space Agency and the opportunity areas detailed in our Space Industry Roadmap.

Our industry engagement in the sector continued to deepen. We hosted two 'Space 2.0' workshops that connected SMEs and start-ups, the research sector, end-users and governments, and we celebrated our 30-year partnership with Boeing by announcing 20 new projects – including four space-related projects – demonstrating our shared commitment to solving the greatest challenges.

Our collaboration with the United States' National Aeronautics and Space Administration (NASA) continued through our role managing the Canberra Deep Space Communication Complex on its behalf, tracking and communicating with more than 30 missions exploring the solar system. Our work in this area was further enhanced by a new contract to provide operational support from June 2019 for the European Space Agency's ground station near New Norcia in Western Australia.

We extended our civilian satellite capability by securing access to one of the world's most sophisticated high-performance satellites – NovaSAR-1 – which we'll operate as a national facility, giving Australian scientists direct control of environmental data collection in our region. Launched from India in September, the satellite is undergoing commissioning and is expected to be operational in the second half of 2019.

Furthering our work in observing Earth from above is a new pilot CubeSat project known as CSIROSat-1. Supported by a grant from the Science and Industry Endowment Fund, and built in collaboration with Adelaide-based SME Inovor Technologies, this miniature satellite is expected to be launched into low Earth orbit from the International Space Station by mid-2020.

Our Parkes radio telescope was called on by NASA to support the Canberra Deep Space Communication Complex to track Voyager 2 as it entered interstellar space.

Industry roadmaps

At CSIRO, we align our world-class science with key industry sectors. The Industry Growth Centres (IGC) Initiative is an industry-led approach to focus science and research in key areas, with the aim of delivering commercial outcomes. The initiative covers six industry sectors:

- Advanced Manufacturing
- Food and Agribusiness
- Medical Technologies and Pharmaceuticals
- Mining Equipment, Technology and Services
- Oil, Gas and Energy Resources
- Cyber Security

We have collaborated with all six IGCs – Advanced Manufacturing Growth Centre, Food Innovation Australia Limited, MTPConnect, METS Ignited, National Energy Resources Australia and AustCyber – as well as across government and industry to understand emerging industry opportunities and associated enabling science and technology. These efforts have produced Industry Roadmaps for each IGC industry, with the final roadmap for Cyber Security delivered during 2018–19. We also delivered the Space Industry Roadmap in collaboration with the Australian Space Agency to drive opportunities for growth in the Australian space ecosystem; the National Hydrogen Roadmap which provides a blueprint for the development of a hydrogen industry in Australia; and produced a vision and set of enabling priorities for Australia's health sector through the *Future of Health* report with inputs from the Department of Industry, Innovation and Science and the Department of Health.

Public perception of CSIRO

We are well-known and trusted by the Australian community. Each year, we assess our reputation through external community and business surveys, and an internal staff survey. The results provide us with insights to guide our communication and engagement activities to strengthen our role as Australia's national science agency.

Public awareness of CSIRO remains high at 87 per cent, with 64 per cent of Australians perceiving us positively, consistent with previous years. The awareness of the ability to engage with us, as derived from a survey of Australian business, has remained stable from 2018 at 35 per cent, while the knowledge by businesses of what we do has increased to 50 per cent from 45 per cent in 2018.

Our Corporate Affairs Strategy continues to strengthen our awareness and reputation by creating more relevant and accessible opportunities to engage our community and customers. The launch of our online Commercialisation Marketplace provided a central, searchable database of opportunities available to commercialise CSIRO technology and capabilities, enhancing our reputation as being open and ready for business.

Our campaigns to promote innovation breakthroughs made international headlines: campaigns on super-bug-fighting platypus milk, a crease-free cotton and smart ear tags for livestock reached a combined media audience of 22 million.

Managing national research infrastructure

Our Parkes radio telescope helped track NASA's Voyager 2 spacecraft, collecting extra data as the probe reached a major milestone (read more on page 65).

To solve the greatest challenges, Australia needs world-class research infrastructure. We manage national research infrastructure on behalf of the scientific community to help with the delivery of research. There are two types of national research infrastructure: national research facilities and national research collections.

We are the national provider of a range of specialised laboratories, scientific and testing equipment, and other research facilities. Our science-ready facilities are used by Australian and international researchers through application and user-funded arrangements.

Our national research facilities include:

- Australian Animal Health Laboratory (AAHL), Geelong
- Australia Telescope National Facility (ATNF) comprising:
  - Parkes radio telescope, Parkes (NSW)
  - Australia Telescope Compact Array, Narrabri (NSW)
  - Australian Square Kilometre Array Pathfinder (ASKAP) telescope and the Murchison Radio-astronomy Observatory, Western Australia
  - Mopra telescope, Coonabarabran (NSW)
- Marine National Facility (MNF), Hobart
- Pawsey Supercomputing Centre, Perth
- Atlas of Living Australia (ALA).

The National Research Collections Australia comprise:

- Australian National Fish Collection (ANFC), of marine fish
- Australian National Herbarium (ANH), of native plants and weeds
- Australian National Insect Collection (ANIC), of terrestrial invertebrates
- Australian National Wildlife Collection (ANWC), of terrestrial vertebrates
- Australian National Algae Culture Collection (ANACC) of living microalgae cultures
- Australian Tree Seed Centre (ATSC), supplying tree seed to both domestic and overseas customers.

Table 3.6: Summary of our performance for managing national research infrastructure

KPI AND METRIC	TARGET	RESULT	
Maintenance and operation of the research infrastructure to appropriate standards	Compliance with Australian legislation and regulations and ISO accreditations	G	Our research infrastructure achieved compliance with relevant Australian and international standards. AAHL continues to maintain or exceed the regulatory requirements certified by the Department of Agriculture, the Office of the Gene Technology Regulator and the Department of Health's Security Sensitive Biological Agents legislation, and all relevant ISO accreditation.
Use of the facilities and collections as measured through: successful observations, time lost during observations, core hours used, outward loans and successful research days delivered	Minimum of 70% successful astronomy observations	G	The ATNF achieved 77.2% of time for successful astronomy observations and lost only 1.3% of time to unscheduled outages.
	Maximum 5% time lost during scheduled observation		
	90% core hours on Magnus supercomputer	G	91.7% core hours on Magnus were achieved.
	70% outward loans (over 5 years) – combined use of national research collections	G	The NRCA achieved 70% outward loans. We also increased the proportion of the national biological collections that are digitised. The Australian National Algae Culture Collection maintained 100% digitisation.
	Minimum of 90% successful research days delivered on Marine National Facility	G	The MNF achieved 100% successful research days delivering all scheduled operations with no time lost.
	Maximum of 10% time lost during scheduled Marine National Facility operations		

Green shading indicates positive progress for the year and the target has been achieved.

Australian Animal Health Laboratory

The Australian Animal Health Laboratory (AAHL) provides Australia's highest level of biocontainment within a purpose-built biosecurity infrastructure. It is recognised nationally and internationally as a centre of excellence in disease diagnosis, research and policy advice in animal health and human diseases of animal origin. AAHL works to protect Australia's billion-dollar livestock and aquaculture industries, and the community, from exotic and emerging infectious diseases, which helps to maintain Australia's economy and environment, and the health and social wellbeing of our nation.

AAHL is built and operated to safely store and enable work on the most dangerous pathogens, and our experience developed in biosecurity and biosafety is sought by governments and customers around the world. The infrastructure and scientific expertise enables delivery of a vital service to the Department of Agriculture (DoA) as Australia's Reference Laboratory for emerging animal diseases and high-consequence pathogens of animal origin.

AAHL is a crucial part of Australia's biosecurity infrastructure and is funded primarily by CSIRO appropriation. DoA provides funding for an ongoing diagnostic service and the National Collaborative Research Infrastructure Strategy has provided funds to enable national and international researchers to access the facility. AAHL delivers diagnostic and research services to Australian federal and state and territory governments as well as to industry and international bodies. AAHL supports projects to aid regional food security and carries out and hosts a large portfolio of research requiring high containment, which informs national disease control policy and provides opportunities to Australian industry.

Services offered in 2018–19 included:

- laboratory investigation of suspect cases of notifiable diseases
- access to high-containment laboratories and animal facilities for collaborative research
- continued expansion of the customer base, while fully delivering to the DoA contract
- collaborations across CSIRO to develop vaccines and therapeutics against dangerous pathogens, the development of innovative diagnostic methods, disease-resistant poultry and methods of limiting populations of invasive animal species
- quarantine testing for horses, birds, aquatic species and companion animals
- training courses for vets in the diagnosis of animal diseases and biosafety training for scientists
- services that enhanced regional biosecurity and food security across Asia.

Maintenance and operations

During 2018–19, overall maintenance and operational performance continued to meet targets. There were significant plant and equipment upgrades, including a new goods receiving building and upgrade of the dry fire systems, which will continue to 2021, while the Part Life Refit and security system upgrades began in order to ensure site security can appropriately respond to risks in the current environment.

Each year, AAHL analyses samples from around 3,500 cases for diagnostic testing, including more than 700 for rapid response emergency disease exclusion. In 2018–19, this covered more than 70 aquatic and terrestrial animal diseases. Other samples are received from around the world for a range of purposes, including to enable global movements of healthy animals, facilitate import of biological materials, exclude exotic diseases in Australian livestock or characterise viruses detected in our region. AAHL also plays a significant role in public health, testing for important zoonotic diseases.

To fulfil its role in emergency response, AAHL maintains, exercises and updates its Emergency Laboratory Response Plan. The plan has recently proven sufficiently robust to manage laboratory support during an aquatic animal disease outbreak – white spot syndrome virus in Queensland prawn farms.

During 2018–19, AAHL staff contributed to policy advice and guideline setting through a range of World Organisation for Animal Health and World Health Organization ad hoc groups, including those with a focus on bio-banking, aquatic and terrestrial disease diagnosis, response framework for zoonotic diseases and investigation of intentional use of biological agents. This latter area also led to engagement with Departments of Defence, and Foreign Affairs and Trade, and the United Nations.

Testing for African swine fever

In recent years, a devastating disease affecting pigs known as African swine fever (ASF) has been spreading globally and, more recently, in Asia, increasing the risk of the disease entering Australia.

The impacts of ASF include sickness and death in domestic pigs, loss of trade and the costs associated with outbreak response and eradication measures.

Mortalities can approach 100 per cent and there is currently no vaccine or other treatment available to prevent this disease. To tackle the challenge of a secure Australia and region, effective disease control is critical, which depends on rapid detection and strict biosecurity measures.

In response to the recent spread of ASF through parts of Europe, China, Vietnam and Cambodia, AAHL staff have collaborated with international institutions to develop a vaccine and improve our diagnostic testing for ASF to help to control the disease and ensure Australia is prepared should it be found on our shores.

AAHL has the facilities and expertise to manage the animal biosecurity risks of testing samples for African Swine Fever virus.

The Australian Government's Department of Agriculture (DoA) has commissioned additional activities to ensure that its biosecurity measures continue to keep Australia's $60 billion agricultural industries and feral pig populations free from ASF and other exotic diseases.

As part of this, a sample of pork products was seized at international airports and mail processing centres over two fortnightly periods in early December and late January.

The seized samples were tested at the AAHL in Geelong, Victoria.

The tests conducted by staff at AAHL showed that ASF DNA was present in 46 of the 435 intercepted pork products tested. These results do not necessarily mean that the fragments of virus detected can cause infection in pigs. However, staff also undertook further testing to determine whether the whole virus, which would be more likely to infect pigs, was present in the seized products.

As a result, DoA took action to inform Australians of the increased biosecurity practices at borders and to remind all visitors to comply with Australia's strict biosecurity requirements. The department will be using the results to refine and strengthen its border protection measures. Australia's Minister for Agriculture has also introduced increased penalties for travellers who try to bring meat or meat products illegally into the country.

In addition to testing, staff at AAHL also conducted research on ASF and provided training to perform rapid field investigations and laboratory diagnosis for early detection of the disease in the Asia-Pacific region, which is now on high alert for incursions of ASF.

Australia Telescope National Facility

The Australia Telescope National Facility (ATNF) has observatories near the towns of Parkes, Narrabri and Coonabarabran in New South Wales and in the mid-west region of Western Australia. These observatories house our telescopes: the Parkes radio telescope, Australia Telescope Compact Array (ATCA), Mopra and Australian Square Kilometre Array Pathfinder (ASKAP), respectively. Our Murchison Radio-astronomy Observatory, home to ASKAP, will soon be home to the low frequency telescope of the international Square Kilometre Array project. We also link our telescopes with others in Australia and around the world to form the Long Baseline Array (LBA).

The ATNF comprises the major part of our Astronomy and Space Science, which also operates the Canberra Deep Space Communication Complex (CDSCC) on behalf of the United States' National Aeronautics and Space Administration (NASA), and the European Space Agency (ESA) tracking station at New Norcia, near Perth. We also manage CSIRO's time on the NovaSAR Earth observation satellite and coordinate CSIRO's space research.

Use of the ATNF

All our telescopes can be operated remotely from the Science Operations Centre at our Sydney headquarters, or virtually from anywhere in the world. Our telescopes are used for astronomy research into such areas as the formation and evolution of stars and galaxies, the interstellar medium, cosmic magnetism and the extreme physics of pulsars and black holes. We also perform follow-up observations for other observatories, for example those investigating gravitational waves.

Most observing time on ATCA and the Parkes radio telescope is awarded free of charge on the basis of scientific merit. About 38 per cent of observing time on the Parkes radio telescope was purchased by external partners. Mopra is no longer offered for merit-based access and is used by a consortium of universities that fund its operation.

All 36 antennas of ASKAP, equipped with our novel phased array feed receivers, were brought online and into one array in February. Astronomers have already completed the most comprehensive Galactic survey ever made of the southern sky in just ten days' observing time (such surveys traditionally take years). This is the first of several such surveys at different frequencies that each cover three quarters of the sky.

Throughout the year, ASKAP continued its highly successful search for fast radio bursts. These are inexplicably bright 'flashes' of radio waves lasting a few milliseconds. They've garnered much publicity and are the subject of intense interest to astronomers. Only two dozen fast radio bursts had been found since the first one in 2007, but the team using ASKAP has almost doubled this number and pinpointed the location of one, which will lead to an improved understanding of their origins.

In 2018–19, research teams of 856 astronomers from 35 countries submitted proposals to use ATCA, the Parkes radio telescope and the LBA. For ASKAP, 10 survey science projects are allocated observing time for the first five years of full operation.

Figures for 2018–19 below show the use of ATCA and the Parkes radio telescope.

Table 3.7: Use of the ATNF

	TARGET	2016–17	2017–18	2018–19
Successful astronomy observations (%)[9]	70 (min)	72.0	74.7	77.2
Time lost during scheduled observations (%)[10]	5 (max)	2.0	3.3	1.3

9 The target is that at least 70% of the available time (24 hours a day, year-round) is used for successful astronomical observations. The remaining time allows for planned and unplanned non-availability e.g. maintenance, upgrades, weather events, etc.

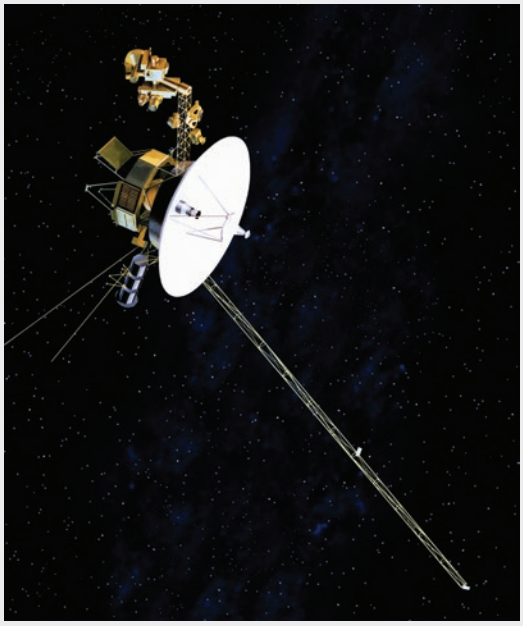
10 Includes time lost through malfunction on fully operational facilities, but not commissioning time for new equipment or facilities.

Parkes tracks a tiny space traveller

In 2018–19 our Parkes radio telescope helped track NASA's Voyager 2 spacecraft, collecting extra data as the probe reached a major milestone.

Launched in 1977, Voyager 2 is now more than 18 billion kilometres away – 120 times further from the Sun than Earth is. The spacecraft's radio signals, which travel at the speed of light, take more than 16 hours to reach Earth. And those signals are small to start with: the transmitter that generates them runs on just 20 watts – about the same power as two LED lightbulbs.

Readings taken in September showed the spacecraft was about to cross the heliopause, the edge of a protective bubble created by our Sun as we move through our galaxy, and enter interstellar space. Interstellar space is almost a vacuum, but not quite: it contains a very thin soup of charged particles.



NASA's Voyager 2 spacecraft officially entered interstellar space in November. Our Parkes radio telescope was called on to collect valuable data.

In 2012, Voyager 1, Voyager 2's sibling spacecraft, became the first human-made object to cross the heliopause and officially enter interstellar space. Its instruments showed a big jump in the density of particles. Voyager 2 has been on a different path, and scientists wanted to see if it encountered the same conditions, while gathering as much data as possible about the heliopause.

Voyager 2's location means it can only be tracked from the Southern Hemisphere. The Canberra Deep Space Communication Complex (CDSCC), which we manage on NASA's behalf, tracks Voyager 2 using either its 70-metre dish or two 34-metre dishes.

However, CDSCC needs to communicate with dozens of spacecraft and in this period the New Horizons space probe was commanding much of its capacity, limiting the amount of time it could devote to Voyager 2. To ensure as much data as possible on the heliopause crossing was captured, NASA asked for the help of our 64-metre Parkes radio telescope.

Parkes tracked Voyager 2 from November to February, supplementing CDSCC for 10 to 11 hours a day. The telescope captured 745 hours of data, which helped collect valuable information about Voyager 2's historic crossing of the heliopause.

This is the twelfth time Parkes has supported NASA space missions. Its first support role was to help track NASA's Mariner 2 spacecraft, sent to Venus in 1962. Most famously, Parkes received television signals from the Apollo 11 Moon landing – and helped send them to 600 million people around the world – in 1969.

On all these occasions Parkes worked cooperatively with other NASA tracking stations. Its closest links have been with CSDSCC, which is one of three stations in NASA's Deep Space Network for communicating with spacecraft exploring the solar system.

As investment in Australia's burgeoning space industry grows, these world-class capabilities will be critical to growing future industries for Australia in space.

Marine National Facility

The Marine National Facility (MNF) is part of Australia's landmark research infrastructure. It provides world-class, blue-water research capabilities for Australian researchers and their international collaborators for work in Australia's vast and largely unexplored marine areas. The MNF enables excellent scientific research in the national interest, supporting evidence-based decision-making on challenges affecting climate policy and programs, and marine environment and resources.

MNF includes the world-class research vessel *Investigator*, a suite of scientific equipment, expert technical staff and more than 30 years of freely available marine data. *Investigator* is able to be at sea for up to 60 days without re-supply, accommodate 40 scientists, technical staff and other participants, and cover 10,000 nautical miles per voyage, with an operational range from the Antarctic ice edge to the tropics.

An independent Steering Committee advises the CSIRO Board on strategic development of the Facility and advises the MNF Director on strategic matters, performance of the MNF and on allocation of sea time. The Steering Committee is supported by two expert panels, a Scientific Advisory Committee and the National Benefit Assessment Panel, which provide advice on the merit of applications received. Applications for sea time are open to all researchers working in Australian universities or research institutions and are assessed through an independent, competitive, and peer-reviewed assessment, which considers scientific and technical excellence, and the national benefit of the proposed research.

In 2018–19, the MNF transitioned to full-year operations following a new funding announcement under the Australian Government's 2018 Research Infrastructure Implementation Plan, bringing at-sea capacity to approximately 300 days of merit-based scientific missions per year. Scaling up has involved an increase in operational and technical capability; digitisation of business systems to streamline voyage planning and information flow for users and operators; strengthening health and safety procedures; and investment in scientific instruments and spares. An independent review of the access framework was completed in May to ensure the principles, criteria and processes for awarding of sea time remained robust.

Use of the MNF

In 2018–19 the MNF participated in the Australian Antarctic Festival with an open ship, and undertook nine primary research voyages. One technical and two transit voyages were undertaken including research on:

- iron inputs and cycling in the southern extension of the East Australian Current to understanding relationships between nutrient supply and biological productivity in the open ocean
- the Antarctic Circumpolar Current (ACC) to help improve ocean and climate modelling, and better understand and predict climate change
- deep-water coral communities of the Tasmanian seamounts (see case study on page 67)
- the processes driving plate tectonic movement and forces in separation of Australia and Antarctica
- the distribution and abundance of the Antarctic blue whale, and their prey, to inform management of expanding Antarctic krill fisheries
- uncovering shipwrecks, including the SS *Iron Crown*, torpedoed in Bass Strait in World War II.

Table 3.8: Use of the MNF

	TARGET	2018–19
Successful research days delivered (%)[11]	90 (min)	100
Time lost during scheduled operations (%)[12]	10 (max)	0

11 Successful research days against scheduled operations. Success means the science was able to be completed consistent with the voyage objectives and allows for planned and unplanned non-availability e.g. maintenance, upgrades, weather events, etc.
12 Includes time lost through malfunction on fully operational facilities, but not commissioning time for new equipment or facilities.

Putting deep ocean life on the map

In late 2018, we led a collaborative research voyage on *Investigator* to survey deep-sea coral communities on undersea mountains (seamounts) off southern Tasmania. The remoteness and testing nature of deep-water research means knowledge of the distribution and ecology of these communities is limited, creating unique barriers for marine park managers. Deep-sea coral communities are fragile and slow-growing, vulnerable to human activities and to changes in ocean temperatures and acidity. To help solve the challenge of maintaining a resilient and valuable environment, there is an urgent need to map the location and biodiversity of deep-sea coral communities and learn more about their behaviour.

Investigator's flexible platform and capacity allowed ambitious and novel research.

The collaborative hub created by the MNF brought together researchers from national and international organisations including CSIRO, National Environmental Science Program Marine Biodiversity Hub, Australian Museum, Museums Victoria, Tasmanian Museum and Art Gallery, three Australian universities, Parks Australia, and New Zealand's National Institute of Water and Atmospheric Research.

During the month-long voyage, 45 seamounts were surveyed and 147 seabed transects completed using specialised deep-water cameras. Seamounts previously sampled 10 and 20 years ago – some impacted by bottom trawling and some now protected in marine parks – were also surveyed, providing information about recovery and resilience of these communities. The technical expertise of MNF and ASP Ship Management technical staff, working in partnership with voyage scientists, enabled high-resolution imagery of the coral communities across 200 kilometres of transects to be successfully collected. Biological specimens were collected during the voyage, along with other important oceanographic and bathymetric (seafloor mapping) data.

Investigator's ability to offer real-time data streams was used to engage the public in the research. The voyage was an Australian first, with the complete voyage livestreamed 24/7 via CSIRO.au. This included vision from the deep tow camera surveys, providing a real-time window on life 2,000 metres below the surface. More than 5,000 viewers were given a front-row seat to the research, creating a powerful tool for public engagement with marine science.

The voyage collected around 7 terabytes of data, including 60,000 stereo images and 300 hours of video. On board facilities on *Investigator* allowed researchers to conduct a preliminary review and annotation of large volumes of the visual data, ensuring it was available for further analysis and use before the ship returned to port. All data collected are made freely available for any researcher to access and use.

The outcomes of this research will be substantial, providing distribution data to map the extent of these globally significant deep-sea coral communities. It will also provide world-first recovery and resilience data for the Australian Government, as well as other national and international bodies. Ultimately, the research is contributing to a national government and industry blueprint to cost-effectively monitor the marine environment and help sustainable management of our fisheries and food supplies.

Information from this research will be incorporated into Australia's State of the Environment reporting and provides a measure by which Australia can be compared and assessed.

Nick Mortimer with 'pilot' Karl Forcey, CSIRO, flying the deep-tow camera over a seamount.

Pawsey Supercomputing Centre

The Pawsey Supercomputing Centre is a high-performance computing centre located in Western Australia. It is one of only two high-performance computing facilities in Australia. Pawsey enables scientific research to be accelerated for the benefit of the nation by helping researchers to tackle large-scale data problems and simulations. The Centre provides access to world-class expertise and infrastructure in supercomputing, data and visualisation services to researchers across government, academia and industry.

Currently serving more than 80 organisations, Pawsey achieves unprecedented results in science domains including radio astronomy, geosciences, resources engineering, bioinformatics and health sciences. It has an integral role in the operation of our newest radio telescope (read more on page 69).

Pawsey is an unincorporated joint venture between CSIRO, Curtin University, Edith Cowan University, Murdoch University and the University of Western Australia. It is funded by the Australian Government, the West Australian Government and Pawsey members, and governed by a Members' Agreement and a Board comprised of core member representatives, independent members and an independent chair.

CSIRO as the centre agent owns and operates the Centre on behalf of Pawsey. The Centre is located at our Kensington site and offers a range of supercomputing and large-scale data facilities including:

- Magnus – a Cray XC40, a petascale system designed to tackle the largest simulations possible
- Galaxy – a Cray XC30 dedicated to radio astronomy, including ASKAP, the Australian precursor projects to the SKA and the Murchison Widefield Array run by Curtin University
- data-storage capabilities expandable up to 100 petabytes.

In 2018, the Australian Government awarded $70 million to upgrade Pawsey's supercomputing infrastructure to enable Australia's researchers to remain globally competitive, and increase our scientific ambitions, outcomes and impact. Over the past year, planning began for the installation and performance benchmarking of the new HPC infrastructure, which are anticipated to be completed by mid-2022.

Pawsey has 50 staff members who are employed by CSIRO as the centre agent. The staff at Pawsey provide expertise in several disciplines, which enables Australian researchers to take advantage of the Centre's wide range of services.

Use of Pawsey

Access to Pawsey supercomputing resources was provided through several merit allocation schemes:

- Pawsey Partner Merit Allocation Scheme – 30 per cent of resources allocated, with 12-month allocations, budgeted quarterly
- Radio-astronomy Scheme – 25 per cent of Pawsey resources allocated (i.e. Galaxy)
- National Computational Merit Allocation Scheme – 25 per cent of resources allocated; the call for proposals was made in September/October, with 12-month allocations, budgeted quarterly
- Energy and Resources Merit Allocation Scheme – 15 per cent of resources allocated, with 12-month allocations, budgeted quarterly
- Pawsey Director's Allocation Scheme – five per cent of resources allocated. This is a responsive-mode grant assessment process, available most of the year and most resources were small (<0.1 per cent of available resource time) three-month allocations.

The Centre supports more than 1,900 researchers across Australia, a number which has increased by 20 per cent in the last year. Demand continues to exceed availability: last year, the three major allocation schemes recorded an average of 53 per cent success rate (time allocated vs time requested). More than 485 million core hours[13] were requested when only 260 million core hours were available.

Table 3.9: Allocation of the Magnus Supercomputer

	TARGET	2018
Core hours used on the Cray XC-40 supercomputer Magnus (%)	90	91.7

13 "core hours" refers to the duration of use (in hours) multiplied by the number of processor units (cores) used.

Pawsey helps us see more of the Universe

Pawsey Supercomputing Centre is integral to the operation of our newest radio telescope and has just helped it spot what may be a new galaxy forming.

Our Australian Square Kilometre Array Pathfinder (ASKAP) in Western Australia is designed to test new technology and techniques as a precursor instrument for the international SKA telescope. What sets ASKAP apart from other telescopes is its 'phased array feeds': CSIRO-developed receiving systems that let the telescope see a huge area of sky at once – 120 times the size of the full Moon. These receivers make ASKAP one of the world's most powerful survey telescopes, able to do in weeks what took earlier telescopes years.

With the telescope's 36 antennas working together at full throttle, they output nine terabytes of data an hour – equivalent to streaming 9,000 Netflix movies at once. This huge data output requires supercomputing power to process the raw data into images and other science products. To date, this has been done by batch-processing with Pawsey's Galaxy machine, a Cray XC30.

ASKAP is now just a few steps away from starting the key survey projects that will take advantage of its special capabilities. The survey science teams are making preliminary 'Early Science' observations with a subset of the ASKAP antennas to hone their techniques and strategies.

One of these surveys is WALLABY (the Widefield ASKAP L-band All-Sky Blind Survey), led by researchers from CSIRO and the University of Western Australia, which will give us the distances of 600,000 galaxies, plus their masses, and how much neutral hydrogen gas and dark matter they contain. These measurements will help us understand which factors drive change in galaxies over time.

The data already collected during Early Science observations for WALLABY, when only 12 ASKAP antennas were available, was processed by the Galaxy supercomputer at Pawsey. The observations covered a well-known galaxy group (NGC 7232) but revealed several radio sources that had not been detected before with other telescopes. One of these objects may be a new dwarf galaxy coming into existence.

This is just the beginning. When full survey science operations begin, ASKAP is set to find many more galaxies and provide new insights into their physical processes. The Australian Government's recently announced $70 million upgrade to Pawsey's supercomputing infrastructure will help astronomers process and store more data, helping fuel new discoveries.

As investment in Australia's burgeoning space industry grows, these world-class capabilities will be critical to growing future industries for Australia in space.

Our ASKAP radio telescope in remote Western Australia is being used by astronomers to study the Universe; the Pawsey Centre in Perth is providing integral data processing and storage to make new discoveries.

National Research Collections Australia

Australia is home to more than half a million species of plants and animals, with three-quarters of these found nowhere else on Earth. This unique biodiversity is a national treasure and a crucial environmental asset, providing ecosystem services and economically valuable resources.

We are the custodian of National Research Collections Australia (NRCA), our nation's most reliable set of nationally representative biological collections underpinning research in agriculture, biosecurity, biodiversity and climate change. NRCA is used by researchers all over the world to identify, quantify and explore Australia's biodiversity to inform public policy decisions, support biosecurity and contribute to environmental management. NRCA is comprised of six collections with more than 15 million specimens, representing a 240-year time series of data – Australian National Herbarium (ANH), Australian National Insect Collection (ANIC), Australian National Wildlife Collection (ANWC), Australian National Algae Culture Collection (ANACC), Australian Tree Seed Centre (ATSC) and Australian National Fish Collection (ANFC).

The Environomics Future Science Platform, hosted by NRCA, is developing new ways to use genomic resources in nature and gather more accurate environmental information (read more on page 48).

The Atlas of Living Australia (ALA) is hosted by CSIRO. It is a collaborative partnership of organisations with stewardship of Australian biodiversity data and is supported by the Australian Government through the National Collaborative Research Infrastructure Strategy (NCRIS). The ALA provides free, online access to Australia's biodiversity data gathered from multiple sources, delivering to more than 45,000 users annually in research, industry and government.

Use of the collections

Some of our 2018–19 highlights include:

- 230 new species: described 30 genera and more than 60 insect species (ANIC); more than 20 plant species.
- Contributions to national and global research through loans, exchanges and provision of samples: more than 1,111 plant specimens, 216 fish specimens and 22,000 insect specimens were sent on loan; 5,521 plant specimens on exchange with 18 countries, and 2,547 (188 plant, 532 fish, 1,827 wildlife) tissue samples sent to other collections and research institutions. Currently more than 200,000 specimens are on loan around the world.
- Achieved 80 per cent digitisation for ANH and ANFC, 100 per cent for ANACC and ANWC. More than 22,000 new digital records made available through the ALA.
- Addressed Australian biosecurity risks by determining the origins of several weeds and testing machine learning methods for weed incursion identification, and hosted a workshop for Department of Agriculture staff on insect identifications at our borders.
- ATSC collected seeds from mallee eucalypts seed for biomass energy production; assisted conservation of eucalypt species native to the ACT and southern NSW.
- The ALA surpassed 80 million biodiversity datapoints and began developing infrastructure for next-generation provision of genetic and phenomic information to researchers to better understand the environment and biodiversity.

Table 3.10: Combined use of national research collections

	TARGET	2017–18	2018–19
Outward loans (% over 5 years)	70%	70%	70%

Achieving sustainable regional fisheries

We are helping to solve the challenge of sustainable regional food security through the Australian National Fish Collection (ANFC). Based in Hobart, the collection holds more than 157,000 validated fish specimens from Australia and adjacent regions, particularly Indonesia and Papua New Guinea.

In 2018, we launched fishIDER (fish Identification Database and Educational Resource), a website and online training tool helping to identify important food fish species in Indonesia, including tuna, billfish and sharks. It was built using a combination of ANFC's expertly identified fish specimens and is the culmination of more than two decades of collaborative research with Indonesian fisheries.

fishIDER is being used by Indonesian fisheries staff to improve their fish identification skills, which is fundamental to assist in fisheries management.

Fisheries staff identifying species at a fish landing site in Indonesia.

Indonesia is one of the largest maritime nations and one of the largest fish producers in the world, catching 6.2 million tonnes in 2015 alone – 40 times more than Australia. Accurate fish species identifications conducted at docks and local fish markets are essential for sustainable management of its fisheries. Identifications are used to generate stock assessments, which inform important management decisions, including catch quotas and maximum sustainable yields. If identifications made by fisheries staff are correct, stock assessments will be more accurate. If monitored and enforced, this can move a fishery towards sustainability.

Fish sold in markets can be notoriously difficult for fisheries staff to identify. These fish may be juveniles, in poor condition, or missing key features like heads or fins. They often look very different from photos in field guides. fishIDER solves this problem by making it possible to quickly identify fish regardless of their condition, and includes images of fish taken in market situations, thus in market condition.

Supporting neighbouring countries to achieve sustainable fisheries benefits Australia, which shares the same fisheries resources for migratory species such as tuna.

Improvements in data quality – by boosting the fish identification skills of fisheries data collection staff – help ensure national and international fish stocks are sustained at healthy levels. It may also improve the speed of data collection from illegal catches where time is often limited.

fishIDER is bilingual (Bahasa Indonesia and English) and includes four main areas: species profiles with ecological and life history information; interactive learning tools; a photo gallery of verified species photographed in real market situations; and an interactive glossary, which helps improve knowledge of taxonomic terminology.

We developed fishIDER in collaboration with Indonesia's Agency for Marine and Fisheries Research and Human Resources, with funding from the Australian Centre for International Agricultural Research. It was launched at the Our Ocean Conference in Bali on 29–30 October 2018.

We seek to expand fishIDER throughout South East Asia and possibly more broadly in the Indian Ocean, as well as to increase the number of species included.

fishIDER is available at: www.fishider.org.

Developing national science talent

We're passionate about inspiring the next generation of STEM professionals to strengthen our future innovation capacity.

As Australia's innovation catalyst, we have a responsibility to develop Australia's scientific and research capability, ensuring a future population of Australians can solve the greatest challenges through innovative science and technology. Through our education and outreach programs, we help increase science, technology, engineering and mathematics (STEM) knowledge and its application. We also provide tailored innovation programs that help address research and development needs of Australia's industries and businesses.

CSIRO Education and Outreach delivers high-quality, engaging STEM learning experiences for primary and secondary school students, teachers and the community to equip all Australian students with the skills they need to enter the workforce. Through our science outreach programs, we promote the importance and application of our research to the community and increase Australia's STEM literacy.

We also support undergraduate and postgraduate students as well as postdoctoral researchers to boost the calibre of researchers working in Australian industry and strengthen our future innovation capacity.

Science outreach programs

2018–19 highlights

- We inspired the next generation of STEM professionals – more than 190,000 primary and secondary school students participated in our science education programs.
- We helped more than 1,900 university students develop their skills to meet the demand for STEM capability in employment.
- We increased the interest in STEM of 25 young Indigenous women through our new Indigenous Girls' STEM Academy program.
- We helped 125 students and teachers from 13 schools apply their learning through our award-winning PULSE@Parkes program.

Table 3.11: Summary of our performance for developing national science talent

KPI AND METRIC	TARGET	RESULT	
Use of science outreach programs as measured through participation	5% increase in participation compared to 2015–16	G	We increased total number of visitors and education program participants by 51.8% compared to 2015–16.
Innovation hubs established to facilitate partnering activity	5 hubs established	G	Average of 5 hubs established per year over the past 3 years, to a cumulative total of 15 innovation hubs established or used by 2018–19. (2017: 5 hubs; 2018: 12 hubs; 2019: 15 hubs.)

Green shading indicates positive progress for the year and the target has been achieved.

Programs for primary and secondary school students

CSIRO Education and Outreach delivers more than 16 STEM education programs and has education specialists and facilities in each capital city as well as in Townsville, Cairns and Newcastle. This year, more than 190,000 primary and secondary students took part in our STEM education programs, and more than 1,000 teachers participated in our teacher professional learning programs.

The STEM Professionals in Schools program partners STEM professionals with primary and secondary teachers around the country. At 30 June 2019, 845 STEM Professionals in Schools partnerships were operating in 787 schools. Of these, 29 per cent were in regional and remote schools. The number of partnerships is lower this year than previous years because we are transitioning to a new customer relationship management system, which will allow us to manage new child safe requirements.

The BHP Foundation Indigenous STEM Education Project increases the participation and achievement of Aboriginal and Torres Strait Islander students in STEM in schools and through to employment. In 2018–19, 922 teachers and teacher assistants and 46,989 students, (of which 12,397 were Aboriginal and Torres Strait Islander students) in 168 schools and 11 communities took part in school programs.

CSIRO Sustainable Futures was introduced to 198[14] schools Australia-wide to help them understand the science behind climate change and sustainability.

The Digital Careers program increases student participation and interest in ICT courses and careers. During 2018–19, 123,450 students took part in the suite of Bebras computational thinking challenge programs and 1,311 students took part in the Young ICT Explorers program.

In 2018–19, Creativity in Research, Engineering, Science and Technology (CREST) helped more than 5,860 students plan and conduct research projects, including 47 participants from an international school in Malaysia. Many students then participated in the BHP Foundation Science and Engineering Awards that recognise outstanding scientific research and technology projects by school students. In 2018–19, 12,014 students entered Science & Technology Australia competitions.

We introduced two new programs: Generation STEM to increase students' interest and participation in STEM in high school, higher education and into employment in New South Wales; and the Indigenous Girls' STEM Academy in partnership with CareerTrackers Indigenous Internship Program. The latter program aims to encourage young Indigenous women to participate in STEM at school, higher education and into employment. In 2018–19, 25 students took part in the Academy.

Another way we shared our science with school students is at the CSIRO Discovery Centre in Canberra, where we welcomed 4,500 more students to the Centre compared to last year, and major visitor centres at observatories near Parkes and Narrabri and the Canberra Deep Space Communication Complex (CDSCC). These centres are purpose-built to showcase our research in an entertaining way that demystifies and educates people of all ages about research and innovation.

Education and outreach programs at CDSCC – where the visitor centre now features large digital displays – attracted 10,094 school students during 2018–19. The total number of general visitors was 68,581.

In 2018–19, the visitor centre at the Parkes radio telescope welcomed 112,224 people. Our award-winning PULSE@Parkes program attracted 125 students and teachers from 13 schools, seven of which were new to the program. A public session at Perth Astrofest drew around 100 people.

Table 3.12: Science outreach: education programs

PROGRAM	2014–15	2015–16	2016–17	2017–18	2018–19
Creativity in Research, Engineering, Science and Technology (CREST) (participants)	10,805	9,600	5,579[15]	5,436	5,860
BHP Foundation Science and Engineering Awards (participants)	8,146	7,639	10,950	12,567	12,014

14 In previous years, Sustainable Futures participation numbers reported were cumulative. For this report, only new school registrations are reported.

15 For the last three years, our CREST program has been focused on refreshing resources and developing new ones to align with the Australian curriculum and include investigations across the spectrum of STEM.

STEM X Academy

Run in partnership with the Australian Science Teachers Association, CSIRO and Questacon, STEM X Academy is a professional learning experience that develops hands-on, inquiry-based lessons and activities that tie the national science, technology, engineering and mathematics (STEM) curriculum to Australian research.

STEM X provides an important and focused professional development opportunity at a time when scientific inquiry is becoming more collaborative, multidisciplinary and necessary to solve the challenges of the future. Teachers walk away with confidence, enthusiasm and the ability to create and deliver high-quality, inquiry-based lessons that tap new ideas in STEM and use innovative teaching tools.

The signature STEM X event is a five-day residential experience held annually in Canberra. Regional STEM X experiences have also been held in most states and territories. The demand from primary and secondary teachers to attend STEM X continues to grow, with the number of applicants far exceeding the number of places available. Last year, 102 teachers and eight alumni participated in STEM X or STEM X regional events.

The main CSIRO STEM X activity is the Future Challenge inquiry where teachers are presented with a future scenario based on CSIRO's Global Megatrends, and work in teams alongside CSIRO mentors to design a STEM-focused solution.

Our researchers also present and provide tours of CSIRO facilities. Additional skillset sessions focus on building teacher capacity, including sustainability, coding and data literacy.

Darwin primary school teacher, Simone Timms, attended STEM X in 2018. Since participating, she has used the Megatrends to help teachers at her school develop inquiry lessons and has learnt to frame up inquiry questions that matter.

Similarly, Angela Roccasalva attended STEM X in 2019 and said the experience changed the way she teaches. She starts every unit with an overarching problem that needs investigating. For example, with her Year 5 and 6 students, she investigated how to reduce the impact of natural disasters. Using robotics kits to build and program an earthquake simulator, her students made predictions about what kind of building would survive. The students recorded results in a table and drew conclusions. They then used this knowledge to design, build and test their own buildings.

STEM X alumni have reported positive learning outcomes for their students, including higher student engagement, better developed creative thinking skills and greater student confidence in their abilities, ideas and solutions.

A STEM X teacher explaining her journey to CSIRO Education Specialist, Melissa Lane.

Table 3.13: Science outreach: visitor centres

CENTRE	2014–15	2015–16	2016–17	2017–18	2018–19
CSIRO Discovery Centre (visitors)	33,189	18,477[16]	26,332	27,622	32,122
Parkes radio telescope (visitors)	68,427	95,212	83,851	105,085	112,224
Canberra Deep Space Communication Complex (visitors)	61,051	67,378	70,753	69,279	68,581
Australia Telescope Compact Array, Narrabri (visitors)	10,971	11,511	10,965	12,081	10,363

Programs supporting university students

We give undergraduate and postgraduate students the opportunity to collaborate with scientists to help them develop their skills and meet the increasing demand for Australia's STEM capability. Through collaborative efforts with industry, we are supporting tertiary science students with their career progression and providing opportunities to innovate and generate new theoretical perspectives. Our programs include industrial traineeships, vacation scholarships, and opportunities for Aboriginal and Torres Strait Islander peoples.

Our Postgraduate Scholarship program provides opportunities in science and engineering for outstanding graduates who enrol at Australian tertiary institutions as full-time postgraduate students for research leading to the award of a PhD or master's degree.

Over the past year, we supported 1,985 undergraduate and postgraduate students through our programs, represented in Table 3.14. The number of students fluctuates within a year and across years, as students start and finish programs at different times of the year.

Table 3.14: Our program students in the 12 months to 31 May 2019

TYPE OF ENGAGEMENT	2017–18	2018–19
Tertiary level		
Undergraduate students	633	529
Postgraduate students	1,438	1,456[17]
Total	**2,071**	**1,985**

Supervised students have a CSIRO staff member appointed officially by the university as a co-supervisor for their research project. Some of these are also sponsored, receiving a partial or full scholarship paid from CSIRO funds to pursue a research project leading to the award of a PhD or master's degree.

Table 3.15 compares the numbers of students that we supervised only, or both supervised and sponsored. These numbers represent a point in time at 31 May 2019, not the total number of students over the course of the whole year.

16 Visitor numbers are lower than normal as the Centre was closed for renovations for part of the year.
17 Includes nine supervised in collaboration with Cooperative Research Centres over the 12 months.

Table 3.15: Our supervised students as at 31 May 2019[18]

	2015	2016	2017	2018	2019
Undergraduates[19]					
Industrial Trainees	-	-	-	100	100
Honours Students	80	89	84	74	54
Total	**-**	**-**	**-**	**174**	**154**
Sponsored postgraduates[20]					
PhD	224	280	416	418	390
Masters	16	36	27	12	7
Total	**240**	**316**	**443**	**430**	**397**
Supervised postgraduates					
PhD	621	599	673	816	812
Masters	70	132	115	159	144
Total	**691**	**731**	**788**	**975**	**956[21]**
Number of all students					
Total	**-**	**-**	**-**	**1,149**	**1,110**

Industry PhD program

This industry-focused applied research training program produces the next generation of work-ready research and innovation leaders in Australia. In March, we piloted the program at the University of New South Wales. We have since expanded the program to another five universities: University of Adelaide, University of Western Australia, Curtin University, Edith Cowan University and Murdoch University. Students began the program at three universities in 2019. Expressions of interest are now open to find new industry projects for students to start across all six universities in 2020.

Innovation hubs

In 2018–19, ON delivered programs in nine innovation hubs; since inception, accumulatively ON has delivered programs in 15 hubs. We deliver our ON programs geographically based on demand. Prime5 was delivered in six hubs and Prime6 was delivered at 11 hubs nationally. Accelerate5 was also delivered in six hubs.

ON delivered programs in the following 15 locations across various programs and delivery formats, and within the ON partner network (read more about ON programs on page 54):

- New South Wales: Sydney, Newcastle, Narrabri, Wollongong
- Victoria: Melbourne, Geelong
- Australian Capital Territory: Canberra
- Western Australia: Perth
- Queensland: Brisbane, Cairns, Toowoomba, Townsville
- South Australia: Adelaide
- Northern Territory: Darwin
- Tasmania: Hobart.

18 In previous annual reports Honours students were counted as postgraduate students. This annual report regards Honours students as undergraduate students since they are studying for a Bachelor-level degree.
19 This includes Honours students and Industrial Trainees.
20 A student may be sponsored and supervised, or supervised only.
21 The total number of postgraduate students as at 31 May 2019 was 956, including eight supervised in collaboration with Cooperative Research Centres.

Enabling a healthy and sustainable organisation

Staff morale and culture are a priority, and 92 per cent of our staff are proud to be associated with CSIRO (read more on page 80).

We support the growth of an innovative culture and empower our people to make the best decisions for their research and their partners, in line with our organisational priorities. We nurture an environment that supports our people to take risks in the pursuit of excellence, while always prioritising their safety and the trust placed in us by the community. When our people are empowered to do their best work, our partners and Australia thrive.

Table 3.16: Summary of our performance for enabling a healthy and sustainable organisation

KPI AND METRIC	TARGET	RESULT	
Morale: Staff are proud to be associated with CSIRO as measured through the staff survey	84% of CSIRO staff are proud to be associated with the organisation	G	Staff survey results show that 92% of staff are proud to be associated with CSIRO, an increase from 90% reported last year.
Engagement: Staff engagement score as measured through the staff survey	80% of CSIRO staff are engaged with the organisation	G	The staff engagement score of 80%, as measured through the staff survey, has achieved the target and is a solid improvement from 78% recorded last year. This represents a continued positive trajectory trending towards longer-term targets.
Diversity in leadership: female proportion of candidates shortlisted for leadership roles	>35% of shortlisted candidates are female	G	44% of shortlisted applicants for leadership positions were female, based on applications where gender identity was available. The overall proportion of female leaders employed by CSIRO has increased to 35%, up from 32% last year.
Staff safety: • Regulatory reportable Comcare incidents • % Health Safety Environment audits and review actions completed on time	No more than 9 Comcare incidents	P	10 incidents were reportable to Comcare, an increase from 8 last year, while our reportable injury frequency rate increased to 12.1 from 8.1 last year.
	80% audits and review actions completed on time	G	92% audits and review actions completed on time.
Financial Management: operating result bottom line	Meet or exceed budget	G	Budget achieved for 2018–19.

Green shading indicates positive progress for the year and the target has been achieved.
Purple shading indicates progress through the year was less than anticipated and continues to be closely monitored.

Morale and engagement

Staff engagement is an overall measure of employee connection to their organisation and is closely correlated with productivity and performance. This year, we met our target of 80 per cent, compared to 78 per cent last year and 75 per cent in 2017. Staff continue to report at very high rates that they are proud to be associated with CSIRO, with 92 per cent responding positively this year. The staff survey measures progress against the six elements outlined in our cultural vision: people first, mutual trust, collaborative networks, inclusion and participation, agility and experimentation, and transparency and accountability. This year, we reached 58 per cent of people who experienced the elements of the cultural vision, which is an increase from the 52 per cent recorded in 2018 (the first year this was measured).

Staff morale and culture continue to be a focus at CSIRO and we have seen year-on-year significant improvements since 2015. We continue to support initiatives explicitly focused on building engagement and mutual trust with staff, including staff webinars, senior leader-led round tables and site visits, and state-wide all-employee CSIRO Connect events (2017–19), where staff come together to contribute to achieving our strategic and cultural goals.

In 2018–19, 2,300 staff attended eight CSIRO Connect events across Australia in Perth, Brisbane, Canberra, Melbourne, Adelaide and Townsville. These events provide an opportunity for staff to come together to share different perspectives and contribute to achieving our strategic and cultural goals. We introduced a workshop for participants to describe what is unique about CSIRO, for staff to help us in co-creating our values. A new initiative in 2018–19, the Taking Action program, addressed significant enterprise issues. Staff had the opportunity to contribute ideas and solutions, and work directly on these during the Connect events (read more about our people on page 18).

These events and initiatives develop a shared sense of purpose around our strategic direction, and ensure that people feel included and valued. As a result, we have reached a historically high level of 92 per cent of our staff being proud to be associated with the organisation.

Other initiatives that support progress against our cultural vision include: the ON Innovation and Customer Experience programs which promote a culture of agility and experimentation; actions to increase transparency around our internal and external collaboration metrics and build our collaborative networks; and Switch, our staff mobility program. Now in its second year, Switch increases the exchange of people and know-how between research, industry and government.

CSIRO Connect in Brisbane: people from across the organisation came together to share different perspectives and contribute to achieving our strategic and cultural goals.

It helps us improve our connection and engagement with our partner organisations by developing strategic collaborative relationships, creating new business and project leads, and exposing our staff to different business models (read more about Switch on page 19).

Diverse cultural initiatives focused on the goal of building a people first culture, combined with regular opportunities to provide feedback through staff surveys and other engagement channels. Senior leader actions in response to this feedback, have driven significant improvements in staff morale.

Diversity in leadership

We're committed to creating an environment where each individual is included and supported, and can realise their full potential. We're achieving this through a workplace culture that accepts, values and enables difference (read more about diversity and inclusion on page 20). During the year, more than 44 per cent of candidates shortlisted for leadership positions, where their gender identity was known, were female. This is an indication of proactive efforts to ensure gender diversity in the attraction and selection in recruitment and promotion. The female proportion of employees in leadership positions increased from 32 per cent to 35 per cent during 2018–19.

The steady increase in the overall proportion of female leaders represents a trajectory towards improved gender balance of our leadership. In addition, we have achieved 48 per cent female representation in our leadership development programs, strengthening the diversity of our future leadership pipeline.

The CSIRO Diversity and Inclusion Strategy 2019–22 highlights our long-term focus on diversity and inclusion, with targeted actions focused on gender, Indigenous Australians, disability and cultural diversity.

Actions from our plan are built around three aims:

- to hold ourselves collectively responsible for delivering outcomes and impacts
- to equip our people to value, advocate and model inclusion in everything we do
- to be recognised as an employer of choice where diverse talent thrives, and space is created for individual needs.

Our ongoing participation in the Science in Australia Gender Equity (SAGE) program and the Male Champions of Change (MCC) remain key features of the strategy. The SAGE program provides an accreditation framework designed to improve gender equity and diversity in science, technology, engineering, mathematics and medicine via the pilot of the Athena Swan Charter in Australia.

In December, we were awarded a Bronze SAGE Award, recognising our capacity to eliminate gender inequity and our commitment to demonstrating improved outcomes in the hiring, promotion and retention of women. We continue to make progress on the 90 targeted actions to address cultural, systemic and pipeline barriers to women's progression in STEM.

Our Chief Executive continued to drive gender equity outcomes in the MCC STEM Group. In 2018–19, the MCC Implementation Team delivered 13 key actions within the 2018–19 MCC Group Action Plan, including actions to create respectful and inclusive environments, growing the talent pipeline and a report on *Gender Equity and the Future of Work*.

As part of our strategy, we also introduced new programs to support victims of family and domestic violence and a Disability Action Plan to fast-track outcomes for the recruitment and retention of people with disabilities. As part of International Women's Day, we implemented a '50/50 If not, why not?' pledge, which asked us to actively seek diverse representation by calling out imbalances in our teams, committees and around decision-making tables.

In the 2018–19 Budget, the Australian Government announced the development of a Department of Industry, Innovation and Science Women in STEM Strategy and a Decadal Plan for Women in STEM, developed by the Australian Academy of Science. Both documents, launched in April, work together to drive a system-level response with long-term strategic action from across the sector – government, industry, academia and education.

We provided input into both documents and our SAGE Action Plan is strongly aligned to the principles and objectives articulated in both. We will provide ongoing reporting to both the Department and the Academy on our progress on gender outcomes.

In 2018–19 we revised our SAGE diversity metric to better reflect the aspirations and desired impact of our SAGE program and targeted actions. To ensure consistency and alignment to ongoing gender reporting, leadership roles are now defined by job role.

Staff safety

Our commitment to the health, safety and wellbeing of our people is driven by our Health Safety and Environment Sustainability Policy.

To provide a safer workplace, we changed how we support leaders and our people in meeting their safety responsibilities. We did this by growing our wellbeing and safety team to include more specialists and a team focused on wellbeing and injury prevention and management. We created site-based support with a team of safety experts and a new business partner team working with our senior leaders.

In recognition of the way our science and other work is conducted, we began the transition to a new approach to risk management by adopting an activity-based method. We updated our health and safety management system to align with the national standard and continued to focus our safety programs on preventing musculoskeletal injuries and improving wellbeing.

We continued our programs to improve personal ownership of safety and after the success of our first HS-Me Day in May 2018, we are planning a second HS-Me Day in September 2019 when we will stop work across all our sites globally and at home, in the field, laboratory or office to focus on making safety, health and wellbeing personal, to everyone at CSIRO.

The safety contacts program was extended to senior leaders in all Business Units, ensuring our leaders better understand and respond to the safety and wellbeing issues our people face in their work.

In addition to focusing on our safety, we are growing our work on wellbeing. In November, our staff participated in our first wellbeing survey. Wellbeing overall is slightly below external benchmarks in the Australian National Norm and R&D Norm, and we are working now to improve our performance in this important area.

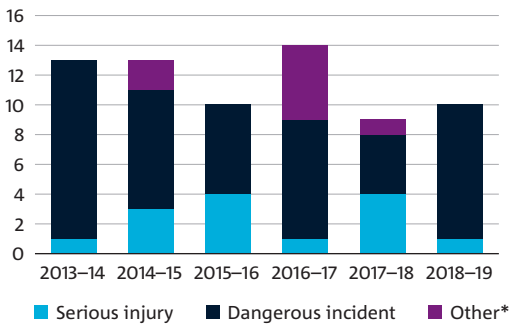
Our laboratories across Australia use a wide range of reticulated gases in their research. We completed a comprehensive external audit of sites where we use gas and assessed them against the relevant legislation and standards. We are working towards ensuring every laboratory is managed at the same level.

Safety performance

Our safety performance this year was not satisfactory. Increases across our key performance metrics, while not to historical levels, has concerned senior leaders and triggered a new focus on safety leadership and our safety system.

There were 10 regulatory notifiable incidents reported to Comcare this year, two involving contractors and an overall increase with nine reported last year. While we saw a reduction in serious injuries, we did not achieve our target of nine.

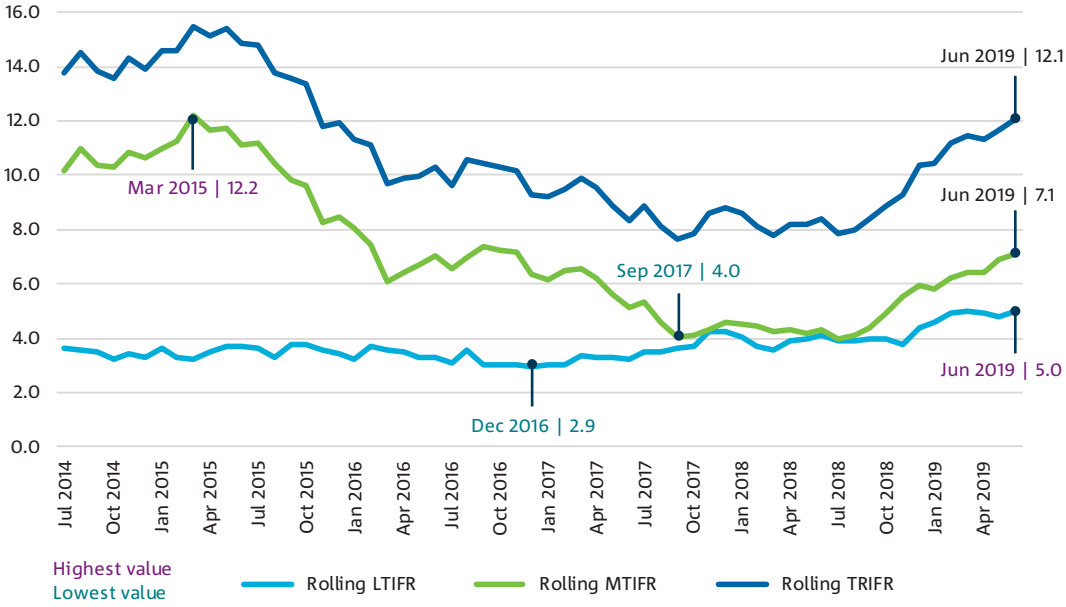
Figure 3.6: Regulatory notifiable incidents, 2013–14 to 2018–19



*2017–18: Biosecurity incident, reportable to the Department of Agriculture

Forty-eight people suffered an injury serious enough to prevent them from coming to work compared to 37 last year. These injuries occurred at a rate of 5.0 per million hours worked, an increase from 3.9 in 2017–18. The majority of injuries related to occupational overuse, manual handling and slips, trips and falls. An increase in injuries requiring medical treatment resulted in the Recordable Injury Frequency Rate increasing from 8.1 to 12.1.

Figure 3.7: CSIRO recordable injury frequency rate[22], 2014–15 to 2018–19



Thirty-three audits and reviews were undertaken this year, including by the Office of Health Protection; Office of the Gene Technology Regulator; Department of Agriculture; Australian Radiation Protection and Nuclear Safety Agency and Australian Safeguards and Non-Proliferation Office. Work undertaken included an audit of the CSIRO Rehabilitation Management System and a gap analysis of CSIRO Firearms. Ninety-two per cent of the review actions arising from these audits and reviews were completed on time.

Managing our environment

We educate, research and innovate to advance scientific knowledge and develop solutions for a sustainable planet. To achieve our research goals, we operate multiple facilities, with significant energy and water consumption and waste output, including laboratories, glasshouses, farm properties, supercomputers and telescope facilities, as well as manage plants and livestock and facilities such as the high-security microbiological facility, Australian Animal Health Laboratory (AAHL).

Our commitment to the principles of Ecological Sustainable Development (ESD) is included in our Corporate Plan and Heath Safety and Environmental Sustainability Policy. Our alignment and contribution to ESD is summarised in the following table.

Environmental awareness is promoted through inductions, the intranet, training, and communication and engagement programs.

Further information on our core business activities can be found in this section.

Reducing emissions and consumption

We have an ambitious 20 per cent carbon emission reduction target to be achieved by the end of June 2020, measured against business-as-usual projections. This target is aligned with the Australian Government emissions reduction target against a 2000 baseline and articulated through our Carbon Strategy.

22 The Recordable Injury Frequency Rate is calculated as the sum of Lost Time Injuries per million hours worked (LTIFR) plus the Medical Treatment Injuries per million hours worked (MTIFR).

Electricity, gas and liquid fuel-related emissions (Scopes 1 and 2) account for approximately 38 per cent of our total carbon footprint.[23] Emissions embedded in our supply chain (Scope 3) make up the other 62 per cent. During 2018–19, key focus areas included:

- developing sustainable buildings that meet future research and enterprise needs
- installing photovoltaic (PV) systems and lighting upgrades across multiple sites
- improving our vehicle fleet as part of measures to progressively phase out our petrol cars with more environmentally friendly and cost-effective alternatives including electric vehicles.

Our Fleet team developed the Environmental Strategy 2024 for CSIRO Fleet to help reduce emissions through electric vehicles pool growth. Where we can't introduce electric vehicles, we are looking at hybrid alternatives. Energy research teams collaborated to further the development of the charging stations and hydrogen cells technologies.

Table 3.17: Our alignment and contribution to ecological sustainable development

ECOLOGICAL SUSTAINABLE DEVELOPMENT PRINCIPLE	OUR ALIGNMENT AND CONTRIBUTION
Decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations.	Our Planning and Performance Framework includes impact evaluations and reviews to assess the environmental, economic and social outcomes from our work.
If there are threats of serious or irreversible environmental damage, lack of full scientific certainly should not be used as a reason for postponing measures to prevent environmental degradation.	Our operational and scientific procedures ensure that our research and activities have low environmental impact. Environmental protection is mandated when planning and undertaking major capital works. Any proposed activities that may fall under the *Environment Protection and Biodiversity Conservation Act 1999* are assessed for referral to the Department of the Environment and Energy. Proposals for new or modifications to existing facilities undergo rigorous internal safety, regulatory and environmental processes with independent oversight.
The principle of inter-generational equity – that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.	Our Planning and Performance Framework includes impact evaluations and reviews to assess the social outcomes of our work. As a world leader in sustainability research and one of Australia's top 300 carbon emitters, we actively integrate environmental responsibility and sustainability into our operations, minimising our environmental footprint through building infrastructure and behaviour change, and preventing, minimising and controlling pollution. Reducing our consumption of energy, water and resources not only supports sustainable objectives, it also contributes to our financial sustainability and allows us to redirect more funds into our science.
The conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making.	We understand environmental assessments are a part of our decision-making frameworks as they relate to our facilities.
Improved valuation, pricing and incentive mechanisms should be promoted.	We have no activities in this area.

23 Baynes, T., Saldanha, T., Malik, A., Haque, N., Schandl, H., Lenzen, M., *Carbon Footprint Report*, 2015–16.

Energy consumption (electricity and gas) decreased from 626[24] terajoules in 2017–18 to 610 terajoules in 2018–19; a reduction of three per cent. This includes our use of electricity generated by on-site solar PV systems. Our energy consumption continues to decrease, falling by six per cent over the last five years (see Figure 3.8). During 2018–19, newly installed PV systems and lighting upgrades reduced our electricity consumption. For example, grid-fed electricity consumption fell by 45 per cent at our Darwin (NT) site and 11 per cent at our Werribee (VIC) site after the PV systems were installed. In addition, grid-fed electricity usage at the Armidale (NSW) and Black Mountain (ACT) sites decreased by 20 per cent and one per cent, respectively.

Our rate of energy-related carbon emissions reduced by four per cent compared to the previous year and 10 per cent compared to the average of the past five years (see Figure 3.8). Electricity-related emissions fell by four per cent in the last 12 months, attributed to both reductions in consumption and changes in emission factors. Gas-related emissions dropped by one per cent.

Our mains water usage decreased marginally compared to the previous year. Mains water consumption in 2018–19 was eight per cent below the average of the past five years (347 ML).

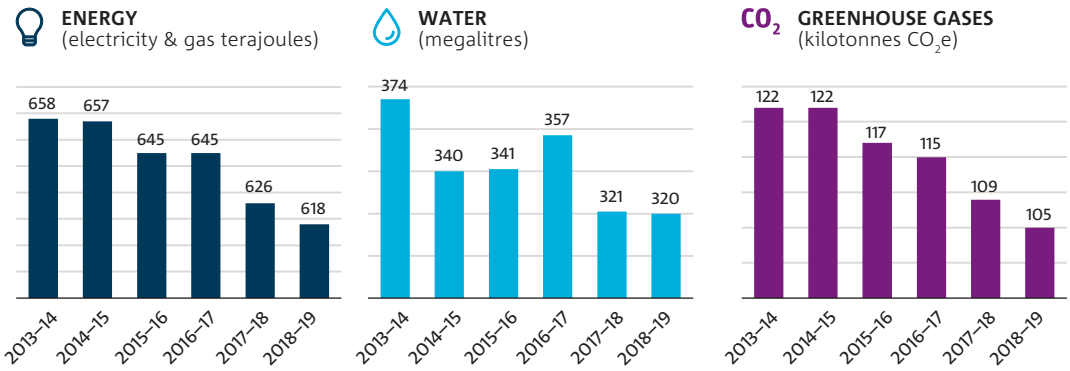
Our air travel, based on kilometres flown, increased by seven per cent in 2018–19, eight per cent above the average for the past five years. Approximately 54 per cent of our air travel is international, which accounts for approximately 50 per cent of our air-travel-related carbon emissions.

Sustainable facilities

We continued to improve the energy performance of our buildings, realising significant cost and carbon emission savings. More than 5,700 lights have been upgraded to LED at Clayton, Werribee and Hobart. Following this success, further upgrades are underway at Black Mountain, Newcastle, Darwin, Kensington, Adelaide and Waite. The upgrades are expected to achieve savings of approximately $500,000 and 2000 tCO_2e per year.

Other initiatives included building air leakage trials, expanded deployment of building fault detection and diagnostic tools at Black Mountain and upgrades to fume cupboard controls and sashes. Completed initiatives are expected to reduce emissions by over 300 tCO_2e per annum. Our Hobart property team is taking advantage of the natural building hot house effect to heat linkways between buildings.

Figure 3.8: CSIRO energy and water consumption, and greenhouse gas emissions (electricity and gas only)



24 2017–18 energy consumption was revised down from 630 TJ to 626 TJ following receipt of new data.

Table 3.18: CSIRO energy, air travel and water intensities

PERFORMANCE MEASURE	INDICATOR(S)	2013–14	2014–15	2015–16	2016–17	2017–18	2018–19
Energy	Purchased energy (electricity and gas) consumed per employee (GJ/FTE)[25]	121	136	131	129	121	114
Air travel	Million air kilometres travelled (km)	113	100	117	110	114	129
	Air travel per employee (km/FTE)	20,853	18,874	24,187	19,644	21,872	23,981
Relative mains water use	Amount of total water use per employee (kilolitres/FTE)	69	70	72	71	62	59

The system optimises cooling by venting hot air directly outside. The team also upgraded data centre cooling systems and now it uses rejected heat to warm the buildings, and the free cooling when external temperatures permit.

We continued our focus on access to credible building data by improving the submetering system and use of data to analyse building performance, and automating energy and water data monitoring.

Business and Infrastructure Services and the Grids and Energy Efficiency research team within the Energy Business Unit collaborated to develop the Data Clearing House (DCH) trial. DCH is a horizontally integrated open data platform that supports the collection, processing and sharing of building data in a secure way. By making building data accessible, DCH will drive innovation across a broad spectrum of built environment stakeholders, resulting in increased value out of available data.

Solar-powered science

We are progressing towards our onsite renewable energy target of 5 megawatts (MW), with solar PV installations in progress at Black Mountain (950kW), Clayton (1,186kW), Pullenvale (760kW) and Waite (404kW). PV installations at Newcastle (195kW), Waterford (245kW) and Kensington (174kW) will begin shortly.

Resource recovery and diversion from landfill

We actively manage more than 30 waste and recycling categories through our national waste and recycling contract. Total waste generation was stable compared to the previous 12 months and diversion from landfill increased. From May 2018 to April 2019, we diverted more than 13,000 cubic metres (weighing 1,500 tonnes) of waste from landfill, equating to a 40 per cent diversion rate by volume or 51 per cent by weight, which is slightly ahead of our 50 per cent diversion target.

CSIRO's War on Waste was a new initiative, which encouraged staff to proactively reduce single-use plastics. Waste audits were conducted in CSIRO cafeterias at Hobart, Clayton and Black Mountain. Building on the audits' data, we introduced a crowdsourcing task to staff across all sites to identify where single-use plastic waste is generated and to source ideas about how to avoid this waste. The audits triggered changes in cafeterias to reduce plastic use and initiated discussions about embedding circular economy principles in the new tender processes.

25 GJ/FTE is gigajoules per full-time equivalent (staff). FTE refers to CSIRO Officers as at June 2019.

Managing our heritage

We recognise our responsibility to conserve the Commonwealth and national heritage values of the places we own or control, and we manage these values under the *Environment Protection and Biodiversity Conservation Act 1999*. Our Heritage Strategy for CSIRO Land and Buildings 2016–26 outlines our objectives and responsibilities and has been endorsed by the Australian Heritage Commission.

As part of the CSIRO Heritage Program for 2018–19, our Business and Infrastructure Services approached the market and procured a Heritage Assessment Report for one CSIRO site. We are reviewing proposals for a further two sites to be completed in 2019. We will provide a three-year update to the Department of Environment and Energy in July 2019.

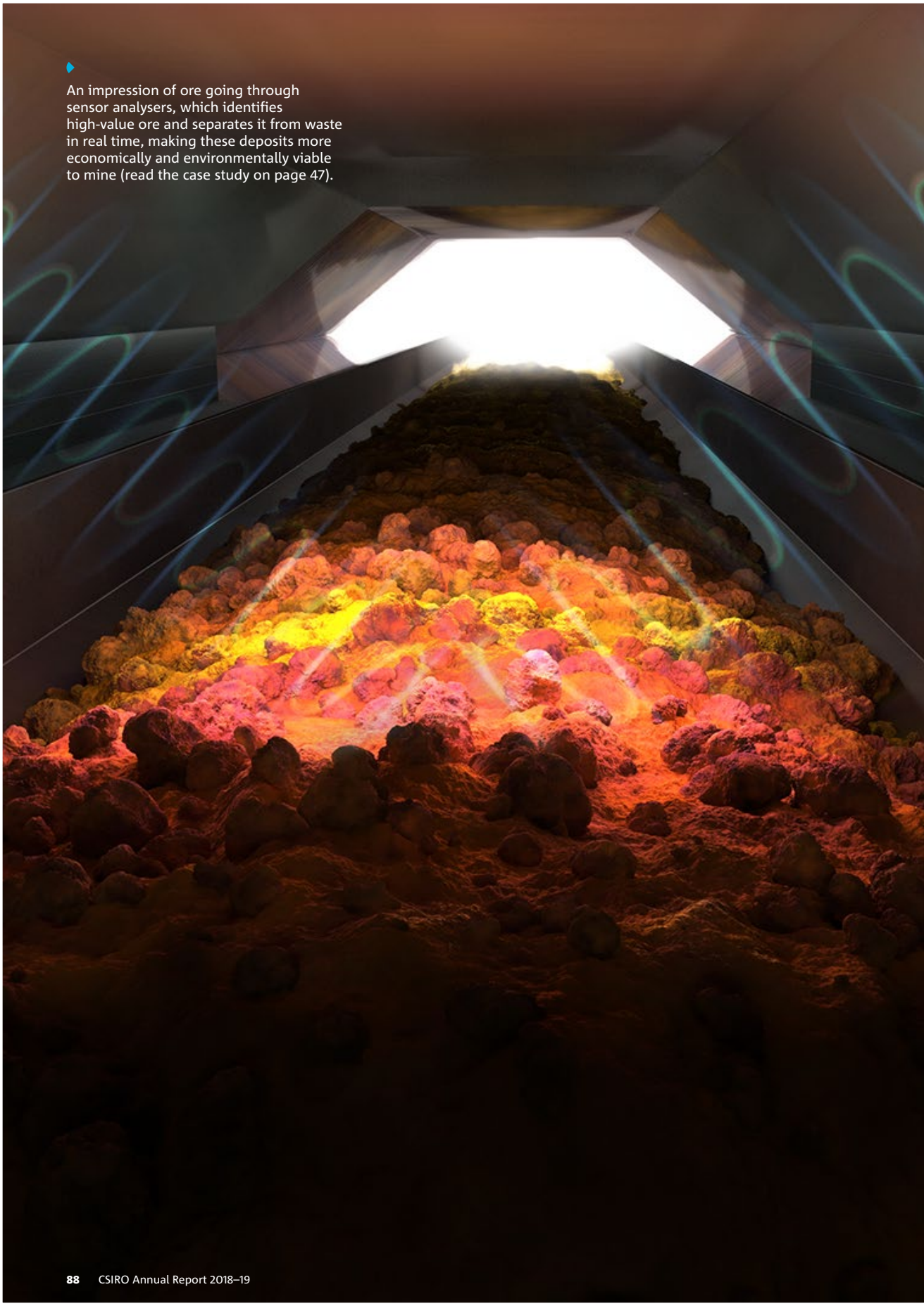
All Heritage Management Plans and information on other Commonwealth heritage-listed sites are available at www.csiro.au/Heritage.

Budget operating result

Through careful management of expenditure and projects generating revenue, the operating deficit of $33 million this year was within tolerance of the operating deficit approved by the Australian Government. This was the result of total expenses of $1,396 million, externally generated revenue of $529 million and government appropriations of $835 million, all being materially consistent with approved budgets (see Table 3.19).

Table 3.19: Our financial performance by source of revenue, $m

REVENUE SOURCE	2014–15	2015–16	2016–17	2017–18	2018–19
Australian private sector	69.4	80.1	86.9	84.4	85.9
Australian governments	181.1	147.8	165.6	173.9	208.9
Rural industry research and development (R&D) corporations	38.1	31.7	38.7	42.7	44.5
Cooperative Research Centres	9.5	10	12	9.1	9.8
Overseas entities and international	81.4	99.3	80.7	93.6	93.2
Work in progress/deferred revenue	–6.1	–4.0	–9.3	–2.8	–8.9
Total co-investment, consulting and services	**373.4**	**364.9**	**374.7**	**400.8**	**433.4**
Intellectual property (IP)—royalty and licence revenues	60.8	59.7	51.1	43.2	34.4
Total research and services revenue	**434.2**	**424.7**	**425.8**	**444.0**	**467.8**
Other external revenue	44.6	37.8	57.3	55.1	48.6
Gain/(loss) on sale of assets	0	1.2	0.9	0.1	11.5
Other fair value gains and reversals	6.7	-	-	-	1.1
Total external revenue	**485.5**	**463.7**	**484**	**499.2**	**529.0**
Revenue from government	745.3	750.3	787.3	793.5	834.6
Total revenue	**1,230.8**	**1,214.0**	**1,271.3**	**1,292.7**	**1,363.6**
Less expenses	1,245.3	1,270.6	1,292.1	1,352.5	1,396.4
Operating result	**–14.5**	**–56.6**	**–20.8**	**–59.8**	**–32.8**



An impression of ore going through sensor analysers, which identifies high-value ore and separates it from waste in real time, making these deposits more economically and environmentally viable to mine (read the case study on page 47).

Part 4
Management and accountability

Government engagement

Throughout 2018–19, our staff had regular meetings with ministers, parliamentarians and senior staff from relevant government departments to discuss their needs, share research activities and provide scientific information. We also provided advice to inform policy development and program implementation and evaluation.

During the last financial year, we made 10 submissions to parliamentary inquiries and our staff provided information at 11 inquiry hearings. The inquiry topics included automated mass transport; cane toad control; the impact of vegetation and land management policy on the agricultural sector; the national energy market; the impact of feral pigs, goats and deer; electric vehicles; consumer data rights; the mining sector and regional economies; and faunal extinction in Australia.

Legislation and government policy

We are a Corporate Commonwealth entity constituted and operating under the provisions of the *Science and Industry Research Act 1949* (SIR Act).

Our primary functions are to carry out scientific research to:

- assist Australian industry and to further the interests of the Australian community
- contribute to national and international objectives and responsibilities of the Commonwealth
- encourage or facilitate the application and use of the results of CSIRO scientific research.

Our secondary functions include international scientific liaison, training of research workers, publishing research results, technology transfer of other research, providing scientific services and disseminating information about science and technology.

Reporting, accountability and other rules for our operations are set out in the *Public Governance, Performance and Accountability Act 2013* (PGPA Act).

Pursuant to section 19 (1) (e) of the PGPA Act, we have had no instances of significant non-compliance with finance law in 2018–19.

We also provide administrative support services to the Trustee of the Science and Industry Endowment Fund consistent with the *Science and Industry Endowment Act 1926*. The Fund has its own governance structure (see pages 150 for more information on the Fund).

There were no government policy orders to CSIRO during 2018–19.

Responsible Minister

As at 30 June 2019, the responsible Minister for CSIRO was the Hon Karen Andrews MP, Minister for Industry, Science and Technology. Senator the Hon Michaelia Cash, Minister for Jobs and Innovation, was the responsible Minister for CSIRO from 1 July 2018 to 28 August 2018.

Hon Karen Andrews MP, Minister for Industry, Science and Technology

Under the SIR Act, the Minister has power to:

- add to the purposes for which CSIRO may carry out scientific research (SIR Act, section 9(1)(a)(iv))
- provide to the CSIRO Board, in writing, directions and guidelines with respect to the performance of the functions, or the exercise of the powers, of the Board or of the Organisation (SIR Act, section 13).

The Minister provides CSIRO with a Statement of Expectations and the Board responds with a Statement of Intent. The latest Statement of Expectations was provided by then Minister Greg Hunt on 18 November 2016. CSIRO's responding Statement of Intent was provided to then Minister Arthur Sinodinos on 1 May 2017.

These documents are available at www.csiro.au/en/About/Leadership-governance/Minister-and-Board/Statement-of-Expectations.

Ministerial directions and notifications

On 15 July 2014, the Minister directed the CSIRO Board to apply the Australian Government Public Sector Workplace Bargaining Policy to Enterprise Bargaining Agreement negotiations in CSIRO. During 2018–19, CSIRO kept its responsible Minister and the Minister for Finance informed of the activities of CSIRO through our Board and in accordance with section 19 of the PGPA Act.

Governance

We are governed by a Board,[26] which is responsible to the Australian Government for the overall strategy, governance and performance of our organisation.

The Board comprises nine part-time, non-executive members including the Chairman, and a full-time Chief Executive. At June 2019, there were no vacancies on the Board. All non-executive members are appointed by the Governor-General. The Chief Executive is appointed by the CSIRO Board, in consultation with the Minister.

In 2018–19, our Board operated in part through three standing committees:

- The Audit and Risk Committee, which assists the Board to fulfil its governance responsibilities in areas of financial management and performance reporting, risk oversight, internal controls and compliance with relevant laws and policies.
- The People, Health and Safety Committee, which assists the Board to fulfil its governance responsibilities in relation to people, health and safety strategies, obligations, performance and culture.
- The Science Excellence Committee, which assists the Board to fulfil its governance responsibilities with respect to science, capability and strategic plans to ensure the organisation continues to maintain its reputation for scientific excellence and capacity to respond to national challenges and opportunities.

On appointment, Board members receive a formal induction on the organisation and their duties. Members maintain their professional development and participate in visits to CSIRO sites as well as governance and business briefings. In the pursuit of their duties, Board members may seek independent professional advice and liaise with CSIRO senior management.

Under its Charter and Operating Guidelines, the CSIRO Board reviews its performance, composition and skill base at regular intervals to ensure it is operating efficiently, effectively and with regard for the principles of good corporate governance. A review of Board performance is usually conducted at least every 18 months, with the most recent being a self-assessment in February.

Details of remuneration and meeting attendance are shown in the financial statements (Part 5).

Board membership

Front: Ms Katheryn Fagg AO; Ms Shirley In't Veld; Dr Peter Riddles. Middle: Dr Larry Marshall; Mr David Thodey AO; Mr Drew Clarke AO. Back: Mr David Knox; Prof Tanya Monro; Dr Michele Allan.

26 The Board Charter and other details are at: https://www.csiro.au/en/About/Leadership-governance/Minister-and-Board.

Board qualifications and experience

Mr David Thodey AO – Chairman: BA FAICD, Company Director (15 October 2015 to 14 October 2020)

Mr David Thodey AO is a business leader focused on innovation, technology and telecommunications, with more than 30 years' experience.

Mr Thodey is a non-executive board director of Ramsay Health Care, a global hospital group; Tyro, Australia's only independent EFTPOS banking institution; Vodafone Group Plc; and Xero, a cloud-based accounting software provider for small and medium businesses. Mr Thodey is currently leading the Independent Review of the Australian Public Service (APS). This review was commissioned by the Prime Minister to ensure that the APS is fit-for-purpose to serve Australian governments and the Australian people into the future. Mr Thodey also had a successful career as Chief Executive Officer of Telstra, Australia's leading telecommunications and information services company and Chief Executive Officer of IBM Australia and New Zealand.

In 2017, Mr Thodey was made an Officer (AO) in the General Division of the Order of Australia.

Dr Larry Marshall – Chief Executive: BSc (Hons) PhD GAICD FTSE (1 January 2015 to 31 December 2016; 1 January 2017 to 30 June 2020)

Dr Larry Marshall is a scientist, technology innovator and business leader with more than 25 years' experience in creating new value and impact with science. Dr Marshall has more than 100 peer reviewed publications and conference papers, holds 20 patents, has founded six successful companies in biotechnology, photonics, telecommunications and semiconductors in the United States, and has served on 20 boards of high-tech companies operating in the United States, Australia and China. Dr Marshall is a Male Champion of Change committed to tackling gender equality. He is a passionate supporter of Australian innovation, returning to Australia to lead CSIRO, which he believes is the essential catalyst to improve Australia's innovation performance.

Ms Shirley In't Veld – Deputy Chair: BCom LLB FAICD, Company Director (28 June 2012 to 27 June 2015; 28 June 2015 to 27 June 2020)

Ms Shirley In't Veld brings tremendous skills and experience, as well as important Western Australian experience and connections, as CSIRO seeks to further enhance its relationships in Western Australia. She is on the boards of the National Broadband Network, Northern Star Resources and Australian Pipeline Limited, and is a member of the Takeovers panel and the COAG Energy Council Independent Energy Appointments Selection Panel.

Dr Michele Allan – Member: BAppSc MMgtTec MCommLaw DBA FAICD, Company Director (5 May 2016 to 4 May 2019; 5 May 2019 to 4 May 2024)

Dr Michele Allan is a food industry and agribusiness specialist who has held senior executive and director positions in the food and education sectors and has an academic background in biomedical science, management and law. Dr Allan is the Chair of the boards of Meat and Livestock Australia, Charles Sturt University and Apple and Pear Australia, and Chair of the Defence Cooperative Research Centre for Trusted Autonomous Systems. Her board positions include Food and Agribusiness Growth Centre, Grain Growers Limited, Nuffield Australia, Wine Australia, MJCP Holdings Pty Ltd and Dairy Food Safety Victoria. Dr Allan has a Bachelor of Applied Science Major – Biomedical Science – Cytology from University Technology Sydney, Master of Management (Technology) from the University of Melbourne, Doctor of Business Administration from Royal Melbourne Institute of Technology and a Master of Commercial Law from Deakin University. She is also a Fellow of the Australian Institute of Company Directors.

Mr Drew Clarke AO – Member: PSM BAppSc (Surveying) MSc GAICD FTSE, Company Director (24 August 2017 to 23 August 2022)

Mr Drew Clarke AO has served for more than 20 years in senior roles in the Australian Public Service, including as secretary of the Department of Resources, Energy and Tourism, and secretary of the Department of Communications. His last executive role was as chief of staff in the Office of the Prime Minister. In 2009, Mr Clarke was awarded a Public Service Medal for his energy policy work, and in 2016 was appointed an Officer in the Order of Australia for distinguished service to public administration. He brings a valuable mix of skills to the CSIRO Board with his background in applied science, public policy and government administration. He has a Master of Science from The Ohio State University and is a Fellow of the Australian Academy of Technological Sciences and Engineering. Mr Clarke is Chairman of the Australian Energy Market Operator board and a Director on the NBNCobBoard. He has been an ex officio member of the Industry Research and Development board (as executive general manager of AusIndustry), chair of ANZLIC – the Spatial

Information Council, chair of the COAG Energy Council Standing Committee of Officials, a director of the Cooperative Research Centre for Spatial Information and a member of the International Energy Agency governing board.

Prof Edwina Cornish AO – Member: BSc (Hons) PhD FTSE AICD (26 November 2015 to 25 November 2020)

Professor Edwina Cornish AO brings vast experience in the interface between government, research, science and the higher education sector, and is an experienced board member with strong business, industry and financial skills. Professor Cornish played a key role in building one of Australia's first biotechnology companies, Florigene Limited, which developed and successfully commercialised the world's first genetically modified flowers under her leadership. Professor Cornish is a Member of the Council of La Trobe University and was previously provost and senior vice-president of Monash University. In 2014, she was made an Officer of the Order of Australia, in part for her advances in biotechnology and horticultural genetic modification.

Ms Kathryn Fagg AO – Member: BE (Hons) Chem Eng and Mcom (Hons) FTSE GAICD, Company Director (2 August 2018 to 1 August 2023)

Ms Kathryn Fagg AO is an experienced senior executive and former engineer. A highly experienced board member and chair, Ms Fagg is the Chair of Boral and is on the boards of listed companies Incitec Pivot and Djerriwarrh Investments. She was a member of the Board of the Reserve Bank of Australia from 2013–18. In the not-for-profit sector, Ms Fagg is Chair of the Breast Cancer Network Australia, as well as being a board member of the Grattan Institute, the Myer Foundation and the Male Champions of Change. She is the immediate past president of Chief Executive Women, a former chairman of Parks Victoria and the Melbourne Recital Centre and a former board member of the Australia Centre for Innovation. Ms Fagg has held senior executive roles in logistics, manufacturing, resources, banking and professional services, including with Linfox, BlueScope Steel and the ANZ Banking Group. Her qualifications include a Bachelor of Engineering (Honours) from the University of Queensland and a Master of Commerce (Honours) from the University of New South Wales. In 2017 she was awarded the Ada Lovelace Medal for Outstanding Woman Engineer by the University of New South Wales. In June, Ms Fagg was made an Officer of the Order of Australia (AO).

Mr David Knox – Member: BSc (Hons) Mech Eng MBA FIE Aust FTSE GAICD, Company Director (5 May 2016 to 4 May 2019; 5 May 2019 to 4 May 2024)

Mr David Knox is Managing Director and Chief Executive Officer of Australian Naval Infrastructure. He was previously chief executive officer and managing director of Santos Limited from 2008 to 2015 and managing director for BP Developments in Australasia from 2003 to 2007. He has worked for BP in the United Kingdom and Pakistan, and has held management and engineering positions at ARCO and Shell in the United States, the Netherlands, the United Kingdom and Norway. Mr Knox is originally from Edinburgh, Scotland, and has a Bachelor of Science (Honours) in Mechanical Engineering and a Master of Business Administration. He is a Fellow of the Australian Academy of Technology and Engineering, and the Insitution of Engineers Australia and a graduate of the Australian Institute of Company Directors. He is a Director of Migration Council Australia, Redflow and a member of the Royal Institution of Australia Council. Mr Knox also sits on the board of the Adelaide Festival and is Chair of i3 Energy and The Australian Centre for Social Innovation.

Prof Tanya Monro – Member: BSc (Hons) PhD FAA FTSE FOSA FAIP GAICD, Company Director (25 February 2016 to 24 February 2021)

Professor Tanya Monro is the Chief Defence Scientist, appointed in March 2019. She was previously deputy vice chancellor Research and Innovation and an Australian Research Council (ARC) Georgina Sweet Laureate Fellow at the University of South Australia.

Professor Monro was the inaugural director of the Institute for Photonics and Advanced Sensing from 2008 to 2014 and was also the inaugural director for the ARC Centre of Excellence for Nanoscale BioPhotonics at the University of Adelaide. Her research is in the field of photonics, with a focus on sensing, lasers and new classes of optical fibres.

Professor Monro obtained her PhD in physics in 1998 from The University of Sydney, for which she was awarded the Bragg Gold Medal for the best Physics PhD in Australia. In 2000, she received a Royal Society University Research Fellowship at the Optoelectronics Research Centre at the University of Southampton in the United Kingdom, and is also an inaugural Bragg Fellow of the Royal Institution of Australia.

Professor Monro is a Fellow of the Australian Academy of Science, the Australian Academy of Technological Sciences and Engineering, the Optical Society of America and the Australian Institute of Physics. She is a member of the South Australian Premier's Economic Advisory Council and Science Patron of the National Youth Science Forum. Her awards include the Prime Minister's Malcolm McIntosh Prize for Physical Scientist of the Year (2008), South Australian Scientist of the Year (2010), South Australia's Australian of the Year (2011) and the Eureka Prize for Excellence in Interdisciplinary Scientific Research (2015).

Dr Peter Riddles – Member: BSc (Hons), PhD, Grad Dip Bus FAICD, Company Director (24 April 2014 to 23 April 2017; 24 April 17 to 23 April 2022)

Dr Peter Riddles began his career as a research scientist in molecular biology in the public sector, holding positions at the University of Queensland, Stanford University and the CSIRO. Since then, he has accumulated decades of experience in the life sciences industry in Australia and internationally, having provided leadership to diverse organisations, including biotechnology start-up companies, industry organisations and University Commercial Offices.

His current priorities include working with clinical entrepreneurs in enterprise creation and maintaining an interest in innovation policy and practice. In this regard he is a Fellow of the Royal Society for Arts (United Kingdom), a Member of Chatham House (United Kingdom), and a Fellow of the California Technology Council (United States). Other roles include member of the Science and Industry Endowment Fund (SIEF) Advisory Council in Australia, chairing its Experimental Development Program Review Panel, Director of The Hear and Say Centre for Deaf Children (Brisbane, Australia), Advisor to digital health start-up BetterBySport (Bern, Switzerland) and member of the Council of Reference to Academic Health Solutions (London, United Kingdom). He is Founder and Chair of the Steering Group of Commonwealth Health Innovation Services Alliance, Advisor to the Queensland Government regarding the next generation of Boggo Road Precinct and advisory board member of Circular Economy Laboratory.

CSIRO Executive Management

The Chief Executive is accountable for managing the affairs of the organisation in accordance with our strategy, plans and policies approved by the Board as well as the Board Directions to the Chief Executive.

Our Chief Executive is supported by our Executive Team (ET). As a team and through their individual roles, the members lead, direct, coordinate and control our operations and performance. The Data61 Chief Executive Officer continued as a member of the ET to build on our unique digital plus industry expertise. This year, and in accordance with the Executive Team Charter, the ET was responsible for development of the Corporate Plan 2019–20 and Budget.

The ET is assisted by the Major Transactions Committee as a standing committee, providing governance oversight on our involvement in major transactions, and related matters and investments. During 2018–19, this committee held 25 meetings, including five out-of-session meetings. Our CSIRO Leadership Team of senior managers provides a forum for sharing and discussing issues relating to CSIRO's management and future strategy.

Remuneration of key management personnel, executives and other highly paid staff

In accordance with the *Public Governance, Performance and Accountability Rule 2014*[27] (PGPA Rule), remuneration details are provided to meet enhanced disclosure requirements. Remuneration of key management personnel and senior executives is reported in detail in note 3.2 of the Financial statements on page 131 and in Table 4.1 of this section for other highly paid staff. Annual reportable remuneration includes base salary, benefits and allowances, bonuses, superannuation, termination benefits, long service leave and other short-term and long-term benefits. The remuneration reported has been calculated on an accrual basis and is not representative of actual remuneration paid in 2018–19.

27 Incorporating the Public Governance, Performance and Accountability Amendment (Reporting Executive Remuneration) Rules 2019.

L–R: Dr Cathy Foley; Mr Nigel Warren; Dr Anita Hill; Dr David Williams; Dr Larry Marshall; Dr Peter Mayfield; Ms Ilona Charles; Mr Adrian Turner; Ms Judi Zielke.

Remuneration policy, strategy and governance

Our remuneration policy considers applicable remuneration provisions within both the *CSIRO Enterprise Agreement 2017–2020* and the *CSIRO Canberra Deep Space Communication Complex (CDSCC) Enterprise Agreement 2018–2021*.
Clause 11 and 12 of the *CSIRO Enterprise Agreement 2017–2020* provides for market-related remuneration and individual flexibility arrangements.
The remuneration policy also considers the Workplace Bargaining Policy 2018 as provided by the Australian Public Service Commission.
Key management personnel, executives and other highly paid staff are remunerated in accordance with their contracts of employment and relevant governing provisions.

The Chief Executive is a position within the Commonwealth Principal Executive Officer structure. The Remuneration Tribunal sets the Total Remuneration reference rate and the maximum achievable performance payment.

Remuneration for members of the CSIRO Board is established by Determination of the Remuneration Tribunal for Part Time Office Holders. Determinations of the Remuneration Tribunal are established in accordance with the *Remuneration Tribunal Act 1973*.

The Remuneration Committee

The CSIRO Board People, Health and Safety Committee assists the Board to fulfil its governance responsibilities in relation to organisational development, people-related activities and health and safety. In relation to remuneration and performance, this committee:

- makes recommendations to the Board on the remuneration and performance of the Chief Executive, including possible key result areas and performance targets
- reviews the decisions of the Chief Executive in respect of the remuneration and performance assessment of Executive Team members, and ratifies these recommendations if thought appropriate
- exercises oversight of the executive remuneration policy of the organisation, including the senior executive banding structure (focus on positions, not individuals) and with references to the market
- specifically oversees negotiations with the Chief Executive or nominee regarding terms and conditions of appointment.

Table 4.1: Remuneration of other highly paid staff for 2018–19

REMUNERATION BAND	NUMBER OF HIGHLY PAID STAFF	SHORT-TERM BENEFITS		
		AVERAGE BASE SALARY ($)	AVERAGE BONUSES ($)	AVERAGE OTHER BENEFITS AND ALLOWANCES ($)
$220,001 – $245,000	116	176,543	1,735	4,787
$245,001 – $270,000	58	184,792	4,681	9,680
$270,001 – $295,000	35	207,051	6,203	10,931
$295,001 –$320,000	15	224,555	7,468	15,134
$320,001 – $345,000	4	237,878	12,000	26,853
$345,001 – $370,000	5	293,384	8,858	6,926
$370,001 – $395,000	2	299,220	8,000	8,657
$395,001 – $420,000	2	276,590	16,000	17,314
$445,001 – $470,000	2	290,676	32,000	8,657

- Base salary includes annual leave accrued in the period.
- Bonus amounts represent estimated amounts based on the contract amount allowable. Actual bonuses are decided by the Board following the end of financial year.

Remuneration Framework

The Chief Executive evaluates and determines the appropriate level of pay for executive positions based on our executive remuneration policy. Our Remuneration Framework consists of both fixed and variable components. Base salary is determined based on a range of factors, including work value assessments, individual performance, competence and skill, internal relativities and external market rates. The annual variable 'at-risk' component of remuneration is based on the achievement of pre-determined key result areas.

Annual remuneration review

We review remuneration levels for executives annually. The Chief Executive and Board People, Health and Safety Committee review any increases and performance payment structure for the next financial year.

The remuneration review process considers:

- market practice
- individual performance
- organisation performance and affordability
- current remuneration competitiveness vs desired remuneration level.

Market-related remuneration arrangements may increase because of contract provisions aligned with Enterprise Agreement salary increases or by market-related adjustments, which are determined annually by the CSIRO Board People Health and Safety Committee.

The Board People Health & Safety Committee makes recommendations to the Board on the remuneration and performance of the Chief Executive, including possible key result areas and performance targets. The CSIRO Board determines the remuneration of the Chief Executive and any applicable performance payment within the range set by the Remuneration Tribunal following the Tribunal's annual determination of the reference rate.

	POST-EMPLOYMENT BENEFITS	OTHER LONG-TERM BENEFITS		TERMINATION BENEFITS	TOTAL REMUNERATION
	AVERAGE SUPERANNUATION CONTRIBUTIONS* ($)	AVERAGE LONG SERVICE LEAVE ($)	AVERAGE OTHER LONG-TERM BENEFITS ($)	AVERAGE TERMINATION BENEFITS ($)	AVERAGE TOTAL REMUNERATION ($)
	30,003	17,294	392	944	231,698
	31,640	17,193	914	7,342	256,242
	33,822	20,753	948	-	279,708
	35,065	23,205	643	-	306,070
	39,394	12,428	5,053	-	333,606
	29,531	19,580	–3,206	-	355,073
	31,654	18,460	7,004	-	372,995
	51,295	40,454	-	-	401,653
	43,084	69,033	4,482	-	447,932

Disclosure of interests and related entity transactions

Board members and the Chief Executive declare material interests in accordance with the SIR Act and PGPA Act. The Board Governance document contains processes for managing conflicts of interest, including a requirement that members absent themselves from discussions and voting where a member has declared a material personal interest, or where a potential or actual conflict of interest or duty arises.

In 2018–19, the Board considered the following transaction where a Board member was also a director on the entity involved in the transaction:

- Board 212 Item 4.4, Science and Industry Endowment Fund – 10-year condition of CSIRO Gift – Dr Peter Riddles is on the SIEF Advisory Council and did not participate in the decision.

There have been 172 transactions involving entities related to CSIRO above $10,000, which came to a total combined value of $21.8 million.

Risk management

The identification and management of risk is central to delivering our purpose and objectives and – in turn – maximising the impact of our science and benefit to Australia. This includes understanding scientific, financial, commercial and legal, health, safety and security, environmental and reputational risks.

By actively identifying and managing strategic, operational and external risks, we aim to increase our effectiveness as an organisation and provide greater certainty and confidence for the Government, staff members, collaborators, partners and other stakeholders in the community about our operations. Our Risk Framework, methodology and approach is grounded in and aligned with both the international standard AS/NZS ISO 31000 Risk Management Principles and Guidelines and Commonwealth Risk Management Policy.

The CSIRO Board is also active in supporting our efforts to identify and manage our risks though three Board standing committees (read more about these committees on page 91):

- People, Health and Safety Committee
- Audit and Risk Committee
- Science Excellence Committee.

Our Risk Framework is applied to capture and report risks at the Enterprise, Business Unit and activity levels. In 2017, we recognised that while this framework has supported the organisation well, we must continually evolve and improve our approach to strengthen the development of a strong risk culture that supports taking risks mindfully to deliver innovation for Australia. We have therefore begun and are continuing a program of improvement to increase our risk maturity through:

- Risk Culture: Consistent with the development of a positive culture to deliver innovation, we are developing a culture towards the identification and management of risk that supports the posture that you can take risk where this is done mindfully, within organisational tolerances and is managed effectively.
- Integration: Risk is aligned with key processes to enable decision-making. We continue to strengthen that alignment through increasing risk capability applied to each element of our Strategic Planning and Execution Framework.
- Risk Capability: While risk planning and management has been very visible at Board, Executive and senior leader levels and in our Enterprise Support Services, cascading it to Business Units and projects has been inconsistent. This is being addressed through an enhanced focus on risk reporting at the enterprise level, supported by regular update and review of risk registers across all Business Units and Enterprise Support areas.
- Resilience: Our ability to respond to significant issues and events has been strengthened through the review and update of the Situation Management Framework in 2016. We continue to enhance our design and application of our Situation Management Framework in responding to external risks and events. This includes running scenario-based exercises at all levels.

Our Organisational Risk Profile articulates how we manage our key risks at an enterprise level. The profile is developed in a consultative and considered manner involving extensive engagement with organisational leaders across the Executive and all Business Units and Functions. It conducts an internal and external environmental scan that considers external, strategic and internally generated risks with the potential to impact the achievement of our objectives. Consistent with our objective to increase risk maturity, in coming years we will continue to deepen the level of engagement and analysis that supports the development of the profile.

The Organisational Risk Profile was reported to the Board Audit and Risk Committee and Board at their respective meetings in November. Key risk activities and changes to the Organisational Risk Profile are reported to the Board Audit and Risk Committee throughout the year.

General insurance, including General Liability and Professional Indemnity Insurance, is provided through Comcover. Our workers' compensation liability is covered through a Comcare premium.

Advisory mechanisms

Our Advisory Committees provide advice on our longer-term strategic direction and research and development priorities, and on how we can meet the research, technical and business needs of customers and communities. The committees meet at least twice a year, or more regularly if required. The advice provided by these committees relates to the effectiveness of our businesses to achieve their goals. The committees comprise representatives from industry, government, non-government organisations and other stakeholders.

Policies, principles and procedures

Our Policy Framework comprises policies, principles and procedures. The policies, approved by our Board, reflect our commitment in relation to:

- people
- science and delivery
- governance
- risk
- health, safety and environmental sustainability
- freedom to conduct CSIRO research and technology transfer
- child safety
- finance.

The CSIRO Policy Reform Project supports the continual streamlining of our policies, principles and procedures, and is intended to lead to improved transparency, accountability, efficiency and effectiveness in the daily work of all staff.

Ethics and CSIRO Code of Conduct

The CSIRO Code of Conduct sets out the standard of behaviour expected of staff and others working in the organisation. All staff members and staff members of CSIRO affiliates are required to undertake training in the code as part of their induction and every two years.

Ethical conduct is a priority and we have procedures for Ethical Conduct in Human Research and Animal Welfare regarding the care and use of animals in scientific research. Our practices comply with national codes and relevant state and national legislative requirements. We operate two human research ethics committees to cover our social and interdisciplinary science, and health and medical-related research. These committees review about 240 new projects each year and provide ongoing monitoring and support for more than 400 active projects at any given time. The committees provide independent, expert advice regarding appropriate engagement of people and communities in research and the use of human data. They issues such as privacy, informed consent and the risks and benefits flowing from research are effectively managed.

We operate five Animal Ethics Committees that review our use of animals in research. This covers a range of fields including wildlife conservation, farm animal production, nutrition, disease control and prevention, and human health. These committees review about 137 new projects each year. They also play an active role in monitoring the care and wellbeing of animals during any research and ensure we comply with all regulatory requirements. Ongoing support and monitoring is provided for more than 240 projects at any given time.

We provide targeted training programs on human and animal research ethics to staff and ethics committee members each year to ensure capability levels for responsible research practice are supported and maintained. We also provide online resources to support best practice.

In mid-2018, a revised version of the *Australian Code for the Responsible Conduct of Research (2018)* was released by the National Health and Medical Research Council. This document provides a national framework for responsible research conduct and sets out principles and responsibilities for researchers and institutions when conducting research in Australia or under the auspices of Australian institutions. Following this release, we began a project to assess the alignment of the organisation's policies, procedures and practices to the new guidelines with a view to formally adopting the revised code as part of the organisation's governance framework for research integrity. As a result, updates have been made to some areas of our policy to ensure compliance with the revised standards and further support best practice. In the coming financial year, we will implement additional initiatives such as establishing a network of research integrity advisers within the organisation.

Internal controls

We comply with section 10 of the *Public Governance, Performance and Accountability Rule 2014* (PGPA Rule), which requires us to establish and maintain an effective fraud control framework. Our Fraud and Corruption Control Plan comprises strategies to prevent, detect, respond and report fraud and corruption affecting CSIRO, and is complemented by our policy and procedures, system and internal controls, financial management, assurance and accountability activities, and an Enterprise Risk Framework. We adhere to the Commonwealth Fraud Control Framework 2017's Fraud Rule, and in line with fraud control best practice, endeavour to apply the Fraud Policy and Fraud Guidance. We are committed to nurturing an anti-fraud culture, which is predicated on predicting, pre-empting and preventing fraud and misconduct affecting our organisation.

We identify the Protective Security Policy Framework as a better practice guide and use elements from this framework as well as the Information Security Manual to inform our security frameworks. We continually review the organisation's risk appetite. We implement agreed management actions on protective security and will continue to do so through an endorsed Enterprise Security Program.

We continue to embed Cyber and ICT Security to support our strategy to demonstrate to our customers that we are a trusted advisor.

Security and fraud control

As a Corporate Commonwealth entity under the *Public Governance, Performance and Accountability Act 2013* (PGPA Act), we are required to comply with section 10 of the *Public Governance, Performance and Accountability Rule 2014* (Fraud/PGPA Rule). The Fraud Rule sets out the Australian Government's expectations in relation to fraud prevention, detection and response and sets a standard for the effective management of organisational fraud risks and fraud incidents. Our Fraud and Corruption Control Framework is accompanied by our Enterprise Risk Framework, policy and procedures, system, financial and internal controls, and other assurance and accountability practices, procedures and activities.

Reviews by outside bodies

The Senate Standing Committees on Economics examines the operations of CSIRO following the Federal Budget, the tabling of our annual report and the introduction to Parliament of the additional Appropriation Bills. This year, our senior executives appeared before the Committee during the Senate Estimates process on two occasions and responded to all questions on notice.

Judicial decisions

During 2018–19, there were no judicial decisions or decisions of administrative tribunals that have had, or may have, a significant effect on the operations of CSIRO.

Enterprise agreements

Enterprise agreements set the terms and conditions of employment for our staff. Two enterprise agreements are in operation: the CSIRO Enterprise Agreement 2017–20 and the CSIRO Canberra Deep Space Communication Complex (CDSCC) Enterprise Agreement 2018–21.

The CSIRO Enterprise Agreement 2017–20 came in to operation on 14 August 2017. It reaches its nominal expiry date on 14 November 2020.

The CSIRO CDSCC Enterprise Agreement 2018–21 came into operation on 21 February 2019. It reaches its nominal expiry date on 20 February 2022.

Service charter

Our service charter describes the standards of service we aim to deliver to our customers and our commitment to ensuring that these standards are maintained.

In summary:

- We believe our customers and partners are essential to our success.
- We maintain relevance in our work through input from the public, government, industry and the research community.
- We communicate with our customers in a courteous, helpful and professional manner.
- We respect customer confidentiality.
- We evaluate our services to ensure continuous improvement of our service delivery.

Our full service charter is available at www.csiro.au/Service-Charter.

We welcome feedback on our performance. Contact the CSIRO officer with whom you have been dealing or CSIRO Enquiries, which can direct your feedback to the relevant person:

Private Bag 10, Clayton South VIC 3169
1300 363 400
csiroenquiries@csiro.au

Administrative Law

Freedom of information

The *Freedom of Information Act 1982* (FOI Act) provides the public with a general right of access to documents held by Australian Government agencies, including CSIRO. The general right is limited by exceptions to protect essential public interests and the privacy or business affairs of those who give information to the agency. In the reporting year to 30 June 2019, we received 66 requests for, or consultations on, documents under the FOI Act.

General information about our FOI procedures, including how to make an FOI request, is available at www.csiro.au/en/About/Access-to-information/Freedom-of-Information.

Part V of the FOI Act confers a right to request CSIRO to amend a document to which lawful access has been granted, where the applicant claims that information in the document:

- relates to his or her personal affairs
- is incomplete, incorrect, out of date or misleading
- has been used, is being used or is available for use by the agency or Minister for an administrative purpose.

During 2018–19, we received no requests for amendments of personal information under the FOI Act.

Information Publication Scheme

We are required to publish information to the public as part of the Information Publication Scheme. This requirement is in Part II of the FOI Act and has replaced the former requirement to publish a section 8 statement in an annual report. We provide a plan on our website showing what information we publish in accordance with the Information Publication Scheme requirements.

Members of the public may obtain access to scientific and technical publications from CSIRO Publishing (www.publish.csiro.au) and the ePublish Repository (publications.csiro.au). Research data used by CSIRO is routinely published on the CSIRO Data Access Portal (data.csiro.au/dap/browse).

Archives, privacy and administrative decisions

We maintain an archives collection that includes material from the Council for Science and Industrial Research, the predecessor of CSIRO, dating from 1926. Certain CSIRO records are held by the National Archives of Australia. Disposal arrangements for CSIRO records are made in accordance with the *Archives Act 1983*. Access to records over 20 years old is provided in accordance with that Act.

We are bound by the Australian Privacy Principles under the *Privacy Act 1988*. We have various measures in place to manage compliance with the Privacy Act, including the mandatory data breach requirements that came into effect in February 2018. During 2018–19, we notified the Office of the Australian Information Commissioner (OAIC) of one data breach. During 2018–19, OAIC undertook two investigations under section 36 of the *Privacy Act 1988* in relation to CSIRO.

The *Administrative Decisions (Judicial Review) Act 1977* enables a person aggrieved by certain classes of administrative decisions made by Australian Government agencies, including CSIRO, to obtain reasons for or to challenge those decisions. During 2018–19, we received no challenges or requests for statements of reasons under the Act.

Contact

All enquiries under the above legislation (including FOI requests) should be directed to:

FOI and Privacy Officer, CSIRO
GPO Box 1700
Canberra ACT 2601
02 6276 6431
FOI@csiro.au

Public Interest Disclosure

The *Public Interest Disclosure Act 2013* (PID Act) came into effect on 15 January 2014. Internal procedures have been implemented to meet compliance through a Public Interest Disclosure (PID) Scheme. The PID Scheme promotes integrity and accountability by encouraging the disclosure of information about suspected wrongdoing, protecting people who make disclosures and ensuring we take appropriate action. We have contributed to the Commonwealth Ombudsman's annual report on the PID, as required in section 76(3) of the Act. In 2018–19, we received no public interest disclosures pursuant to s26 of the PID Act.

Consultancy services

We engage consultants where we lack specialist expertise or when independent research, review or assessment is required. Consultants are typically engaged to investigate or diagnose a defined issue or problem; carry out defined reviews or evaluations; or provide independent advice, information or creative solutions to assist in our decision-making.

Before engaging consultants, we consider the skills and resources required for the task, the skills available internally and the cost-effectiveness of engaging external expertise. The decision to engage a consultant is made in accordance with the Commonwealth Procurement Rules, our procurement policy and other relevant internal policies.

Our policy on selection and engagement of consultants is based on the principles of:

- value for money
- open and effective competition
- ethics and fair dealing
- accountability and reporting
- national competitiveness and industry development
- support for other Australian Government policies.

Tables 4.2, 4.3 and 4.4 summarise the consultancies let and the annual spend, the reason for the consultancy and the procurement method. All values include goods and services tax.

Table 4.2: Annual spend on consultancies

YEAR	SPENT ($)	LET ($) (ESTIMATED WHOLE OF LIFE)
2012–13	1,104,000	1,417,754
2013–14	5,294,552	5,796,633
2014–15	630,870	737,617
2015–16	373,751	853,957
2016–17	1,642,455	1,440,220
2017–18	1,561,210	1,247,100
2018–19	1,553,566	1,700,668
TOTAL	**12,160,404**	**13,193,949**

Table 4.3: Summary by reason code for 2018–19

CATEGORY CODE	REASON FOR CONSULTANCY	NUMBER OF CONSULTANCIES	VALUE ($)
IS	Need for independent study/evaluation	7	827,762
PA	Need for professional assistance to manage and facilitate change and its consequence	4	792,574
SS	Specialist skills were not otherwise available	2	80,332
TOTAL		**13**	**1,700,668**

Table 4.4: Summary by procurement method code for 2018–19

CATEGORY CODE	PROCUREMENT METHOD	NUMBER OF CONSULTANCIES	VALUE ($)
OT	Tenders sought from the marketplace through Open Approach (Request for Proposal, Request for Tender, Expressions of Interest).		
PM	An existing panel member – this category includes standing offers, common use arrangements and approved supplier panels.	11	1,620,336
ST	Tenders being sought from suppliers who have pre-qualified through some form of previous competitive process.		
RQ	Purchasing was undertaken in accordance with Division 1 of the Commonwealth procurement rules (CPRs) and procurement did not require application of Division 2 of the CPRs.		
EX	Exemption applied that saw CSIRO undertake the procurement as a Limited Tender as defined in Division 2 of the CPRs.	2	80,332
TOTAL		**13**	**1,700,668**

The Northern Australia Water Resource Assessment investigated the Fitzroy River catchment in Western Australia (pictured), the Finniss, Adelaide, Mary and Wildman river catchments in the Northern Territory, and the Mitchell River catchment in Queensland. We wanted to better understand the scale and nature of future development opportunities (read the case study on page 40).

Part 5
Financial statements

Australian National Audit Office

INDEPENDENT AUDITOR'S REPORT

To the Minister for Industry, Science and Technology

Opinion

In my opinion, the financial statements of the Commonwealth Scientific and Industrial Research Organisation and the Consolidated Entity for the year ended 30 June 2019:

(a) comply with Australian Accounting Standards – Reduced Disclosure Requirements and the *Public Governance, Performance and Accountability (Financial Reporting) Rule 2015*; and

(b) present fairly the financial positions of the Commonwealth Scientific and Industrial Research Organisation and the Consolidated Entity as at 30 June 2019 and their financial performance and cash flows for the year then ended.

The financial statements of the Commonwealth Scientific and Industrial Research Organisation and the Consolidated Entity, which I have audited, comprise the following statements as at 30 June 2019 and for the year then ended:

- Statement by the Chairman of the Board, Chief Executive and Chief Finance Officer;
- Statement of Comprehensive Income;
- Statement of Financial Position;
- Statement of Changes in Equity;
- Cash Flow Statement; and
- Notes to and forming part of the financial statements.

Basis for opinion

I conducted my audit in accordance with the Australian National Audit Office Auditing Standards, which incorporate the Australian Auditing Standards. My responsibilities under those standards are further described in the *Auditor's Responsibilities for the Audit of the Financial Statements* section of my report. I am independent of the Commonwealth Scientific and Industrial Research Organisation and the Consolidated Entity in accordance with the relevant ethical requirements for financial statement audits conducted by the Auditor-General and his delegates. These include the relevant independence requirements of the Accounting Professional and Ethical Standards Board's APES 110 *Code of Ethics for Professional Accountants* (the Code) to the extent that they are not in conflict with the *Auditor-General Act 1997*. I have also fulfilled my other responsibilities in accordance with the Code. I believe that the audit evidence I have obtained is sufficient and appropriate to provide a basis for my opinion.

Accountable Authority's responsibility for the financial statements

As the Accountable Authority of the Entity, the Commonwealth Scientific and Industrial Research Organisation, the Board is responsible under the *Public Governance, Performance and Accountability Act 2013* (the Act) for the preparation and fair presentation of annual financial statements that comply with Australian Accounting Standards – Reduced Disclosure Requirements and the rules made under the Act. The Board is also responsible for such internal control as the Board determines is necessary to enable the preparation of financial statements that are free from material misstatement, whether due to fraud or error.

In preparing the financial statements, the Board is responsible for assessing the ability of the Commonwealth Scientific and Industrial Research Organisation and the Consolidated Entity to continue as a going concern, taking into account whether the entities' operations will cease as a result of an administrative restructure or for any

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other reason. The Board is also responsible for disclosing, as applicable, matters related to going concern and using the going concern basis of accounting unless the assessment indicates that it is not appropriate.

Auditor's responsibilities for the audit of the financial statements

My objective is to obtain reasonable assurance about whether the financial statements as a whole are free from material misstatement, whether due to fraud or error, and to issue an auditor's report that includes my opinion. Reasonable assurance is a high level of assurance, but is not a guarantee that an audit conducted in accordance with the Australian National Audit Office Auditing Standards will always detect a material misstatement when it exists. Misstatements can arise from fraud or error and are considered material if, individually or in the aggregate, they could reasonably be expected to influence the economic decisions of users taken on the basis of the financial statements.

As part of an audit in accordance with the Australian National Audit Office Auditing Standards, I exercise professional judgement and maintain professional scepticism throughout the audit. I also:

- identify and assess the risks of material misstatement of the financial statements, whether due to fraud or error, design and perform audit procedures responsive to those risks, and obtain audit evidence that is sufficient and appropriate to provide a basis for my opinion. The risk of not detecting a material misstatement resulting from fraud is higher than for one resulting from error, as fraud may involve collusion, forgery, intentional omissions, misrepresentations, or the override of internal control;
- obtain an understanding of internal control relevant to the audit in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the Entity's and the Consolidated Entity's internal control;
- evaluate the appropriateness of accounting policies used and the reasonableness of accounting estimates and related disclosures made by the Accountable Authority;
- conclude on the appropriateness of the Accountable Authority's use of the going concern basis of accounting and, based on the audit evidence obtained, whether a material uncertainty exists related to events or conditions that may cast significant doubt on the Entity's or the Consolidated Entity's ability to continue as a going concern. If I conclude that a material uncertainty exists, I am required to draw attention in my auditor's report to the related disclosures in the financial statements or, if such disclosures are inadequate, to modify my opinion. My conclusions are based on the audit evidence obtained up to the date of my auditor's report. However, future events or conditions may cause the Entity or the Consolidated Entity to cease to continue as a going concern;
- evaluate the overall presentation, structure and content of the financial statements, including the disclosures, and whether the financial statements represent the underlying transactions and events in a manner that achieves fair presentation; and
- obtain sufficient appropriate audit evidence regarding the financial information of the entities or business activities within the Consolidated Entity to express an opinion on the financial report. I am responsible for the direction, supervision and performance of the Consolidated Entity audit. I remain solely responsible for my audit opinion.

I communicate with the those charged with governance, regarding, among other matters, the planned scope and timing of the audit and significant audit findings, including any significant deficiencies in internal control that I identify during my audit.

Australian National Audit Office

Brandon Jarrett

Senior Executive Director

Delegate of the Auditor-General

Canberra

30 August 2019

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATION
Financial Statements

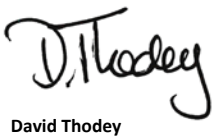
for the period ended 30 June 2019

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATION
STATEMENT BY THE CHAIRMAN OF THE BOARD, CHIEF EXECUTIVE AND CHIEF FINANCE OFFICER

In our opinion, the attached financial statements for the period ended 30 June 2019 comply with subsection 42(2) of the Public Governance, Performance and Accountability Act 2013 (PGPA Act), and are based on properly maintained financial records as per subsection 41(2) of the PGPA Act.

In our opinion, at the date of this statement, there are reasonable grounds to believe that the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and its subsidiaries will be able to pay their debts as and when they fall due.

This statement is made in accordance with a resolution of the directors.



David Thodey
Chairman of the Board
30 August 2019

Larry Marshall
Chief Executive and Board Member
30 August 2019

Tom Munyard
Chief Finance Officer
30 August 2019

CONSOLIDATED FINANCIAL STATEMENTS
STATEMENT OF COMPREHENSIVE INCOME
For the period ended 30 June 2019

		Consolidated		CSIRO	
		2019	2018	**2019**	2018
NET COST OF SERVICES	**Notes**	**$'000**	$'000	**$'000**	$'000
Expenses					
Employee benefits	1.1A	**763,169**	699,295	**760,029**	697,888
Suppliers	1.1B	**482,954**	443,153	**483,718**	447,790
Depreciation and amortisation	2.2A	**148,019**	181,609	**147,861**	181,455
Finance leases		**1,430**	1,562	**1,403**	1,547
Impairment allowance on financial instruments	1.1C	**536**	1,093	**536**	684
Write-down and impairment of other assets	1.1D	**13**	5,910	**13**	5,910
Losses from asset sales		**2,847**	15,087	**2,847**	15,087
Total expenses		**1,398,968**	1,347,709	**1,396,407**	1,350,361
Own-Source Income					
Own-source revenue					
Sale of goods and rendering of services	1.2	**410,432**	384,554	**435,475**	405,190
Bank and term deposits interest	1.2	**13,501**	10,572	**10,536**	7,944
Rental income	1.2	**10,546**	11,001	**10,546**	11,001
Royalties and licence fees	1.2	**34,427**	43,175	**34,427**	43,175
Other revenues	1.2	**28,961**	35,864	**25,453**	31,832
Sale of investments and intellectual property	1.2	**12,094**	1,943	**11,498**	-
Total own-source revenue		**509,961**	487,109	**527,935**	499,142
Gains					
Gain on recognition of assets	1.2	-	66	-	66
Gain/(loss) on foreign exchange- non-speculative	1.2	**117**	(828)	**238**	(746)
Gain/(loss) on revaluation of investment properties	1.2	**2,375**	(1,413)	**2,375**	(1,413)
Gain/(loss) on valuation of equity investments	1.2	**14,660**	-	**(1,497)**	-
Total gains		**17,152**	(2,175)	**1,116**	(2,093)
Total own-source income		**527,113**	484,934	**529,051**	497,049
Net cost of services		**(871,855)**	(862,775)	**(867,356)**	(853,312)
Revenue from Government	1.2	**834,561**	793,549	**834,561**	793,549
Surplus/(deficit)		**(37,294)**	(69,226)	**(32,795)**	(59,763)
OTHER COMPREHENSIVE INCOME					
Items not subject to subsequent reclassification to net cost of services - change in asset revaluation reserves	1.3A	**30,943**	110,554	**30,943**	110,554
Items subject to subsequent reclassification to net cost of services - change in other reserves	1.3B	**(15,256)**	9,853	**(5,982)**	5,617
Total other comprehensive income		**15,687**	120,407	**24,961**	116,171
Total comprehensive income/(loss)		**(21,607)**	51,181	**(7,834)**	56,408
Profit for the year is attributable to:					
Non-controlling interest		**4,316**	-	**-**	-
CSIRO		**(41,610)**	(69,226)	**(32,795)**	(59,763)
Total surplus/(deficit)		**(37,294)**	(69,226)	**(32,795)**	(59,763)
Total comprehensive income for the year is attributable to:					
Non-controlling interest		**4,316**	-	**-**	-
CSIRO		**(25,923)**	51,181	**(7,834)**	56,408
Total comprehensive income/(loss)		**(21,607)**	51,181	**(7,834)**	56,408

The above Statement should be read in conjunction with the accompanying notes.

CONSOLIDATED FINANCIAL STATEMENTS
STATEMENT OF FINANCIAL POSITION
as at 30 June 2019

		Consolidated		CSIRO	
		2019	2018	**2019**	2018
	Notes	**$'000**	$'000	**$'000**	$'000
ASSETS					
Financial Assets					
Cash and cash equivalents		**320,075**	321,647	**198,829**	183,974
Trade and other receivables	2.1A	**76,295**	84,165	**72,486**	80,801
Other investments	2.1B	**145,805**	77,516	**125,335**	98,714
Total financial assets		**542,175**	483,328	**396,650**	363,489
Non-Financial Assets					
Land and buildings	2.2A	**1,564,162**	1,625,607	**1,564,162**	1,625,607
Heritage and cultural	2.2A	**4,463**	4,463	**4,463**	4,463
Plant and equipment	2.2A	**563,342**	548,632	**563,143**	548,296
Intangibles	2.2A	**16,740**	16,573	**16,740**	16,573
Investment properties	2.2B	**52,072**	49,697	**52,072**	49,697
Inventories		**1,265**	1,440	**1,265**	1,440
Other non-financial assets	2.2C	**50,060**	44,295	**50,152**	44,271
Total non-financial assets		**2,252,104**	2,290,707	**2,251,997**	2,290,347
Properties held for sale		**59,200**	5,200	**59,200**	5,200
Total assets		**2,853,479**	2,779,235	**2,707,847**	2,659,036
LIABILITIES					
Payables					
Suppliers	2.3A	**72,519**	83,844	**72,695**	82,112
Other payables	2.3B	**151,602**	142,332	**145,239**	136,361
Total payables		**224,121**	226,176	**217,934**	218,473
Interest Bearing Liabilities					
Finance leases	2.4A	**27,337**	31,968	**27,337**	31,968
Deposits	2.4B	**23,310**	12,315	**27,364**	12,336
Total Interest bearing liabilities		**50,647**	44,283	**54,701**	44,304
Provisions					
Employee provisions	3.1A	**238,498**	218,956	**238,374**	218,774
Provision for remediation		**41,020**	29,815	**41,020**	29,815
Total provisions		**279,518**	248,771	**279,394**	248,589
Total liabilities		**554,286**	519,230	**552,029**	511,366
Net assets		**2,299,193**	2,260,005	**2,155,818**	2,147,670
EQUITY					
Contributed equity		**300,954**	290,954	**300,646**	290,646
Asset revaluation reserves		**1,523,229**	1,492,286	**1,523,229**	1,492,286
Other reserves		**(27)**	15,229	**-**	5,982
Retained surplus		**435,198**	461,536	**331,943**	358,756
Non-controlling interest		**39,839**	-	**-**	-
Total equity		**2,299,193**	2,260,005	**2,155,818**	2,147,670

The above Statement should be read in conjunction with the accompanying notes.

CONSOLIDATED FINANCIAL STATEMENTS
STATEMENT OF CHANGES IN EQUITY – CONSOLIDATED
For the period ended 30 June 2019

	Retained earnings		Asset revaluation reserve		Other reserves		Contributed equity/capital		Non-controlling interest		Total equity	
	2019 $'000	2018 $'000	**2019 $'000**	2018 $'000	**2019 $'000**	2018 $'000	**2019 $'000**	2018 $'000	**2019 $'000**	2018 $'000	**2019 $'000**	2018 $'000
Opening balance	**461,536**	530,762	**1,492,286**	1,381,732	**15,229**	5,376	**290,954**	280,954	**-**	-	**2,260,005**	2,198,824
Comprehensive income												
Other comprehensive income[1]	**15,272**	-	**30,943**	110,554	**(15,256)**	9,853	**-**	-	**-**	-	**30,959**	120,407
Surplus/(deficit) for the period	**(41,610)**	(69,226)	**-**	-	**-**	-	**-**	-	**4,316**	-	**(37,294)**	(69,226)
Total comprehensive income/(loss)	**(26,338)**	(69,226)	**30,943**	110,554	**(15,256)**	9,853	**-**	-	**4,316**	-	**(6,335)**	51,181
Other movements	**-**	-	**-**	-	**-**	-	**-**	-	**-**	-	**-**	-
Contributions by owners												
Equity injection	**-**	-	**-**	-	**-**	-	**10,000**	10,000	**35,523**	-	**45,523**	10,000
Contributions by owners – other	**-**	-	**-**	-	**-**	-	**-**	-	**-**	-	**-**	-
Closing balance	**435,198**	461,536	**1,523,229**	1,492,286	**(27)**	15,229	**300,954**	290,954	**39,839**	-	**2,299,193**	2,260,005

The above Statement should be read in conjunction with the accompanying notes.

1. Refer to Note 1.3.

Accounting Policy

Equity Injections

Amounts that are designated as equity injections for a year are recognised directly in contributed equity in that year.

Non-controlling interests

Non-controlling interests refer to equity in a subsidiary that is not attributable (directly or indirectly) to CSIRO as parent. CSIRO holds a non-controlling interest in the CSIRO Innovation Fund.

CONSOLIDATED FINANCIAL STATEMENTS
STATEMENT OF CHANGES IN EQUITY – CSIRO
For the period ended 30 June 2019

	Retained earnings		Asset revaluation reserve		Other reserves		Contributed equity/capital		Non-controlling interest		Total equity	
	2019 $'000	2018 $'000	**2019 $'000**	2018 $'000	**2019 $'000**	2018 $'000	**2019 $'000**	2018 $'000	**2019 $'000**	2018 $'000	**2019 $'000**	2018 $'000
Opening balance	**358,756**	418,519	**1,492,286**	1,381,732	**5,982**	365	**290,646**	280,646	**-**	-	**2,147,670**	2,081,262
Comprehensive income												
Other comprehensive income[1]	**5,982**	-	**30,943**	110,554	**(5,982)**	5,617	**-**	-	**-**	-	**30,943**	116,171
Surplus/(deficit) for the period	**(32,795)**	(59,763)	**-**	-	**-**	-	**-**	-	**-**	-	**(32,795)**	(59,763)
Total comprehensive income/(loss)	**(26,813)**	(59,763)	**30,943**	110,554	**(5,982)**	5,617	**-**	-	**-**	-	**(1,852)**	56,408
Contributions by owners												
Equity injection	**-**	-	**-**	-	**-**	-	**10,000**	10,000	**-**	-	**10,000**	10,000
Contributions by owners – other	**-**	-	**-**	-	**-**	-	**-**	-	**-**	-	**-**	-
Closing balance	**331,943**	358,756	**1,523,229**	1,492,286	**-**	5,982	**300,646**	290,646	**-**	-	**2,155,818**	2,147,670

The above Statement should be read in conjunction with the accompanying notes.

1. Refer to Note 1.3.

CONSOLIDATED FINANCIAL STATEMENTS
CASH FLOW STATEMENT
For the period ended 30 June 2019

	Consolidated		CSIRO	
	2019	2018	**2019**	2018
	$'000	$'000	**$'000**	$'000
OPERATING ACTIVITIES				
Cash received				
Receipts from Government	**832,641**	793,549	**832,641**	793,549
Sale of goods and rendering of services	**545,055**	502,153	**557,414**	524,053
Interest	**13,841**	9,833	**10,967**	7,468
Net GST received	**17,900**	14,947	**19,031**	17,073
Deposits	**9,329**	7,138	**13,362**	3,992
Total cash received	**1,418,766**	1,327,620	**1,433,415**	1,346,135
Cash used				
Employees	**742,886**	697,537	**739,716**	696,223
Suppliers	**552,049**	486,039	**552,034**	497,370
Finance costs	**1,430**	1,562	**1,403**	1,547
Total cash used	**1,296,365**	1,185,138	**1,293,153**	1,195,140
Net cash from operating activities	**122,401**	142,482	**140,262**	150,995
INVESTING ACTIVITIES				
Cash received				
Proceeds from sales of property, plant and equipment	**967**	5,090	**988**	5,074
Proceeds from sales of equity investments and intellectual property	**6,147**	5,391	**425**	-
Total cash received	**7,114**	10,481	**1,413**	5,074
Cash used				
Purchase of property, plant and equipment	**119,647**	116,631	**119,647**	116,510
Equity investments	**52,250**	18,696	**12,492**	10,800
Other selling costs	**82**	69	**50**	69
Total cash used	**171,979**	135,396	**132,189**	127,379
Net cash used in investing activities	**(164,865)**	(124,915)	**(130,776)**	(122,305)
FINANCING ACTIVITIES				
Cash received				
Contributed equity	**45,523**	10,000	**10,000**	10,000
Total cash received	**45,523**	10,000	**10,000**	10,000
Cash used				
Finance leases	**4,631**	5,787	**4,631**	5,787
Total cash used	**4,631**	5,787	**4,631**	5,787
Net cash from financing activities	**40,892**	4,213	**5,369**	4,213
Net increase (decrease) in cash held	**(1,572)**	21,780	**14,855**	32,903
Cash and cash equivalents at the beginning of the reporting period	**321,647**	299,867	**183,974**	151,071
Cash and cash equivalents at the end of the reporting period	**320,075**	321,647	**198,829**	183,974

The above Statement should be read in conjunction with the accompanying notes.

CONSOLIDATED FINANCIAL STATEMENTS
NOTES TO AND FORMING PART OF THE FINANCIAL STATEMENTS

CONSOLIDATED FINANCIAL STATEMENTS
NOTES TO AND FORMING PART OF THE FINANCIAL STATEMENTS
Overview

Objectives of the CSIRO and its Subsidiaries (the Group)

CSIRO is an Australian Government controlled not-for-profit entity and is classified as a Corporate Commonwealth entity under the *Public Governance, Performance and Accountability Act 2013*. CSIRO is a research enterprise that aims to deliver great science and innovative solutions for industry, society and the environment.

CSIRO is structured to meet the following outcome:

> Innovative scientific and technology solutions to national challenges and opportunities to benefit industry, the environment and the community, through scientific research and capability development, services and advice.

The continued existence of CSIRO in its present form and with its present programs is dependent on Government policy and on continued funding by Parliament for CSIRO's administration and programs.

The Basis of Preparation

The financial statements are required by section 42 of the *Public Governance, Performance and Accountability Act 2013* and are general purpose financial statements.

CSIRO and the Group's Consolidated Financial Statements have been prepared in accordance with:

- *Public Governance, Performance and Accountability (Financial Reporting Rule) 2015* (FRR) for reporting periods ending on or after 1 July 2015; and
- *Australian Accounting Standards and Interpretations – Reduced Disclosure Requirements* issued by the Australian Accounting Standards Board (AASB) that apply for the reporting period

The financial statements have been prepared on an accrual basis and in accordance with the historical cost convention, except for certain assets and liabilities at fair value. Except where stated, no allowance is made for the effect of changing prices on the results or the financial position.

The financial statements are presented in Australian dollars and values are rounded to the nearest thousand dollars unless otherwise specified.

Key Judgements and Estimates

In the process of applying the Group's accounting policies, management has made a number of judgements and applied estimates and assumptions to future events. Information around judgements and estimates which are material to the financial statements are found in the following notes:

- Note 3.1 Employee Provisions
- Note 4.3 Fair Value Measurement

CSIRO has a provision (under provisions) for remediation costs required at a remote and other CSIRO locations, based on estimates provided by internal and external qualified experts. The provision is predominantly based on externally provided costings, with additional amounts derived from comparable remediation works. The provision is based on the scope of work as it currently stands as at 30 June 2019. As remediation works progress, the scope and costs may be subject to change. The work is expected to take several years to reach completion. Provisions for remediation also includes a provision for the makegood costs at leased CSIRO sites which is based on rates provided by an expert valuer.

Consolidation

The consolidated financial statements comprise the financial statements of the CSIRO and its subsidiaries (referred to as 'the Group'). The subsidiaries of CSIRO are the Science and Industry Endowment Fund (SIEF), the CSIRO Chile Research Fundación (Fundación), National ICT Australia (NICTA), the Innovation Fund (ten entities) and the US Office (2 entities). WLAN Services Pty Ltd (WLAN) was deregistered in 2019. Refer to Note 3.6 for further information.

CONSOLIDATED FINANCIAL STATEMENTS
NOTES TO AND FORMING PART OF THE FINANCIAL STATEMENTS

The consolidated financial statements incorporate the assets and liabilities of all entities controlled by CSIRO as at 30 June 2019 and the results of the controlled entities for the year then ended. Subsidiaries are consolidated from the date on which control is obtained through to the date on which control ceases. The Group applies consistent accounting policies and the effects of all transactions and balances between the entities are eliminated in full.

Non-controlling interest in the results and equity of subsidiaries are shown separately in the statement of profit or loss and other comprehensive income, statement of financial position and statement of changes in equity of the consolidated Group.

Foreign Currency Translation

The functional currency of CSIRO and its Australian subsidiaries is Australian dollars. The Group has three overseas subsidiary entities, the Fundación and the US Office entities. On consolidation, those entities:

- Assets and liabilities are translated into Australian dollars at the rate of exchange prevailing at the reporting date; and
- The statement of comprehensive income is translated at average exchange rate.

The exchange rate differences arising are recognised in the net cost of services.

New Australian Accounting Standards

Adoption of new Australian Accounting Standard requirements

AASB 9 Financial Instruments came into effect in 2018-19 (refer to notes 1.3 and 4.2 for further disclosure on the transition). No Accounting Standard has been adopted earlier than the application date as stated in the standard. CSIRO has reviewed new standards, revised standards and interpretations/amending standards issued prior to the signing of the financial statements and considers that none of these have had a material financial impact.

Future Australian Accounting Standard requirements

No new or revised pronouncements that were issued by the Australian Accounting Standards Board prior to the finalisation of the financial statements are expected to have a material financial impact on the entity in future reporting periods. The following new or revised standards will be adopted and their implementation will require enhanced disclosure in future reporting periods:

Standard	Effective for reporting periods beginning on or after:	Nature of impending changes and likely impact on application
AASB 15 Revenue from Contracts with Customers	1 January 2019	Specifies the accounting treatment of revenue arising from contracts with customers. CSIRO considers this will have minimal impact.
AASB 16 Leases	1 January 2019	Moderate impact as a new accounting standard which requires assessment of all operating and finance leases.

Taxation

In accordance with Section 53 of the *Science and Industry Research Act 1949*, CSIRO is exempt from all forms of Australian taxation except the fringe benefits tax (FBT) and the goods and services tax (GST). The Group pays applicable taxes in overseas countries.

Revenues, expenses, assets and liabilities are recognised net of GST except:

- where the amount of GST incurred is not recoverable from the Australian Taxation Office; and
- for receivables and payables.

The SIEF is exempt from income tax in Australia. WLAN and the Innovation Fund entities are subject to all applicable taxes in Australia. The Fundación is subject to all applicable taxes in Chile. The US Office is subject to taxes in the United States. NICTA is exempt from income tax however NICTA's subsidiaries (including NICTA IPR Pty Ltd) are subject to applicable taxes in Australia.

Events after the Reporting Period

At the time of completion of these financial statements, the Group is not aware of any significant events occurring after the reporting date.

Future Events

CSIRO is exploring future commercial opportunities for the Ginninderra Field Station, a 701 hectare area of land which CSIRO owns in north Canberra. Due to rapid urban growth in the surrounding area, the site has become under-utilised and the field station requires relocation to a more rural setting. As part of its focus on exploring the future possibilities for this site, CSIRO has successfully requested the National Capital Authority (NCA) to include the site as 'Urban Area' on the General Policy Plan for Metropolitan Canberra in the National Capital Plan draft Amendment 86. The Amendment became effective in November 2016.

This initial step in rezoning the land has allowed CSIRO to commence a process to identify a suitable development partner to progress with the next steps in the planning for the future of the site which will involve ongoing significant community and stakeholder consultation. As this progresses, it is expected that there will be a material increase in the recorded value of the Ginninderra land.

CONSOLIDATED FINANCIAL STATEMENTS
NOTES TO AND FORMING PART OF THE FINANCIAL STATEMENTS

1. Financial Performance

This section analyses the financial performance of CSIRO for the year ended 30 June 2019.

1.1. Expenses

	Consolidated		CSIRO	
	2019	2018	**2019**	2018
	$'000	$'000	**$'000**	$'000
Note 1.1A: Employee Benefits				
Wages and salaries	**563,969**	528,356	**561,042**	527,117
Superannuation	**96,177**	92,215	**96,045**	92,140
Leave and other entitlements	**111,294**	88,263	**111,213**	88,170
Separation and redundancies	**(4)**	(2,135)	**(4)**	(2,135)
Gross employee benefits	**771,436**	706,699	**768,296**	705,292
Less				
Capitalised labour	**(6,403)**	(7,014)	**(6,403)**	(7,014)
Employee cost recovery from subsidiary companies	**(1,864)**	(390)	**(1,864)**	(390)
Total employee benefits	**763,169**	699,295	**760,029**	697,888

Accounting Policy

Accounting policy for employee related expenses is contained in the People and Relationships section.

Note 1.1B: Suppliers				
Goods supplied	**103,314**	103,154	**102,827**	102,709
Services rendered	**336,828**	299,249	**338,568**	304,726
Total goods and services supplied or rendered	**440,142**	402,403	**441,395**	407,435
Other suppliers				
Property lease rental	**33,896**	29,314	**33,429**	28,966
Other operating lease rentals	**5,631**	5,416	**5,631**	5,416
Workers compensation expenses	**3,285**	6,020	**3,263**	5,973
Total other suppliers	**42,812**	40,750	**42,323**	40,355
Total Suppliers	**482,954**	443,153	**483,718**	447,790

Leasing commitments

The CSIRO in its capacity as lessee has the following commitments that arise from effectively non-cancellable operating leases:

1. Office and Scientific Research Accommodation - Lease payments are subject to annual increases in accordance with the terms of the agreement (such as CPI increases). The accommodation leases are current and each may be renewed at the Group's option.
2. Motor Vehicles - No contingent rentals exist and there are no purchases options for vehicle leases.
3. Computer Equipment - Provision of computer equipment as designated necessary in the supply contract for a general period of 2-3 years.

Commitments below are stated inclusive of GST.

Commitments for minimum lease payments in relation to non-cancellable operating leases are payable as follows:

Within 1 year	**44,292**	38,614	**43,715**	38,029
Between 1 to 5 years	**76,587**	100,152	**75,972**	99,300
More than 5 years	**11,728**	18,060	**11,728**	18,060
Total operating lease commitments	**132,607**	156,826	**131,415**	155,389

Accounting Policy

Research and Development Expenditure and Intellectual Property

All research and development costs, including costs associated with protecting intellectual property (e.g. patents and trademarks), are expensed as incurred.

Leases

A distinction is made between finance leases and operating leases. Finance leases effectively transfer from the lessor to the lessee substantially all the risks and rewards incidental to ownership of leased assets. An operating lease is a lease that is not a finance lease. In operating leases, the lessor effectively retains all such risks and benefits.

Where an asset is acquired by means of a finance lease, the asset is capitalised at either the fair value of the lease or, if lower, the present value of minimum lease payments at the inception of the contract and a liability recognised at the same time and for the same amount.

The discount rate used is the interest rate implicit in the lease. Leased assets are amortised over the period of the lease. Lease payments are allocated between the principal component and the interest expense.

Operating lease payments are expensed on a straight-line basis which is representative of the pattern of benefits derived from the leased assets.

	Consolidated		CSIRO	
	2019	2018	**2019**	2018
	$'000	$'000	**$'000**	$'000
Note 1.1C: Impairment loss on financial instruments				
Asset write-downs and impairments from:				
Bad debts written off	**925**	52	**925**	52
Allowance for impairment of trade and other receivables	**(389)**	632	**(389)**	632
Net realisation of fair value loss reserve on available for sale investments	**-**	409	**-**	-
Total write-downs and impairments on financial instruments	**536**	1,093	**536**	684
Note 1.1D: Write-down and impairment of other assets				
Asset write-downs and impairments from:				
Property, plant and equipment	**13**	5,910	**13**	5,910
Total write-down and impairment of other assets	**13**	5,910	**13**	5,910

CONSOLIDATED FINANCIAL STATEMENTS
NOTES TO AND FORMING PART OF THE FINANCIAL STATEMENTS

1.2. Revenue and Gains

	Consolidated		CSIRO	
	2019	2018	**2019**	2018
	$'000	$'000	**$'000**	$'000
Revenues from Government	**834,561**	793,549	**834,561**	793,549
Sale of goods	**12,741**	10,593	**12,741**	10,593
Rendering of services	**397,691**	373,961	**422,734**	394,597
Total sale of goods and rendering of services	**410,432**	384,554	**435,475**	405,190
Bank and term deposits interest	**13,501**	10,572	**10,536**	7,944
Rental Income	**10,546**	11,001	**10,546**	11,001
Royalties and licence fees	**34,427**	43,175	**34,427**	43,175
Sale of investments and intellectual property	**12,094**	1,943	**11,498**	-
Total interest, rental, royalties and licence income	**70,568**	66,691	**67,007**	62,120
Other revenues				
Sale of primary produce	**1,989**	1,916	**1,989**	1,916
Donation	**916**	22	**916**	22
Capital contributions	**12,587**	17,263	**13,805**	17,263
Education programs and subscriptions	**347**	513	**347**	513
Other	**13,122**	16,150	**8,396**	12,118
Total other revenues	**28,961**	35,864	**25,453**	31,832
Total own-source revenue	**509,961**	487,109	**527,935**	499,142
Gain on recognition of assets	**-**	66	**-**	66
Gain/(loss) on foreign exchange- non-speculative	**117**	(828)	**238**	(746)
Gain/(loss) on revaluation of investment properties	**2,375**	(1,413)	**2,375**	(1,413)
Gain/(loss) on revaluation of equity investments	**14,660**	-	**(1,497)**	-
Total own-source revenue including gains	**527,113**	484,934	**529,051**	497,049

Leasing - Rental Income Commitments

CSIRO has commitments receivable for the sub leasing areas of office and scientific research accommodation to external parties. The commitments below are shown at their GST inclusive amounts:

Within 1 year	**3,660**	3,549	**3,660**	3,549
Between 1 to 5 years	**5,663**	5,401	**5,663**	5,401
More than 5 years	**4,030**	3,846	**4,030**	3,846
Total lease commitments receivable	**13,353**	12,796	**13,353**	12,796

Accounting Policy

Sale of Goods and Services Revenue

Revenue from sale of goods is recognised when the risks and rewards of ownership have been transferred to the buyer; the entity retains no managerial involvement or effective control over the goods; the revenue and transaction costs incurred can be reliably measured; and it is probable that the economic benefits associated with the transaction will flow to CSIRO. Revenue from rendering of services is recognised by reference to the stage of completion of contracts at the reporting date. The revenue is recognised when: the amount of revenue, stage of completion and transaction costs incurred can be reliably measured; and it is probable that the economic benefits associated with the transaction will flow to CSIRO.

The stage of completion of contracts at the reporting date is determined by reference to the estimated progress of the contracted deliverables to date. The balances of contract research and development activities in progress are accounted as either contract research work in progress (Note 2.2C), being the gross unbilled amount expected to be collected from clients for contract research and services performed as at 30 June 2019, or contract research revenue received in advance (Note 2.3B), where revenue for contract research and services received and/or billed exceeded revenue earned.

Interest Revenue

Interest revenue is recognised using the effective interest method as set out in *AASB 9 Financial Instruments*.

Royalties and License Fees

Royalties and licence revenue are recognised on an accrual basis in accordance with the substance of the relevant royalty agreements. Revenue from legal settlements related to intellectual property is recognised on an accrual basis in accordance with the substance of the relevant licensing agreements.

Revenues from Government

Funding received from the Australian Government Department of Industry and Science (appropriated to CSIRO as a corporate Commonwealth entity payment item) is recognised as Revenue from Government unless it is in the nature of an equity injection or a loan.

Other Revenue

Other revenues includes sale of CSIRO publications and products, conferences and 'pass through' funding for costs of suppliers and external service providers.

Resources Received Free of Charge

Resources received free of charge are recognised as either revenue or gains depending on their nature. They are recorded as revenue when, and only when, the fair value can be reliably determined and the services would have been purchased if they had not been donated. Use of those resources is recognised as an expense. Contributions of assets at no cost of acquisition or for nominal consideration are recognised as gains at their fair value when the asset qualifies for recognition, unless received from another Government agency or authority as a consequence of a restructuring of administrative arrangements.

Sale of Assets

Gains from disposal of non-current assets are recognised when control of the asset has passed to the buyer.

1.3. Other Comprehensive Income

	Consolidated		CSIRO	
	2019	2018	**2019**	2018
	$'000	$'000	**$'000**	$'000
Items that will not be classified to income or loss				
Note 1.3A: Changes in asset revaluation reserves				
Revaluation of land and buildings	**-**	110,297	**-**	110,297
Revaluation of plant and equipment	**30,943**	-	**30,943**	-
Revaluation of heritage and cultural assets	**-**	257	**-**	257
Net increase/(decrease) in asset revaluation reserves	**30,943**	110,554	**30,943**	110,554
Items that may be reclassified to income and loss				
Note 1.3B: Change in other reserve				
Net change in fair value of equity investments	**(15,272)**	9,861	**(5,982)**	5,617
Net change arising from foreign exchange movements on conversion of subsidiary accounts	**16**	(8)	**-**	-
Net increase/(decrease) in other reserve	**(15,256)**	9,853	**(5,982)**	5,617

Accounting Policy

Reserves for equity valuation

Under *AASB 139 Financial Instruments: Recognition and Measurement*, CSIRO's investment portfolio were classified as available for sale assets and fair value movements treated through other comprehensive income. Under the new standard, *AASB 9 Financial Instruments*, CSIRO's equity investment portfolio are treated as Fair Value through Profit and Loss and the Innovation Fund investment treated as Fair Value through Other Comprehensive Income (refer Note 4.2 and 4.3). On transition at 1 July 2018, the reserve relating to the CSIRO equity portfolio was moved to retained earnings.

2. Financial Position

This section analyses CSIRO's assets used to generate financial performance and the operating liabilities incurred as a result. Employee related information is disclosed in the People and Relationships section.

2.1. Financial Assets

	Consolidated		CSIRO	
	2019	2018	**2019**	2018
	$'000	$'000	**$'000**	$'000
Note 2.1A: Trade and other receivables				
Goods and services	**65,729**	74,406	**65,269**	73,951
Statutory receivables	**5,764**	4,755	**4,311**	4,433
Interest	**1,282**	1,622	**488**	919
Other receivables	**3,965**	4,216	**2,863**	2,332
Total trade and other receivables (gross)	**76,740**	84,999	**72,931**	81,635
Less: impairment loss allowance for trade and other receivables	**(445)**	(834)	**(445)**	(834)
Total trade and other receivables (net)	**76,295**	84,165	**72,486**	80,801
Trade and other receivables (gross) aged as follows				
Not overdue	**61,763**	73,154	**57,954**	73,159
Overdue by				
0 to 30 days	**11,790**	8,628	**11,790**	5,259
31 to 60 days	**1,126**	1,391	**1,126**	1,391
61 to 90 days	**770**	500	**770**	500
More than 90 days	**1,291**	1,326	**1,291**	1,326
Total receivables (gross)	**76,740**	84,999	**72,931**	81,635
Reconciliation of impairment loss allowance				
Opening balance	**834**	202	**834**	202
Increase /(decrease) recognised in net surplus	**(389)**	632	**(389)**	632
Closing balance	**445**	834	**445**	834

Accounting Policy

Loans and Receivables

Receivables for goods and services, which have 30 day terms, are recognised at the nominal amounts due less any impairment allowance. Collectability of debts is reviewed on an ongoing basis and allowances are made when collectability of the debt is no longer probable. All trade and other receivables are expected to be recovered in no more than 12 months.

Impairment of Financial Assets

Financial assets are assessed for impairment at the end of each reporting period. Where there is objective evidence that an impairment loss has been incurred for loans and receivables, the amount of the loss is measured as the difference between the asset's carrying amount and the present value of estimated future cash flows discounted at the asset's original effective interest rate. The carrying amount is reduced by way of an allowance account. The loss is recognised in the Statement of Comprehensive Income.

Note 2.1B: Other Investments				
Listed companies	**9,188**	5,846	**9,188**	5,846
Unlisted companies	**57,236**	42,258	**46,735**	32,677
Innovation Fund	**70,472**	20,021	**60,503**	50,800
Uniseed Investment	**8,909**	9,391	**8,909**	9,391
Total investments	**145,805**	77,516	**125,335**	98,714

Accounting Policy

CSIRO has investments in a number of unlisted start-up companies over which it does not have significant influence or control. These companies have been established for the purpose of commercialisation of CSIRO's intellectual property. CSIRO also has some investments in companies which have been listed on the Australian Stock Exchange and in the Uniseed trust. CSIRO, as part of the National Innovation and Science Agenda, has also established and invested in an Innovation Fund to invest in the development of early stage technology opportunities. Refer to Note 3.6 Related Parties for more information.

CSIRO's other investments are accounted for in accordance with *AASB 9 Financial Instruments* and *AASB 10 Consolidated Financial Statements*. See note 4.2 and 4.3 for further information.

CONSOLIDATED FINANCIAL STATEMENTS
NOTES TO AND FORMING PART OF THE FINANCIAL STATEMENTS

2.2. Non-Financial Assets

Note 2.2A: Reconciliation of the opening and closing balances of Land and Buildings, Plant and Equipment and Intangibles

(a) Reconciliation of the opening and closing balances of Land and Buildings, Plant and Equipment and Intangibles for 2019 - Consolidated

	Land	Buildings	Total land and buildings	Plant and equipment	Heritage and cultural	Intangibles	Total
	$'000	$'000	$'000	$'000	$'000	$'000	$'000
As at 1 July 2018							
Gross book value	440,600	2,613,649	3,054,249	1,149,408	13,997	53,585	4,271,239
Accumulated depreciation and amortisation	-	(1,428,642)	(1,428,642)	(600,776)	(9,534)	(37,012)	(2,075,964)
Net book value as at 1 July 2018	440,600	1,185,007	1,625,607	548,632	4,463	16,573	2,195,275
Additions	-	61,959	61,959	65,860	-	466	128,285
Reclassification	(54,000)	(6)	(54,006)	(2,308)	-	2,314	(54,000)
Revaluations recognised in other comprehensive income	-	-	-	30,943	-	-	30,943
Impairments recognised in net cost of services	-	-	-	(13)	-	-	(13)
Depreciation expense	-	(69,372)	(69,372)	(76,034)	-	(2,613)	(148,019)
Disposals	-	(26)	(26)	(3,738)	-	-	(3,764)
Other movements	-	-	-	-	-	-	-
Net book value as at 30 June 2019	386,600	1,177,562	1,564,162	563,342	4,463	16,740	2,148,707
Net book value as at 30 June 2019 represented by:							
Gross book value	386,600	2,674,812	3,061,412	1,294,098	13,997	56,366	4,425,873
Accumulated depreciation and amortisation	-	(1,497,250)	(1,497,250)	(730,756)	(9,534)	(39,626)	(2,277,166)
Total as at 30 June 2019	386,600	1,177,562	1,564,162	563,342	4,463	16,740	2,148,707

(b) Reconciliation of the opening and closing balances of Land and Buildings, Plant and Equipment and Intangibles for 2019 - CSIRO

	Land	Buildings	Total land and buildings	Plant and equipment	Heritage and cultural	Intangibles	Total
	$'000	$'000	$'000	$'000	$'000	$'000	$'000
As at 1 July 2018							
Gross book value	440,600	2,613,649	3,054,249	1,148,590	13,997	53,585	4,270,421
Accumulated depreciation and amortisation	-	(1,428,642)	(1,428,642)	(600,294)	(9,534)	(37,012)	(2,075,482)
Net book value as at 1 July 2018	440,600	1,185,007	1,625,607	548,296	4,463	16,573	2,194,939
Additions	-	61,959	61,959	65,860	-	466	128,285
Reclassification	(54,000)	(6)	(54,006)	(2,308)	-	2,314	(54,000)
Revaluations recognised in other comprehensive income	-	-	-	30,943	-	-	30,943
Impairments recognised in net cost of services	-	-	-	(13)	-	-	(13)
Depreciation expense	-	(69,372)	(69,372)	(75,876)	-	(2,613)	(147,861)
Disposals	-	(26)	(26)	(3,759)	-	-	(3,785)
Other movements	-	-	-	-	-	-	-
Net book value as at 30 June 2019	386,600	1,177,562	1,564,162	563,143	4,463	16,740	2,148,508
Net book value as at 30 June 2019 represented by:							
Gross book value	386,600	2,674,812	3,061,412	1,293,251	13,997	56,366	4,425,026
Accumulated depreciation and amortisation	-	(1,497,250)	(1,497,250)	(730,108)	(9,534)	(39,626)	(2,276,518)
Total as at 30 June 2019	386,600	1,177,562	1,564,162	563,143	4,463	16,740	2,148,508

	Consolidated		CSIRO	
	2019	2018	**2019**	2018
	$'000	$'000	**$'000**	$'000
Contractual commitments for fixed assets:				
Capital commitments comprise outstanding payments for buildings under construction and commitments for purchase of plant and equipment. Commitments are reported inclusive of GST.				
Land and buildings	**15,797**	28,141	**15,797**	28,141
Plant and equipment	**4,170**	8,199	**4,170**	8,199
Total commitments payable	**19,967**	36,340	**19,967**	36,340
Within 1 year	**18,535**	36,166	**18,535**	36,166
Between 1 to 5 years	**1,432**	174	**1,432**	174
More than 5 years	**-**	-	**-**	-
Total commitments payable	**19,967**	36,340	**19,967**	36,340

Accounting Policy

Acquisition of Assets

Assets are recorded at cost on acquisition except as stated below. The cost of acquisition includes the fair value of assets transferred in exchange and liabilities undertaken. Financial assets are initially measured at their fair value plus transaction costs where appropriate.

Assets acquired at no cost or for nominal considerations are initially recognised as assets and revenues at their fair value at the date of acquisition. Property, plant and equipment which are purchased from contract research funds and where the control and subsequent sale proceeds are refunded to contributors under the terms of the agreements, are expensed during the year of purchase.

Asset Recognition Threshold

Purchases of property, plant and equipment are recognised initially at cost in the Statement of Financial Position, except for purchases costing less than $5,000, which are expensed in the year of acquisition (other than where they form part of a group of similar items which are significant in total).

Revaluations

Following initial recognition at cost, property, plant and equipment, including assets under finance leases are carried at fair value less accumulated depreciation and accumulated impairment losses. Valuations are conducted with sufficient frequency to ensure the carrying amount of assets do not differ materially from the assets' fair value as at reporting date. The regularity of valuation depends upon the volatility of movements in the market values for the relevant assets.

Revaluation adjustments are made on a class basis. Any revaluation increment is credited to equity under asset revaluation reserve, except to the extent that it reverses a previous revaluation decrement of the same asset class that was previously recognised in the surplus or deficit. Revaluation decrements for a class of assets are recognised directly through the statement of comprehensive income except to the extent that they reverse a previous revaluation increment for that class.

Any accumulated depreciation as at the revaluation date is restated proportionately with the change in the gross carrying amount of the asset so that the carrying amount of the asset after revaluation equals its revalued amount.

Fair value for each class of asset is determined as follows:

- Land, which will continue to be used for research activity, is valued by independent valuers at fair value (highest and best use). Highest and best use is determined from the perspective of market participants. An entity's current use of a non-financial asset is presumed to be its highest and best use unless market or other factors suggest otherwise. Land underwent a full revaluation as at 30 June 2018 by Jones Lang LaSalle (JLL).
- Buildings and leasehold improvements, which will continue to be used for research activities, are valued by independent valuers at fair value (highest and best use). Building valuations include plant, fit-outs, fixtures and fittings, which form an integral part of buildings. Buildings underwent a full revaluation as at 30 June 2018 by JLL.
- Plant and equipment which will continue to be used for research activities are valued by independent valuers at fair value (highest and best use). Plant and equipment assets were revalued as at 30 June 2019 by JLL.
- Properties held for sale are valued at the lower of its carrying amount and fair value less costs to sell. An assessment is undertaken annually of any properties held for sale.
- Heritage and cultural assets are valued by independent valuers at their depreciated replacement cost. Heritage assets underwent a full revaluation as at 30 June 2018 by JLL.

Depreciation and Amortisation

Depreciable property, plant and equipment assets are written-off to their estimated residual values over their estimated useful lives using, in all cases, the straight-line method of depreciation. Leasehold improvements are depreciated on a straight-line basis over the lesser of the estimated useful life of the improvements or the unexpired period of the lease. Land is not depreciated.

Depreciation/amortisation rates (useful lives), residual values and methods are reviewed at each reporting date and necessary adjustments are recognised in the current, or current and future reporting periods, as appropriate.

Depreciation rates applying to each class of depreciable asset are based on the following useful lives:

Buildings on freehold land	40 to 80 years
Leasehold improvements	Lease term
Buildings under finance lease	Lease term
Passenger vehicles	7 years
Agricultural and transport equipment	8 to 20 years
Computing equipment	2 to 5 years
Scientific equipment	5 to 20 years
Furniture and office equipment	5 to 15 years
Workshop equipment	20 to 25 years
Research vessel	25 years
Australia telescope	15 to 58 years
Heritage and cultural assets	Indefinite

Impairment

All assets were assessed for impairment as at 30 June 2019. Where indications of impairment exist, the asset's recoverable amount is estimated and an impairment adjustment made if the asset's recoverable amount is less than its carrying amount.

The recoverable amount of an asset is the higher of its fair value less costs to sell and its value in use. Value in use is the present value of the future cash flows expected to be derived from the asset. Where the future economic benefit of an asset is not primarily dependent on the asset's ability to generate future cash flows, and the asset would be replaced if the entity were deprived of the asset, its value in use is taken to be its depreciated replacement cost.

Derecognition

An item of property, plant and equipment is derecognised upon disposal or when no further future economic benefits are expected from its use or disposal.

Heritage and Cultural Assets

Heritage and cultural items include buildings of historical or cultural significance. CSIRO has classified them as heritage and cultural assets as they are primarily used for purposes that relate to their cultural significance and original purpose. Heritage and cultural assets are stored and managed in ways to preserve their heritage and cultural value over time. Where conservation and preservation activities, specified in an asset's Heritage Management Plan, demonstrate that an asset will be maintained for an indefinite period, these items are considered to have indefinite useful lives and therefore, not subject to depreciation. Copies of the Heritage Management Plans may be obtained by contacting enquiries@csiro.au.

Intangibles

Intangibles are internally developed and acquired software for internal use. These assets are carried at cost, less accumulated amortisation and impairment losses, except where the estimated cost of software is less than the $250,000 threshold and expensed in the year of acquisition. Software are amortised on a straight-line basis over their anticipated useful lives. The useful lives are 2 to 10 years (2018: 2 to 10 years). All software assets were assessed for indications of impairment as at 30 June 2019.

CSIRO does not recognise its internally generated intellectual property as an asset on the Balance Sheet as it does not meet the recognition and measurement requirements under *AASB* 138 *Intangible Assets*. CSIRO's Intellectual property includes patents, inventions, trademarks, plant breeder's rights and registered designs.

Properties Held for Sale

Properties which are expected to be recovered primarily through sale rather than through continuing use are classified as 'properties held for sale'. Immediately before classification, the properties are remeasured in accordance with the Group's accounting policies. Thereafter, at reporting date the properties are measured at the lower of their carrying amount and fair value less cost to sell.

Impairment losses on initial classification as held for sale and subsequent gains or losses on re-measurement are recognised in the Statement of Comprehensive Income.

	Consolidated		CSIRO	
	2019	2018	**2019**	2018
	$'000	$'000	**$'000**	$'000
Note 2.2B: Investment properties				
Reconciliation of the opening and closing balances of investment properties				
As at 1 July	**49,697**	51,110	**49,697**	51,110
Net gain/(loss) from fair value adjustments	**2,375**	(1,413)	**2,375**	(1,413)
Total as at 30 June	**52,072**	49,697	**52,072**	49,697

Commitments from investment properties:

Commitments comprise rental income receivable from CSIRO's investment properties. The commitments below are shown at their GST inclusive amounts:

Within 1 year	**4,034**	3,701	**4,034**	3,701
Between 1 to 5 years	**990**	825	**990**	825
More than 5 years	**-**	-	**-**	-
Total commitment receivable	**5,024**	4,526	**5,024**	4,526

No indicators of impairment were identified for investment properties.

Accounting Policy

Investment properties are recorded at their fair value, which is assessed annually by independent valuers. Investment properties were valued as at 30 June 2019 by JLL. Revaluation increments are recorded as a gain or loss in the Statements of Comprehensive Income as disclosed in Note 1.2. Rental income from investment properties is included in the rental income disclosed in Note 1.2 and was $3.6m for 2019 (2018:$3.2m). Operating costs that are recoverable amounted to $1.1m (2018: $1.0m)

Note 2.2C: Other non-financial assets				
Contract research work in progress - at cost	**30,413**	29,253	**30,413**	29,253
Other prepayments	**19,647**	15,042	**19,739**	15,018
Total other non-financial assets	**50,060**	44,295	**50,152**	44,271

No indicators of impairment were identified for other non-financial assets.

Accounting Policy

Accounting policy for contract research work in progress is contained in Note 1.2.

2.3. Payables

	Consolidated		CSIRO	
	2019	2018	**2019**	2018
	$'000	$'000	**$'000**	$'000
Note 2.3A: Suppliers				
Suppliers payable	**72,519**	83,844	**72,695**	82,112
Total	**72,519**	83,844	**72,695**	82,112

Settlement is usually made within 30 days, but all supplier payables are expected to be settled within 12 months.

Note 2.3B: Other Payables				
Accrued salaries and wages	**7,195**	6,380	**7,167**	6,380
Contract research revenue received in advance	**131,008**	118,268	**131,008**	118,268
Other revenue received in advance	**5,294**	8,936	**6,728**	9,616
Other creditors and accrued expenses	**8,105**	8,748	**336**	2,097
Total other payables	**151,602**	142,332	**145,239**	136,361

Accounting Policy

Accounting policy for contract revenue received in advance is contained in Note 1.2.

2.4. Interest Bearing Liabilities

	Consolidated		CSIRO	
	2019	2018	**2019**	2018
	$'000	$'000	**$'000**	$'000
Note 2.4A: Finance Leases				
Lease payments are expected to be settled:				
Within one year				
Minimum lease payments	**5,016**	5,567	**5,016**	5,567
Deduct: future finance charges	**(1,322)**	(1,566)	**(1,322)**	(1,566)
Total payable within one year (current)	**3,694**	4,001	**3,694**	4,001
In one to five years				
Minimum lease payments	**21,902**	24,680	**21,902**	24,680
Deduct: future finance charges	**(2,837)**	(3,911)	**(2,837)**	(3,911)
Total payable within one to five years	**19,065**	20,769	**19,065**	20,769
In more than five years				
Minimum lease payments	**5,120**	8,177	**5,120**	8,177
Deduct: future finance charges	**(542)**	(979)	**(542)**	(979)
Total payable in more than five years	**4,578**	7,198	**4,578**	7,198
Total finance lease liability recognised on the Statement of Financial Position	**27,337**	31,968	**27,337**	31,968

Accounting Policy

Finance leases exist in relation to certain buildings and major equipment assets. The leases are non-cancellable and for fixed terms ranging from 17 to 25 years. CSIRO guarantees the residual values of all assets leased. There are no contingent rentals. The interest rate implicit in the leases averaged 5% per annum (2018: 5% per annum). The lease liabilities are secured by the lease assets. Accounting policies for leases is contained in Note 1.1B.

Note 2.4B: Deposits

Deposits represent monies held on behalf of third parties. If the amounts are not spent for their specified purpose they will be returned to the third party.

Total deposits held are:	**23,310**	12,315	**27,364**	12,336

3. People and Relationships

This section describes a range of employment and post employment benefits provided to our people and our relationship with other key people.

3.1. Employee Provisions

	Consolidated		CSIRO	
	2019	2018	**2019**	2018
	$'000	$'000	**$'000**	$'000
Note 3.1A: Employee Provisions				
Annual leave	**61,274**	58,639	**61,150**	58,457
Long service leave	**167,810**	141,990	**167,810**	141,990
Severance pay	**7,419**	6,523	**7,419**	6,523
Redundancies	**1,995**	11,804	**1,995**	11,804
Total employee provisions	**238,498**	218,956	**238,374**	218,774

Accounting Policy

Liabilities for short-term employee benefits (as defined in *AASB 119 Employee Benefits*) and termination benefits due within twelve months of the end of the reporting period are measured at their nominal amounts. The nominal amount is calculated with regard to the rate expected to be paid on settlement of the liability.

Other long-term employee benefit liabilities are measured at the present value of the estimated future cash outflows to be made in respect of services provided by employees up to the reporting date.

Leave

The liability for employee benefits includes provisions for annual leave, long service leave and severance payments. No provision has been made for sick leave as all sick leave is non-vesting and the average sick leave taken in future years by employees is estimated to be less than the annual entitlement for sick leave.

The leave liabilities are calculated on the basis of employees' remuneration at the estimated salary rates that will apply at the time the leave is taken, including the employer superannuation contribution rates to the extent that the leave is likely to be taken during service rather than paid out on termination.

The liability at 30 June 2019 for long service leave and annual leave has been determined by the short hand method and reference to the work of the Australian Government Actuary (AGA). The estimate of the present value of the liability takes into account attrition rates and pay increases through promotion and inflation.

Separation and Redundancy

Provision is made for separation and redundancy benefit payments. A CSIRO plan of termination is binding when the following criteria are met:

- actions required to complete the plan indicate that it is unlikely that significant changes to the plan will be made;
- the plan identifies the number of employees whose employment is to be terminated; and
- the plan established the termination benefits that employees will receive.

Superannuation

Employees of CSIRO are members of the Commonwealth Superannuation Scheme (CSS), the Public Sector Superannuation Scheme (PSS), or the PSS accumulation plan (PSSap). The CSS and PSS are defined benefit schemes for the Australian Government. The PSSap is a defined contribution scheme.

The liability for defined benefits is recognised in the financial statements of the Australian Government and is settled by the Australian Government in due course. This liability is reported by the Department of Finance as an administered item.

CSIRO makes employer contributions to the employee superannuation schemes at rates determined by an actuary to be sufficient to meet the cost to the Government of the superannuation entitlements of the Group's employees. CSIRO accounts for the contributions as if they were contributions to defined contribution plans.

The liability for superannuation recognised as at 30 June 2019 represents outstanding contributions for the financial year.

3.2. Key Management Personnel Remuneration

		Short Term Benefits			Post Employment Benefits	Other Long Term Benefits			
CSIRO Key Management Personnel	Position	Base Salary $	Bonuses $	Other Benefits and Allowances $	Super-annuation Contributions $	Long Service Leave $	Other Long Term Benefits $	Termination Benefits $	Total Remuneration $
Marshall, Larry	Chief Executive	720,133	185,544	24,920	23,844	24,855	35,370	-	1,014,666
Zielke, Judi	Chief Operating Officer	267,112	14,769	-	41,968	2,260	8,981	-	335,090
Mayfield, Peter	Executive Director – Environment, Energy & Resources	394,146	24,000	17,314	48,602	52,939	67,060	-	604,061
Hill, Anita	Executive Director – Future Industries	335,662	24,000	17,208	59,512	54,923	-	-	491,305
Williams, David	Executive Director - Digital, National Facilities and Collections	376,586	24,000	6,889	23,039	21,784	25,311	-	477,609
Total remuneration for CSIRO Key Management Personnel		2,093,639	272,313	66,331	196,965	156,761	136,722	-	2,922,731
CSIRO Subsidiary Key Management Personnel									
Jimenez, Orlando	Fundacion CEO	295,128	-	1,011	-	-	-	-	296,139
Total remuneration for Fundacion		295,128	-	1,011	-	-	-	-	296,139
Total Consolidated Remuneration for Key Management Personnel		2,388,767	272,313	67,342	196,965	156,761	136,722	-	3,218,870

Bonus amounts represent estimated amounts based on the contract amount allowable. Actual bonuses are decided by the Board following the end of financial year.

During the reporting period ended 30 June 2019, CSIRO had five executives who meet the definition of key personnel. All were employed for the full financial year, with the exception of Judi Zielke as COO (from 19 November 2018 to current). Consolidated figures include the remuneration of the Fundacion CEO Orlando Jimenez (7 March 2014 to current). This note has been prepared on an accrual basis for substantive and long term acting senior management personnel during the period.

CONSOLIDATED FINANCIAL STATEMENTS
NOTES TO AND FORMING PART OF THE FINANCIAL STATEMENTS

Senior Executive Staff Remuneration		Short Term Benefits			Post Employment Benefits	Other Long Term Benefits			
Remuneration Band	Number of Senior Executive Staff	Average Base Salary $	Average Bonuses $	Average Other Benefits and Allowances $	Average Super-annuation Contributions $	Average Long Service Leave $	Average Other Long Term Benefits $	Average Termination Benefits $	Average Total Remuneration $
$0 - $220,000	5	75,900	12,800	4,981	13,079	20,169	-	-	126,929
$220,001 - $245,000	1	167,595	16,000	15,353	24,135	1,384	5,501	-	229,968
$245,001 - $270,000	1	190,512	16,000	14,850	39,181	(5,707)	-	-	254,836
$295,001 - $320,000	3	216,805	16,000	17,314	39,576	16,610	-	-	306,305
$320,001 - $345,000	2	258,972	20,000	15,250	20,198	15,041	4,918	-	334,379
$345,001 - $370,000	2	249,939	20,000	6,992	38,951	37,833	5,436	-	359,151
$370,001 - $395,000	4	217,283	18,000	8,824	35,496	19,416	6,300	73,188	378,507
$420,001 - $445,000	1	305,543	22,904	17,314	54,362	13,913	14,273	-	428,309
$470,001 - $495,000	1	415,131	16,000	-	24,836	11,007	16,587	-	483,561

During the reporting period ended 30 June 2019, CSIRO had twenty executives who meet the definition of senior executive staff. This note has been prepared on an accrual basis for substantive and long term acting senior management personnel during the period. Base Salary includes annual leave accrued in the period. Bonus amounts represent estimated amounts based on the contract amount allowable. Actual bonuses are decided by the Board following the end of financial year.

3.3. Remuneration of Auditors

	Consolidated		CSIRO	
	2019	2018	**2019**	2018
	$	$	**$**	$
Amounts received or due and receivable by the Group's auditors for:				
Audit of the financial statements	**327,759**	331,970	**215,000**	215,000
Audit of projects	**10,709**	9,980	**-**	-
	338,468	341,950	**215,000**	215,000

The Group's auditor (except for the Fundacion) is the Australian National Audit Office (ANAO) who has appointed RSM to assist with the assignment since 2015-16. The Fundacion is audited by Ernst & Young Chile, who conduct both financial statement and project audits for the Fundacion.

3.4. Remuneration of Board Members

Name	Position	Term	Base Salary	Other benefits and allowances	Post employment benefits	Total 2018-19 Remuneration
			$	$	$	$
David Knox	Board member	05/05/15 - 04/05/19; 05/05/19 - 04/05/24	68,801	-	-	68,801
Peter Riddles	Board member	24/04/14 - 23/04/17; 24/04/17 - 23/04/22	68,801	7,973	7,971	84,745
Edwina Cornish	Board member	26/11/15 - 25/11/20	68,801	7,973	7,295	84,069
Tanya Monro	Board member	25/02/16 - 11/03/19	47,629	-	4,526	52,155
Michele Allan	Board member	05/05/16 - 04/05/19; 05/05/19 - 04/05/24	68,801	7,973	7,914	84,688
Drew Clarke	Board member	24/08/17 - 23/08/22	68,801	7,973	7,354	84,128
Kathryn Fagg	Board member	02/08/18 - 01/08/23	57,429	-	5,456	62,885
Shirley In't Veld	Deputy Chairman	28/06/12 - 27/06/15; 28/06/15 - 27/06/20	103,197	-	9,805	113,002
David Thodey	Chairman	15/10/15 - 14/10/20	137,592	-	13,073	150,665
Total remuneration for CSIRO Board Members			689,852	31,892	63,394	785,138
CSIRO Subsidiary Board Members						
Claudia Bobadilla	Board Member	15/3/17-15/3/22	34,090	-	-	34,090
Alejandro Foxley	Board Member	11/6/14-31/12/18	16,981	-	-	16,981
Total remuneration for Fundacion			51,071	-	-	51,071
Total Consolidated Remuneration for CSIRO Group			740,923	31,892	63,394	836,209

The remuneration of the Chief Executive Officer, who is also a CSIRO Board Member is reported under Note 3.2 Key Management Personnel Remuneration.

3.5. Meetings of the Board and Board Committees

During the financial year 2018-19, 7 Board meetings (1 out of session), 5 Board Audit & Risk Committee meetings, 4 Board People, Health & Safety Committee meetings and 4 Board Science Excellence Committee meetings were held. The number of meetings attended by each of the Board members was as follows:

Board member	CSIRO Board		CSIRO Board Audit & Risk Committee		CSIRO Board People, Health & Safety Committee		CSIRO Board Science Excellence Committee	
	Number eligible to attend as a member	Number attended	Number eligible to attend as a member	Number attended	Number eligible to attend as a member	Number attended	Number eligible to attend as a member	Number attended
Michele Allan	7	5	5	3	-	2	4	3
Edwina Cornish	7	7	5	5	-	3	4	4
Shirley In't Veld	7	6	5	5	4	3	-	1
David Knox	7	7	-	1	4	4	4	4
Tanya Monro	7	6	-	2	4	2	4	4
Kathryn Fagg	5	3	-	1	-	4	-	1
Peter Riddles	7	7	5	5	-	3	4	4
David Thodey	7	7	-	5	-	4	-	4
Drew Clarke	7	6	5	4	4	4	-	3
Larry Marshall	7	7	-	5	-	4	-	4

3.6. Related Party Disclosures

(a) Controlled Entities

SIEF was established under the *Science and Industry Endowment Act 1926*. The principal activity of the SIEF Trust is to provide assistance to persons engaged in scientific research and in training of students in scientific research. The SIEF Trustee is the CSIRO Chief Executive and SIEF is a wholly controlled entity. The SIEF's separate financial statements are reported in the CSIRO Annual Report.

WLAN is a small proprietary company limited by shares, which are solely held by CSIRO. The principal activity of WLAN was to provide services to CSIRO. WLAN was established in 2005 and was wound up on 8 April 2019.

The Fundación was established in October 2013. The Fundación is a controlled entity governed by a Board in accordance with the Constitution of the Fundación. The Fundación is working with industry and leading Chilean Universities to develop cutting-edge technologies to reduce the environmental impact of mining and increase productivity.

NICTA is Australia's ICT Research Centre of Excellence and undertakes internationally recognised research in partnership with industry, government and researchers to create national benefit and wealth for Australia. NICTA is the parent entity of NICTA IPR Pty Ltd and a small number of minor proprietary limited companies that exist to hold intellectual property and commercialise research. CSIRO obtained full control of NICTA on 28 August 2015, when the members of the NICTA Board resolved to adopt a revised company constitution which provided CSIRO with effective control over NICTA.

CSIRO has established an Innovation Fund with Commonwealth funding support to invest in the development of early stage technology opportunities from the public research sector, to increase their translation into commercial opportunities to be taken up by Australian industry. The Fund has been established through a structure of ten entities whose purpose is to manage and operate the Fund. These entities are:

- CSIRO Innovation Fund 1, LP is an incorporated limited partnership formed under the Partnership Act 1892 (NSW). It is registered by Innovation and Science Australia as an Early Stage Venture Capital Limited Partnership. It was established in January 2017.
- CSIRO Management Partnership Pty LP is an incorporated limited partnership formed under the Partnership Act 1892 (NSW). It was established in January 2017 as a Venture Capital Management Partnership and acts as the General Partner of the CSIRO Innovation Fund 1, LP.
- CSIRO General Partner 2 Pty Ltd was established in December 2016 and is a small proprietary company limited by shares, which are solely held by CSIRO. This company acts as the general partner of CSIRO Management Partnership Pty LP.
- CSIRO Fund of Funds, LP is an incorporated limited partnership formed under the Partnership Act 1892 (NSW) and is registered by Innovation and Science Australia as an Australian Venture Capital Fund of Funds. It was established in May 2016.
- CSIRO General Partner Pty Ltd was established in May 2016 and is a small proprietary company limited by shares, which are solely held by CSIRO. It acts as the general partner of CSIRO Fund of Funds LP. It also acts as the trustee of CSIRO Innovation Holding Trust that was established in July 2018.
- CSIRO Financial Services Pty Ltd was established in December 2015 and is a small proprietary company limited by shares, which are solely held by CSIRO. The company has been issued an Australian Financial Services License by ASIC and acts as Manager of CSIRO Innovation Fund 1, LP.
- CSIRO Innovation Services Pty Ltd was established in October 2016 and is a small proprietary company limited by shares, which are solely held by CSIRO. It acts as trustee of a discretionary trust established to distribute some returns from CSIRO Innovation Fund 1, LP, and as trustee of a unit trust established to distribute some returns form CSIRO Innovation Follow-on Fund 1.
- CSIRO Innovation Holding Trust is a trust established in July 2018 to distribute returns from CSIRO Innovation Fund 1, LP according to an agreed distribution policy administered by CSIRO Innovation Services Pty Ltd
- CSIRO Follow-on Services Pty Ltd was established in April 2018 and is a small proprietary company limited by shares, which are solely held by CSIRO.
- CSIRO Innovation Follow On Fund 1 was established October 2018 and is structured as a Managed Investment Trust, formed to provide follow-on investment to companies supported by CSIRO Innovation Fund 1, LP.

All of the above Innovation Fund related companies are under the sole control of the CSIRO as at 30 June 2019. The above entities (with the exception of CSIRO Financial Services Pty Ltd and CSIRO Innovation Services Pty Ltd) sit outside the General Government Sector.

CSIRO USA LLC and CSIRO Innovations LLC were established in February 2017 to support the establishment of a CSIRO presence in the United States. Both entities are incorporated within Delaware and are wholly controlled by the CSIRO.

(b) Related party relationships

The entity is an Australian Government controlled entity. Related parties to this entity are the Board, Key Management Personnel including the Portfolio Minister and Executive, and other Australian Government entities.

Transactions with related parties:

Given the breadth of Government activities, related parties may transact with the government sector in the same capacity as ordinary citizens. Such transactions include the payment or refund of taxes, receipt of a Medicare rebate or higher education loans. These transactions have not been separately disclosed in this note.

Significant transactions with related parties can include the payments of grants or loans; purchases of goods and services; asset purchases, sales transfers or leases; debts forgiven; and guarantees. Giving consideration to relationships with related entities, and transactions entered into during the reporting period by the entity, it has been determined that there are no related party transactions to be separately disclosed.

4. Managing Uncertainties

This section analyses how CSIRO manages financial risk within its operating environment.

4.1. Contingent Assets and Liabilities

	Consolidated		CSIRO	
	2019	2018	**2019**	2018
	$'000	$'000	**$'000**	$'000
Quantifiable Contingencies				
Contingent assets				
Insurance claims	**2,123**	1,417	**2,123**	1,417
Bank guarantees received from suppliers	**4,879**	20,834	**4,879**	20,834
Contingent revenue (equity instrument)	**500**	-	**-**	-
Total contingent assets	**7,502**	22,251	**7,002**	22,251
Contingent liabilities				
Estimated legal claims	**6,000**	-	**6,000**	-
Total contingent liabilities	**-**	-	**-**	-
Total net contingent asset/(liability)	**1,502**	22,251	**1,002**	22,251

Depending on the materiality of risks involved with certain commercial transactions, CSIRO has requested bank guarantees where necessary to mitigate risks, notably where substantial advance payments were made.

In June 2019, the Commonwealth Director of Public Prosecutions filed four charges in the Magistrates' Court of Victoria, alleging the Commonwealth Scientific and Industrial Research Organisation failed in its duties under the Work Health and Safety Act 2011 in relation to an incident that occurred in a Melbourne research facility in 2017. If found to be guilty, each charge carries a maximum penalty of $1,500,000.

Unquantifiable contingencies

As disclosed in the Overview Note, a financial provision for the estimated costs in restoring and decontaminating land where a legal or constructive obligation has arisen has been recognised on the Statement of Financial Position. For cases where there is no legal or constructive obligation, the potential costs have not been assessed and are unquantifiable contingencies. CSIRO has no other identified unquantifiable contingencies to report.

Accounting Policy

Contingent liabilities and contingent assets are not recognised in the Statement of Financial Position. They may arise from uncertainty as to the existence of a liability or asset, or represent a liability or asset in respect of which the amount cannot be reliably measured. Contingent assets are disclosed when settlement is probable but not virtually certain and contingent liabilities are disclosed when settlement is greater than remote.

4.2. Financial Instruments

	Consolidated		CSIRO	
	2019	2018	**2019**	2018
	$'000	$'000	**$'000**	$'000
Note 4.2A: Categories of financial instruments				
Financial Assets under AASB 139				
Available for sale financial assets				
Investments		77,516		98,714
Total available for sale financial assets		77,516		98,714
Held to maturity				
Cash at bank		94,769		13,974
Term deposits		226,878		170,000
Total held to maturity		321,647		183,974
Loans and receivables				
Receivable for goods and services		74,406		73,951
Other receivables		5,838		3,251
Total loans and receivables		80,244		77,202
Financial Assets under AASB 9				
Financial assets at fair value through profit or loss				
Investments - CSIRO investment portfolio	**75,333**		**64,832**	
Total financial assets at fair value through profit and loss	**75,333**		**64,832**	
Financial assets at fair value through other comprehensive income				
Investments - CSIRO Innovation Fund	**70,472**		**60,503**	
Total financial assets at fair value through other comprehensive income	**70,472**		**60,503**	
Financial assets at amortised cost				
Cash at bank	**178,936**		**118,829**	
Term deposits	**141,139**		**80,000**	
Receivable for goods and services	**65,729**		**65,269**	
Other receivables	**5,247**		**3,351**	
Total financial assets at amortised cost	**391,051**		**267,449**	
Total financial assets	**536,856**	479,407	**392,784**	359,890
Financial Liabilities				
Financial liabilities measured at amortised cost				
Trade creditors	**72,519**	83,844	**72,695**	82,112
Research revenue received in advance	**131,008**	118,268	**131,008**	118,268
Other creditors	**20,594**	24,064	**14,231**	18,093
Finance lease liabilities	**27,337**	31,968	**27,337**	31,968
Deposits	**23,310**	12,315	**27,364**	12,336
Total financial liabilities at amortised cost	**274,768**	270,459	**272,635**	262,777
Total financial liabilities	**274,768**	270,459	**272,635**	262,777

Classification of financial assets on the date of initial application of AASB 9.

				Consolidated		CSIRO	
Financial assets class	Note	AASB 139 original classification	AASB 9 new classification	AASB 139 carrying amount at 1 July 2018 $'000	AASB 9 carrying amount at 1 July 2018 $'000	AASB 139 carrying amount at 1 July 2018 $'000	AASB 9 carrying amount at 1 July 2018 $'000
Investments	**2.1B**	Available for sale	FVOCI	20,021	20,021	50,800	50,800
Investments	**2.1B**	Available for sale	FVPL	57,495	57,495	47,914	47,914
Cash at bank and term deposits		Held to maturity	Amortised cost	321,647	321,647	183,974	183,974
Receivable for goods and services	**2.1A**	Loans and receivables	Amortised cost	74,406	74,406	73,951	73,951
Other receivables	**2.1A**	Loans and receivables	Amortised cost	5,838	5,838	3,251	3,251
Total financial assets				**479,407**	**479,407**	**359,890**	**359,890**

Reconciliation of carrying amounts of financial assets on the date of initial application of AASB 9.

	Consolidated				CSIRO			
	AASB 139 carrying amount at 1 July 2018 $'000	Reclassification $'000	Remeasurement $'000	AASB 9 carrying amount at 1 July 2018 $'000	AASB 139 carrying amount at 1 July 2018 $'000	Reclassification $'000	Remeasurement $'000	AASB 9 carrying amount at 1 July 2018 $'000
Financial assets at amortised cost								
Loans and receivables, Held to maturity								
Cash at bank	94,769	-	-	94,769	13,974	-	-	13,974
Term deposits	226,878	-	-	226,878	170,000	-	-	170,000
Receivable for goods and services	74,406	-	-	74,406	73,951	-	-	73,951
Other receivables	5,838	-	-	5,838	3,251	-	-	3,251
Total amortised cost	**401,891**	**-**	**-**	**401,891**	**261,176**	**-**	**-**	**261,176**
Financial assets at fair value through other comprehensive income								
Available for sale - equity instruments								
Investments	20,021	-	-	20,021	50,800	-	-	50,800
Total financial assets at fair value through other comprehensive income	**20,021**	**-**	**-**	**20,021**	**50,800**	**-**	**-**	**50,800**
Financial assets at fair value through profit or loss								
Available for sale - equity instruments								
Investments	57,495	-	-	57,495	47,914	-	-	47,914
Total financial assets at fair value through profit or loss	**57,495**	**-**	**-**	**57,495**	**47,914**	**-**	**-**	**47,914**

Accounting Policy

Financial Assets

With the implementation of *AASB 9 Financial Instruments* for the first time in 2019, the entity classifies its financial assets in the following categories:

a) financial assets at fair value through profit or loss;

b) financial assets at fair value through other comprehensive income; and

c) financial assets measured at amortised cost.

The classification depends on both the entity's business model for managing the financial assets and contractual cash flow characteristics at the time of initial recognition. Financial assets are recognised when the entity becomes a party to the contract and, as a consequence, has a legal right to receive or a legal obligation to pay cash and derecognised when the contractual rights to the cash flows from the financial asset expire or are transferred upon trade date. Comparatives have not been restated on initial application.

Financial Assets at Amortised Cost

Financial assets included in this category need to meet two criteria:

1. the financial asset is held in order to collect the contractual cash flows; and

2. the cash flows are solely payments of principal and interest (SPPI) on the principal outstanding amount.

Amortised cost is determined using the effective interest method.

Effective Interest Method

Income is recognised on an effective interest rate basis for financial assets that are recognised at amortised cost.

Financial Assets at Fair Value Through Other Comprehensive Income (FVOCI)

Financial assets measured at fair value through other comprehensive income are held with the objective of both collecting contractual cash flows and selling the financial assets and the cash flows meet the SPPI test. Any gains or losses as a result of fair value measurement or the recognition of an impairment loss allowance is recognised in other comprehensive income. CSIRO values the investment in the CSIRO Innovation Fund as FVOCI.

Financial Assets at Fair Value Through Profit or Loss (FVTPL)

Financial assets are classified as financial assets at fair value through profit or loss where the financial assets either doesn't meet the criteria of financial assets held at amortised cost or at FVOCI (i.e. mandatorily held at FVTPL) or may be designated. Financial assets at FVTPL are stated at fair value, with any resultant gain or loss recognised in profit or loss. The net gain or loss recognised in profit or loss incorporates any interest earned on the financial asset. CSIRO values it's equity investment portfolio in listed companies, unlisted companies and in Uniseed Trust as FVTPL.

Impairment of Financial Assets

Financial assets are assessed for impairment at the end of each reporting period based on Expected Credit Losses, using the general approach which measures the loss allowance based on an amount equal to lifetime expected credit losses where risk has significantly increased, or an amount equal to 12-month expected credit losses if risk has not increased.

The simplified approach for trade, contract and lease receivables is used. This approach always measures the loss allowance as the amount equal to the lifetime expected credit losses. A write-off constitutes a de-recognition event where the write off directly reduces the gross carrying amount of the financial asset.

Financial liabilities

Financial liabilities are classified as either financial liabilities 'at fair value through profit or loss' or other financial liabilities. Financial liabilities are recognised and derecognised upon 'trade date'.

Financial Liabilities at Fair Value Through Profit or Loss

Financial liabilities at fair value through profit or loss are initially measured at fair value. Subsequent fair value adjustments are recognised in profit or loss. The net gain or loss recognised in profit or loss incorporates any interest paid on the financial liability.

Financial Liabilities at Amortised Cost

Financial liabilities, including borrowings, are initially measured at fair value, net of transaction costs. These liabilities are subsequently measured at amortised cost using the effective interest method, with interest expense recognised on an effective interest basis.

Supplier and other payables are recognised at amortised cost. Liabilities are recognised to the extent that the goods or services have been received (and irrespective of having been invoiced).

	Consolidated		CSIRO	
	2019	2018	**2019**	2018
	$'000	$'000	**$'000**	$'000
Note 4.2B: Net income and expense from financial assets				
Financial assets at amortised cost				
Interest revenue	**13,501**	10,572	**10,536**	7,944
Impairment expense	**(536)**	(1,093)	**(536)**	(684)
Net gain from financial assets at amortised cost	**12,965**	9,479	**10,000**	7,260
Investments assets at fair value through profit or loss				
Fair value changes	**14,660**	-	**(1,497)**	-
Net gain/(loss) from investment assets at fair value through profit or loss	**14,660**	-	**(1,497)**	-
Net gain/(loss) on financial assets	**27,625**	9,479	**8,503**	7,260
Note 4.2C: Net income and expense from financial liabilities				
Financial liabilities measured at amortised cost				
Interest expense	**1,430**	1,562	**1,403**	1,547
Net loss from financial liabilities	**1,430**	1,562	**1,403**	1,547

4.3. Fair value measurement

Significant Accounting Judgements and Estimates

In the process of applying the accounting policies listed in this note, CSIRO has made the following judgements that have the most significant impact on the amounts recorded in the financial statements:

- Properties classified as 'properties held for sale' are measured at the lower of the carrying amount and fair value less costs to sell (level 1 inputs), and for 'investment properties' has been taken to be the market value (level 2 inputs), of similar properties as determined by an independent valuer;
- The fair value of land which will continue to be used for research activities, and buildings held for specialised purposes and where there is no readily available market price has been taken to be Fair Value- Highest and Best Use (level 3 inputs), as determined by an independent valuer;
- The fair value of plant and equipment has been taken to be Fair Value – Highest and Best Use (level 2 and 3 inputs) as they mainly comprise of specialised research equipment. Fair value is determined by an independent valuer; and
- The fair value of listed companies is assessed at market value (level 1 inputs); whereas unlisted companies and commercial vehicles are assessed at fair value using the best information available (level 1 and 3 inputs). For investments in unlisted companies where there is no readily available market pricing, the fair value has been determined by applying valuation techniques in line with the generally accepted valuation guidelines 'International Private Equity and Venture Capital Valuation Guidelines (IPEV).' Where recent transactions for the unlisted companies' equity have taken place, these equity transaction prices are used to value CSIRO's investment. For unlisted companies that have not had any recent equity transactions, other IPEV valuation techniques are used such as discounted cash flows and share of net assets. Investments in special purpose entities are either valued at cost of share of net realisable assets since a reliable estimate of fair value cannot be established. These entities have been set up primarily to gain access to research facilities/networks, or to provide services to owners. Hence, there is not 'active market' for these equity investments.

No accounting assumptions and estimates have been identified that have a significant risk of causing a material adjustment to the carrying amounts of assets and liabilities within the next reporting period.

Note 4.3A: Fair value measurement

	Fair value measurements at the end of the reporting period	
	2019	**2018**
	$'000	**$'000**
Financial assets		
Other investments	**145,805**	77,516
Total financial assets	**145,805**	77,516
Non-financial assets		
Land	**386,600**	440,600
Buildings	**1,177,562**	1,185,007
Plant and equipment	**563,342**	548,632
Investment properties	**52,072**	49,697
Properties held for sale	**59,200**	5,200
Heritage and cultural	**4,463**	4,463
Total non-financial assets	**2,243,239**	2,233,599
Financial liabilities		
Finance lease liabilities	**27,337**	31,968
Deposits	**23,310**	12,315
Total financial liabilities	**50,647**	44,283

The above disclosure represents the consolidated financial position of the Group.

5. Other information

5.1. Aggregate Assets and Liabilities

	Consolidated		CSIRO	
		2018	**2019**	2018
	$'000	$'000	**$'000**	$'000
Note 5.1A: Aggregate Assets and Liabilities				
Assets expected to be recovered in:				
No more than 12 months	**505,630**	455,307	**380,667**	314,246
More than 12 months	**2,347,849**	2,323,928	**2,327,180**	2,344,790
Total assets	**2,853,479**	2,779,235	**2,707,847**	2,659,036
Liabilities expected to be settled in:				
No more than 12 months	**261,732**	268,511	**256,896**	260,699
More than 12 months	**292,554**	250,719	**295,133**	250,667
Total liabilities	**554,286**	519,230	**552,029**	511,366

5.2. Cooperative Research Centres (CRCs)

All CRCs have been classified as joint operations as the purpose is for the pursuit of collaborative scientific research where participants share in the scientific outcomes and outputs of the CRCs. In the event that CRC research results in a move to commercialisation, a separate legal entity is established and the CSIRO's share of the new entity is treated either as subsidiary, joint venture or associate in the Statement of Financial Position as appropriate.

CRC grants provide successful applicants with access to grant funds for up to 10 years for collaborations from industry, research and community sectors to solve industry problems and improve the competitiveness, productivity and sustainability of the Australian industries. CRC-P grants support short term industry-led collaborations to develop important new technologies, products and services that deliver tangible outcomes.

CSIRO's total cash and in-kind contribution (e.g. staff and use of assets) to CRCs from its own resources was $16.3 million and to CRC-P's $2.7 million. Contributions made by CSIRO are expensed as incurred and these are included in the Statement of Comprehensive Income.

CSIRO was a participant in the following CRCs during 2018-19.

Name of CRC	Scheduled Termination Date
Alertness Safety & Productivity CRC	30/06/20
Antarctic Climate and Ecosystems CRC	30/06/19
Autism CRC	31/01/20
Bushfire and Natural Hazards CRC	31/12/19
Cancer Therapeutics CRC	30/06/20
Contaminated Assessment and Remediation of the Environment (CRC for CARE)	30/06/20
Cyber Security CRC	31/12/24
Developing Northern Australia CRC	30/06/21
Innovative Manufacturing CRC	30/06/21
Low Carbon Living CRC	30/06/19
Optimising Resource Extraction CRC	30/06/21
Rail Manufacturing CRC	30/06/21
MinEx CRC	30/06/28
Optimising Resource Extraction CRC	30/06/21

CSIRO is a participant in the following CRC-Ps during 2018-19.

Name of CRC-P	Scheduled Termination Date
Automating data collection and analytics in underground mines using drones and AI CRC-P	31/12/21
Developing sustainable cropping systems for cotton, grains and fodder CRC-P	01/10/20
New pastures to increase livestock productivity across the north CRC-P	30/06/20
Implementing intelligent automated reporting in radiology practice CRC-P	30/06/21
Kapunda In-Situ Copper and Gold Field Recovery Trial CRC-P	31/12/20
Large Area Glass Perovskite CRC-P	01/11/18
Long-life alloy components for efficient hydrometalallurgical processing CRC-P	31/12/20
Optimal scheduling of air conditioning systems with renewable energy resources and thermal storage CRC	30/06/21
Oventus CRC-P (targeted therapy for sleep apnoea)	20/12/19
Printed Solar Films CRC-P	21/08/18
Smart Sensor and deep Learning Behavioural Engine for Personalised Health Mentoring CRC-P	31/03/22
Smart tools for agronomic crop insights using Machine Learning (ML) and Artificial Intelligence (AI) CRC-P	01/01/22
Transforming joint surgery rehabilitation with artificial intelligence in telehealth CRC-P	19/07/21

Accounting Policy

Joint Operations – Cooperative Research Centres (CRCs)

The proportionate interests in CRCs regarded as joint operations are disclosed in the financial statements under appropriate headings. Their primary source of funding is from the Australian Government and funding is progressively drawn down over the life of the CRCs and distributed to participants, including CSIRO and universities, for research and development purposes. CSIRO's contributions to the CRCs are expensed as incurred and funds received from CRCs are recognised as revenue to the extent that work has been performed in the Statement of Comprehensive Income. CSIRO has been a participant in 14 CRCs and 13 CRC-P's during the financial year.

5.3. Monies Held in Trust

	2019 $'000	2018 $'000
Monies held in trust represented by cash, deposits and investments for the benefit of the Group which are not included in the Statement of Financial Position are:		
The Sir Ian McLennan Achievement for Industry Award - established to award outstanding contributions by the Group's scientists and engineers to national development.	**422**	404
The Elwood and Hannah Zimmerman Trust Fund - established to fund weevil research and the curation of the Australian National Insect Collection (ANIC) weevil collection.	**5,069**	4,591
The Schlinger Trust - established to research the taxonomy, biosystematics, general biology and biogeography of Australasian Diptera conducted by the Australian National Insect Collection.	**2,371**	2,341
Total monies held in trust as at 30 June	**7,862**	7,336

Summary of movements:	**McLennan $'000**	**Zimmerman $'000**	**Schlinger $'000**	**Total $'000**
Balance as at 1 July 2018	**404**	**4,591**	**2,341**	**7,336**
Adjustments	**-**	**569**	**-**	**569**
Interest and distribution adjustments	**18**	**129**	**30**	**177**
Expenditure in the period	**-**	**(220)**	**-**	**(220)**
Balance as at 30 June 2019	**422**	**5,069**	**2,371**	**7,862**

5.4. Collections

CSIRO is the custodian of several collections used for scientific research. These collections have been established over time and document an extensive range of Australian flora and fauna species. The collections are irreplaceable, bear scientific and historical value and are not reliably measurable in monetary terms. Therefore, CSIRO has not recognised them as an asset in its financial statements.

The main collections held by CSIRO are:

- Australian National Herbarium (ANH) – With a focus on the Australian flora and that of neighbouring regions such as New Guinea and the Pacific, the ANH has over 1 million herbarium specimens, with additional holdings at the Australian Tropical Herbarium (ATH) in Cairns, Queensland. The ANH collections include the Dadswell Memorial Wood Collection and comprehensive holdings of a number of groups, including cryptogams, eucalypts and orchids.

- Australian National Insect Collection (ANIC) – Specialising in Australian terrestrial invertebrates, ANIC houses over 12 million specimens and is the world's largest collection of Australian insects, as well as groups such as mites, spiders, earthworms, nematodes and centipedes. ANIC is an important research collection used by CSIRO researchers, university staff, and students, and scientists from Australian and international research organisations.

- Australian National Wildlife Collection (ANWC) – Specialising in terrestrial vertebrates, ANWC contains specimens of most species of Australian mammals, birds, reptiles, and amphibians. It is particularly rich in specimens of birds from New Guinea. ANWC is a valuable asset for biologists engaged in biodiversity research. Its research library holds 60,000 recordings of wildlife sounds, more than a thousand tissue samples, and the egg collections from more than 300 bird species.

- Australian National Fish Collection (ANFC) – Specialising in marine fishes, the ANFC contains almost 150,000 specimens representing more than 3,000 species from the Indo-Pacific region. It is an invaluable resource for biodiversity and biogeographic research on Australian and Indo-Pacific fishes. Its major strengths are sharks, rays, and deep-water fishes. It also contains a large collection of images and radiographs of Australian fishes.

- Australian Tree Seed Centre (ATSC) – The ATSC is managed as a collection and research centre for Australian native tree species. For over 50 years the centre has been collecting, researching and supplying quality, fully documented tree seed to both domestic and overseas customers. Collections of seed are sourced from wild populations and genetically improved seed from our domestication and improvement programs.

- Australian National Algae Culture Collection (ANACC) – The ANACC consists of more than 300 microalgae species and is a resource for research on algal diversity, distribution, richness, and taxonomic relationships, including those of economic importance and environmental concern. Aligned with the collection is the National Algae Supply Service, which provides microalgae strains as starter cultures to industry, research, organisations and educational institutions in over 70 countries.

6. Budgetary Reports and Explanations of Major Variances

The following provides a comparison of the original budget as presented in the 2018-19 Portfolio Budget Statements to the actual outcome reported for 2018-19. The intention of this variance analysis is to provide the reader with information relevant to assessing the performance of CSIRO, including the accountability for the resources entrusted to it.

Statement of Comprehensive Income
for the period ended 30 June 2019

	Actual	Consolidated Original Budget	Variance
	2019	**2019**	2019
	$'000	**$'000**	$'000
NET COST OF SERVICES			
Expenses			
Employee benefits	**763,169**	**754,282**	(8,887)
Suppliers	**482,954**	**505,670**	22,716
Depreciation and amortisation	**148,019**	**175,423**	27,404
Finance leases	**1,430**	**2,518**	1,088
Impairment allowance on financial instruments	**536**	**-**	(536)
Write-down and impairment of other assets	**13**	**-**	(13)
Losses from asset sales	**2,847**	**-**	(2,847)
Total expenses	**1,398,968**	**1,437,893**	38,925
Own-Source Income			
Own-source revenue			
Sale of goods and rendering of services	**410,432**	**453,338**	(42,906)
Interest - bank and term deposits	**13,501**	**7,620**	5,881
Rental income	**10,546**	**6,000**	4,546
Royalties and licence fees	**34,427**	**47,700**	(13,273)
Other revenues	**28,961**	**23,390**	5,571
Sale of equity investments and intellectual property	**12,094**	**-**	12,094
Total own-source revenue	**509,961**	**538,048**	(28,087)
Gains			
Net gain from sales of assets	**-**	**6,000**	(6,000)
Foreign exchange gains	**117**	**-**	117
Gain on revaluation of investment properties	**2,375**	**-**	2,375
Gain on valuation of equity investments	**14,660**	**-**	14,660
Total gains	**17,152**	**6,000**	11,152
Total own-source income	**527,113**	**544,048**	(16,935)
Net cost of services	**(871,855)**	**(893,845)**	21,990
Revenue from Government	**834,561**	**833,661**	900
Surplus/(Deficit)	**(37,294)**	**(60,184)**	22,890
OTHER COMPREHENSIVE INCOME			
Items not subject to subsequent reclassification to net cost of services			
Changes in asset revaluation reserves	**30,943**	**-**	30,943
Items subject to subsequent reclassification to net cost of services			
Changes in other reserves	**(15,256)**	**-**	(15,256)
Total other comprehensive income	**15,687**	**-**	15,687
Total comprehensive income/(loss)	**(21,607)**	**(60,184)**	38,577

Statement of Financial Position
as at 30 June 2019

	Actual	Consolidated Original Budget	Variance
	2019	**2019**	**2019**
	$'000	**$'000**	**$'000**
ASSETS			
Financial Assets			
Cash and cash equivalents	**320,075**	**245,811**	74,264
Trade and other receivables	**76,295**	**64,142**	12,153
Other investments	**145,805**	**96,212**	49,593
Total financial assets	**542,175**	**406,165**	136,010
Non-Financial Assets			
Land and buildings	**1,564,162**	**1,478,565**	85,597
Plant and equipment	**563,342**	**535,186**	28,156
Heritage and cultural	**4,463**	**4,206**	257
Intangibles	**16,740**	**21,380**	(4,640)
Investment properties	**52,072**	**51,110**	962
Inventories	**1,265**	**1,474**	(209)
Other non-financial assets	**50,060**	**41,337**	8,723
Total non-financial assets	**2,252,104**	**2,133,258**	118,846
Properties held for sale	**59,200**	**-**	59,200
Total assets	**2,853,479**	**2,539,423**	314,056
LIABILITIES			
Payables			
Suppliers	**72,519**	**70,471**	(2,048)
Other payables	**151,602**	**128,831**	(22,771)
Total payables	**224,121**	**199,302**	(24,819)
Interest Bearing Liabilities			
Finance leases	**27,337**	**34,963**	7,626
Deposits	**23,310**	**-**	(23,310)
Total Interest bearing liabilities	**50,647**	**34,963**	(15,684)
Provisions			
Employee provisions	**238,498**	**197,607**	(40,891)
Provision for remediation	**41,020**	**28,665**	(12,355)
Total provisions	**279,518**	**226,272**	(53,246)
Total liabilities	**554,286**	**460,537**	(93,749)
Net assets	**2,299,193**	**2,078,886**	220,307
EQUITY			
Contributed equity	**300,954**	**300,955**	(1)
Asset revaluation reserves	**1,523,229**	**1,387,073**	136,156
Other reserves	**(27)**	**-**	(27)
Retained surplus	**435,198**	**390,858**	44,340
Non-controlling interest	**39,839**	**-**	39,839
Total equity	**2,299,193**	**2,078,886**	220,307

Statement of Changes in Equity

for the period ended 30 June 2019

	Retained earnings			Asset revaluation reserve			Other reserves			Contributed equity/capital			Non-controlling interest			Total equity		
	Actual	Original Budget	Variance	Actual	Original Budget	Variance	Actual	Original Budget	Variance	Actual	Original Budget	Variance	Actual	Original Budget	Variance	Actual	Original Budget	Variance
	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019	2019
	$'000	$'000	$'000	$'000	$'000	$'000	$'000	$'000	$'000	$'000	$'000	$'000	$'000	$'000	$'000	$'000	$'000	$'000
Opening balance	**461,536**	**451,042**	10,494	**1,492,286**	**1,381,697**	110,589	**15,229**	**5,376**	9,853	**290,954**	**290,955**	(1)	**-**		-	**2,260,005**	**2,129,070**	130,935
Comprehensive income																		
Other comprehensive income	**15,272**	**-**	15,272	**30,943**	**-**	30,943	**(15,256)**	**-**	(15,256)	**-**	**-**	-	**-**		-	**30,959**	**-**	30,959
Surplus/(deficit) for the period	**(41,610)**	**(60,184)**	18,574	**-**	**-**	-	**-**	**-**	-	**-**	**-**	-	**4,316**		4,316	**(37,294)**	**(60,184)**	22,890
Total comprehensive income	**(26,338)**	**(60,184)**	33,846	**30,943**	**-**	30,943	**(15,256)**	**-**	(15,256)	**-**	**-**	-	**4,316**		4,316	**(6,335)**	**(60,184)**	53,849
Other Movements	**-**		-			-			-	**-**		-	**-**		-	**-**	**-**	-
Contributions by owners																		
Equity injection	**-**	**-**	-	**-**	**-**	-	**-**	**-**	-	**10,000**	**10,000**	-	**35,523**		35,523	**45,523**	**10,000**	35,523
Contributions by owners – other	**-**	**-**	-	**-**	**-**	-	**-**	**-**	-	**-**	**-**	-	**-**		-	**-**	**-**	-
Closing balance	**435,198**	**390,858**	44,340	**1,523,229**	**1,381,697**	141,532	**(27)**	**5,376**	(5,403)	**300,954**	**300,955**	(1)	**39,839**		35,523	**2,299,193**	**2,078,886**	220,307

Cash Flow Statement

for the period ended 30 June 2019

	Actual	Consolidated Original Budget	Variance
	$'000	$'000	$'000
OPERATING ACTIVITIES			
Cash received			
Receipts from Government	**832,641**	**833,661**	(1,020)
Sale of goods and rendering of services	**545,055**	**502,304**	42,751
Interest	**13,841**	**7,695**	6,146
Net GST received	**17,900**	**-**	17,900
Deposits	**9,329**	**-**	9,329
Other	**-**	**23,390**	(23,390)
Total cash received	**1,418,766**	**1,367,050**	51,716
Cash used			
Employees	**742,886**	**750,407**	7,521
Suppliers	**552,049**	**499,361**	(52,688)
Finance costs	**1,430**	**2,518**	1,088
Total cash used	**1,296,365**	**1,252,286**	(44,079)
Net cash from operating activities	**122,401**	**114,764**	7,637
INVESTING ACTIVITIES			
Cash received			
Proceeds from sales of property, plant and equipment	**967**	**46,300**	(45,333)
Proceeds from sales of equity investments and intellectual property	**6,147**	**-**	6,147
Total cash received	**7,114**	**46,300**	(39,186)
Cash used			
Purchase of property, plant and equipment	**119,647**	**131,100**	11,453
Equity investments	**52,250**	**10,000**	(42,250)
Other selling costs	**82**	**-**	(82)
Total cash used	**171,979**	**141,100**	(30,879)
Net cash used in investing activities	**(164,865)**	**(94,800)**	(70,065)
FINANCING ACTIVITIES			
Cash received			
Contributed equity	**45,523**	**10,000**	35,523
Total cash received	**45,523**	**10,000**	35,523
Cash used			
Finance leases	**4,631**	**4,134**	(497)
Total cash used	**4,631**	**4,134**	(497)
Net cash from financing activities	**40,892**	**5,866**	35,026
Net increase in cash held	**(1,572)**	**25,830**	(27,402)
Cash and cash equivalents at the beginning of the reporting period	**321,647**	**219,981**	101,666
Cash and cash equivalents at the end of the reporting period	**320,075**	**245,811**	74,264

Explanation of Major Variances

Australian Accounting Standard *AASB 1055 Budgetary Reporting* requires variance explanations of major variances between the original budget as presented in the 2018-19 Portfolio Budget Statements and the actual outcome as reported in these financial statements. CSIRO considers that major variances are those greater than 10% of the original estimate and that are relevant to an assessment of the discharge of accountability and to an analysis of the performance of the entity. Variances below this threshold are not included unless considered significant by their nature.

It should be noted that the original budget was prepared before the 2017-18 actual figures were known. As a consequence the opening balance of the 2018-19 Statement of Financial Position needed to be estimated and in some cases, variances between 2018-19 actuals and budget numbers can be, at least in part, attributed to unanticipated movements in the prior period figures. Variances attributable to factors which would not reasonably have been identifiable at the time of the budget preparation, such as the revaluation of plant and equipment and investment properties, sale of equity investments, and impairment of assets, have not been included as part of the explanation.

The Budget is not audited.

Statement of Comprehensive Income

CSIRO's own source revenue is lower than budget due to the impact of the drought in Australia and some unforeseen project delays which have impacted CSIRO's ability to meet milestones.

Net gain from sales of assets is lower than budget due to the expected sale of the former site at Highett, Victoria not occurring in 2018-19.

Statement of Financial Position

Cash and cash equivalents are higher than budget due to the Indigenous Girls STEM Academy being announced post budget and the difference in basis of preparation between the PBS and the financial statements relating to the Innovation Fund investment. The Portfolio Budget Statements are prepared on the basis of only including General Government Sector (GGS) entities, whereas the Financial Statements for CSIRO include the results of CSIRO and all controlled entities, regardless of whether they are within the GGS or not. Therefore, there is a difference in the accounting treatment between the two, resulting in the budget containing the Innovation Fund investment as an *Investment Accounted for using the Equity Method*, while the Financial Statements account for this investment in the consolidation as *Cash and cash equivalents* held by a controlled entity.

Other investments are higher than budget due to the acquisition of a number of shares not foreseen at the time of preparing the budget and difference in basis of preparation between the PBS and the financial statements relating to the Innovation Fund investment.

The former CSIRO site at Highett, Victoria has been recorded as a *Property held for sale* due to the impending finalisation of the sale of the land. At the time of developing the 2018-19 PBS, the land was expected to sell in 2018-19.

Other Payables are higher than budget due to higher amounts recognised as deferred revenue following resourcing constraints which resulted in projects not being finalised in the current year.

Deposits are higher than budget as it includes funding for the Indigenous Girls STEM Academy announced after budget.

The higher balance for *Employee Provisions* is due to the decrease in the long-term government bond rate used to discount expected future employee benefit payments.

Provision for remediation is higher than budget reflecting higher expected make-good, waste removal and site remediation costs.

Retained Surplus is higher than budgeted as the operating loss for 2018-19 was lower than in the budget and in accordance with *AASB 9 Financial Instruments*, equity was moved from Other reserves into Retained Surpluses during the year, which was unbudgeted.

The *Non-controlling interest* balance is higher than budget due to the difference in basis of preparation between the PBS and the financial statements relating to the Innovation Fund investment.

Cash Flow Statement

Variances relating to cash flows occur because of the factors detailed under Income Statement and Balance Sheet.

Paul Breur led the CSIRO team in developing the Going for Gold project (read more on page 156).

Part 6
Science and Industry Endowment Fund

Trustee's report

The Science and Industry Endowment Fund (SIEF) invests in science that contributes to Australia's future. I'm delighted to present the 2018–19 report of SIEF's important role in helping to solve the greatest challenges through innovative science and technology.

This year, SIEF has supported fundamental research into new paradigms for more sustainable use of resources; tactical research that aims to fast-track solutions to national problems; and support for high-quality infrastructure; just to name a few.

SIEF's commitment to addressing our national priorities has been strengthened this year through collaboration and partnerships, funding for research breakthroughs, and its receipt of two new gifts, in addition to the CSIRO Gift and New South Wales Endowment already underway.

CSIRO Gift

The CSIRO Gift funds the Experimental Development Program (EDP) among others, to help research projects attract industry investment and commercialise their technology. Five EDP projects were completed this year, including Megasonics and Going for Gold.

The Megasonics project funded a pilot olive oil extraction plant at an industrial scale demonstrating that using high-frequency ultrasound standing waves increases efficiencies in the production system while maintaining a quality end product. This is a great result for producers as they derive greater profitability from their product.

Going for Gold supported the construction and operation of a mobile demonstration plant that recovered gold using non-toxic products from various gold ores in the field, at scale. The products have the potential to disrupt the gold industry by replacing highly toxic cyanide, currently the industry standard method, thus reducing the industry's environmental impact. This project is expected to increase the economic value of gold recovery markets, with an estimated $3 billion per year of additional gold production in Australia through increased efficiencies of gold recovery practices.

Collaboration is a priority for SIEF through the CSIRO Gift. It is extremely pleasing to see how SIEF funding is providing significant and tangible benefits to Australian and international research through collaboration. One of SIEF's Research Infrastructure programs is a case in point. The Perth Advanced Resource Characterisation Facility is a collaborative partnership with the University of Western Australia, Curtin University and CSIRO. A SIEF grant of $12.4 million helped fund the acquisition of three keystone assets: Maia Mapper, NanoSIMS and Atom Probe, to enable metre to atomic scale analysis of rock. The facility, now fully operational, is experiencing high demand for the use of its keystone assets. Publications indicate that the facility is being used for its intended purposes of geology and minerology research, but is also being sought after by national and international teams for environmental and biomedical research.

The STEM+ Business Fellowship program is also proving to be a highly successful collaborative initiative. Delivered by CSIRO's SME Connect team, its purpose is to embed early career researchers into an industrial workplace environment over a two-to-three-year period to break down the cultural divide between researchers and small to medium-sized enterprises (SMEs). The program provides these early career researchers experience working in industry and fostering innovation. To date, 32 researchers have been funded to work with SMEs in projects with universities and research organisations. The impact of the program is becoming evident: at a House of Representatives Inquiry into Funding Australia's Research in 2018, our colleagues in the Innovative Research Universities network noted the program's streamlined and flexible approach and the benefits they have gained by working closely with industry partners.

As many of the activities supported by the CSIRO Gift are complete, or nearing completion, the funding landscape is changing. Our focus will now shift to our new gifts.

New gifts

In October, SIEF received a gift from National ICT Australia Ltd (NICTA) for the Future National ICT Industry Platform program. The program is intended to promote the NICTA purposes by funding substantial scale, collaborative research in data and digital technologies. Recognising the power of digital technologies to accelerate the impact and scale of domain expertise, the now-completed pilot program addressed food provenance. Three additional research activities have since commenced addressing supply chain integrity, energy, and data-driven cities.

In April 2019, SIEF received the Metcalf Gift through a significant and generous bequest from the late David Ross Metcalf who was a great inventor. Consistent with his wishes and in consultation with his family, I have directed this Gift to enable an additional 8–10 Fellows take part in the successful STEM+ Business Fellowship program, mentioned above, to deliver more solutions from science.

Following the original endowment made in 1926, this brings the total portfolio of gifts and endowments that SIEF manages to five. In my role as SIEF Trustee I am assisted by the advisory bodies and reviewers who generously contribute their time and expertise to SIEF to provide advice for funding decisions across the portfolio. I sincerely thank them for the advice they have provided me this year. With the establishment of the NICTA Gift, I would like to welcome the NICTA Program Advisory Council, and I look forward to working with them.

The future relies on innovation, and innovation is a team sport. Collaboration is key and SIEF's role in investing in Australian science, early career researchers, and cutting-edge technology ensures that we're able to work together to solve the nation's greatest challenges.

SIEF advisory bodies

CSIRO Gift Advisory Council Members

Emeritus Prof Alan Robson (Chair)
Dr Peter Riddles (Chair, EDP Review Panels)
Mr Nigel Poole
Dr Ezio Rizzardo
Prof Margaret Sheil
Prof Tom Spurling

Generation STEM Consultative Council (NSW Government Endowment)

Prof Brian Boyle (Chair)
Ms Maile Carnegie
Mr Simon Rowell
Mr Tom McGinness
Ms Gail Fulton
Mr Graeme Plato

NICTA Program Advisory Council

Ms Michelle Price
Ms Petra Andren
Mr John Paitaridis
Mr Adrian Turner

Dr Larry Marshall
SIEF Trustee

SIEF Performance report

The Science and Industry Endowment Fund (SIEF) is a separately constituted trust under the *Science and Industry Endowment Act 1926*. The Fund invests in science that addresses issues of national economic, industrial, environmental and cultural priority, and contributes to Australia's sustainable future by providing assistance:

a. to persons engaged in scientific research
b. in the training of students in scientific research.

CSIRO Chief Executive Dr Larry Marshall is Trustee of SIEF, and awards funding to parties across the national innovation system. The Trustee seeks independent advice and recommendations on funding of proposals. CSIRO manages the Fund on behalf of the Trustee.

SIEF was rejuvenated by a gift from CSIRO of $150 million, resulting from the patented Fast WLAN technology in 2009 (CSIRO Gift). In June 2018, CSIRO supplemented this with an additional $10 million, specifically to extend the Experimental Development Program. The CSIRO Board has approved to extend disbursal of the CSIRO Gifts until June 2026. Under the CSIRO Gift, some of the programs operate on a competitive basis, others by invitation on the basis of identified needs – all applications are considered against rigorous merit criteria.

In 2018–19, two CSIRO Gift programs ended – The Research Projects Program and the Joint CSIRO Macquarie University Chair in Wireless Communications. Over the life of the Research Projects Program, 17 projects were funded, and for every SIEF dollar invested, more than one and a half dollars was provided in co-investment from research organisations and industry partners. In the case of the Joint CSIRO Macquarie University Chair, SIEF's $2 million investment was supplemented by Macquarie University and external contracts, grants and awards, totalling more than $3 million in additional support.

Programs funded by the CSIRO Gift that remain active are the:

- Experimental Development Program (EDP)
- Promotion of Science Fellowships and Scholarships Program (competitive)
- SIEF-AAS Fellowships to the Lindau Nobel Laureate meeting and the Heidelberg Laureate Forum, facilitated by the Australian Academy of Science (competitive)
- SIEF STEM+ Business Fellowships, facilitated by CSIRO

Of these, the EDP and the SIEF-AAS Fellowships are the only programs currently open for applications.

In 2017, the New South Wales Department of Industry endowed $25 million over 10 years to SIEF to attract, support, retain and train students from this state in the areas of STEM, thus increasing the supply of STEM-engaged students for the future workforce. CSIRO Education and Outreach helps to develop and implement programs for school students and those engaged in higher and vocational education.

The NSW Generation STEM program has established its strategic and operational plans, which lay the foundations for the program's direction and focus for the next three years. The program will take a place-based approach to delivery of STEM programs with the initial focus on Western Sydney.

In 2018 the Trustee of SIEF entered into a Deed of Gift with the National ICT Australia Pty Ltd (NICTA) for $30 million over six years to establish the Future National ICT Industry Platform program. The program will support a series of grants to fund substantial scale research activities and projects on a collaborative basis in the field of data and digital technologies. Four programs of research have been funded to date; the pilot activity addressing food provenance was completed in February.

Research's contribution to solving issues of national importance can only be measured long term, but SIEF has developed several key performance indicators for its programs. As the funds available for allocation under the CSIRO Gift diminish and fewer new projects are started, some performance results will not change from previous years. New performance measures for Generation STEM and the NICTA programs will be added once they are established and operational.

This year, the CSIRO Gift programs continued to perform well. Table 6.1 provides an overview of the evidence against each performance criterion as published in the Portfolio Budget Statements, followed by more detailed analysis and evidence.

Table 6.1: Summary of performance

PERFORMANCE CRITERION	TARGET	RESULT	
Evidence of outcomes and impacts of funded projects as demonstrated by case study impact assessment, independent reviews and evaluations	Minimum two case studies	G	The impacts of the Going for Gold project include the disruption of the gold industry by providing environmental benefits through alternatives to the use of toxic cyanide, economic benefit to gold miners through using a low-cost technology, and unlocking stranded Australian gold deposits. The Hovermap EDP has enabled commercialisation of the technology through a company spun-out of CSIRO's Data61. Applications of Hovermap include mapping of mines, towers, power lines and construction sites. The impacts of the project include improving data collection service quality, increasing safety, reducing costs and driving growth in Australia's R&D, thus creating jobs and increased business opportunities.
Proportion of research projects involving more than one organisation	>94% projects involve more than one organisation	G	Since 2009, 116 different organisations have formally collaborated in CSIRO Gift-funded projects, with many more associated but not formally under a SIEF Funding Agreement; more than 94% of projects involve more than one organisation. Activities under the new programs associated with the NSW Government Endowment and the NICTA Gift also include formal and informal involvement from multiple organisations.
Use of the research infrastructure as measured through time allocations	>60% operational time used, 20% usage in collaborative projects	G	Commissioning of Research Infrastructure equipment is progressively occurring, with use of scheduled operating time reaching 80% for those on line. Use of Research Infrastructure equipment in collaborative projects is also increasing accounting for 36% of available time for commissioned equipment.
Technologies receiving ongoing commercialisation support from venture capital or industry sources after one year of completing the Experimental Development Program	Minimum of one case study	G	The Going for Gold EDP identified both commercialisation opportunities and industry support as a result of the success of the project. The industry partner Eco Minerals Research Ltd has negotiated to commercialise the Going for Gold technology through its subsidiary company, Clean Mining Ltd. In addition, several companies have been assessing the technology's efficacy in extracting gold from their ores. The Hovermap EDP enabled the CSIRO Data61 project team to create a spin-out company called Emesent. It has successfully raised $4.5 million in venture capital to commercialise Hovermap and is working with companies in a variety of applications.
Number of projects where additional STEM+ Business Fellowship funds are spent on research between the company and the STEM+ Fellow's host research team or with others	12	P	Eleven projects in the STEM+ Business Fellowship program have attracted additional funds to support further research between the company and the STEM+ Fellow's host research team or with others, highlighting the catalytic role the program has had in encouraging SMEs to invest in research and development. Seven of these projects involve additional STEM+ Business Fellowship funds through new STEM+ Business projects or extensions of existing fellowships.

Green shading indicates positive progress for the year and the target has been achieved.
Purple shading indicates progress through the year was less than anticipated and continues to be closely monitored.

Evidence of outcomes and impacts of funded projects

We collaborated with Eco Minerals Research Ltd on the Going for Gold project[28] to construct a mobile gold processing demonstration plant in Menzies, Western Australia, to test CSIRO's non-toxic, environmentally friendly gold recovery products. The project demonstrated the effectiveness and application of CSIRO's thiosulphate-based recovery process to mine gold. The technology and vat leach process can be applied to a range of ore types for wider commercial uptake and adoption.

The technology and process will be of great benefit to smaller mining operators as it will enable uptake with a relatively low capital expenditure requirement; the costs of establishing a plant using a vat leach start from around $3 million (capital expenditure required for a typical processing plant is about $30 million). Being free of the regulatory hurdles involved when using cyanide is an added benefit. The flexibility gained by using a mobile processing facility allows miners to unlock gold deposits stranded by factors such as resource sizing and transportation costs.

Additionally, use of the demonstration plant as a gold processing research hub will provide opportunities to demonstrate the method on a greater range of ore types from other gold miners; enable equipment suppliers to trial and develop customer-driven solutions in collaboration with industry and researchers; and provide opportunities for research and training. These outcomes will underpin and drive the uptake of technology for commercialisation.

A gold ingot produced from the first gold extracted by the SIEF-funded demonstration plant.

Hovermap[29] is a self-contained software and hardware system (payload) developed by CSIRO's Data61 that attaches to existing drones to provide omni-directional 3-D sensing and accurate LiDAR (light imaging, detection and ranging) mapping. The tool has capability to safely and efficiently inspect hard-to-reach assets and collect extremely high-fidelity data in previously unreachable places such as powerlines, warehouses and communications towers. The SIEF Experimental Development Program supported the Hovermap team to flight-test the technology in real-life situations and translate current prototypes into commercial products. This has resulted in the establishment of a CSIRO Data61 spin-out company called Emesent that is commercialising the technology.

The technology is being used for a range of applications including asset management in the construction and telecommunications industry for inspection and mapping of assets and buildings, forensic crime scene mapping, and underground mine mapping. The impact of this technology includes a reduction of costs and risks for governments and companies maintaining facilities and infrastructure as Hovermap can be used to monitor the condition of critical facilities and infrastructure, provide high-quality and accurate information and be used in areas where access is difficult or dangerous. This has the potential to make communities safer as barriers to asset assessment are removed, and damaged or aging infrastructure is detected and repaired or replaced. Hovermap will also benefit Australia as it will drive commercial growth in the international drone market and generate investment in Australian research and development, thus creating job growth and increased business opportunities.

28 The Going for Gold case study is available at https://sief.org.au/csiro-gift/what-has-been-funded/what-has-been-funded-experimental-development-program/going-for-gold/cyanide-free-non-toxic-gold-recovery-going-for-gold-case-study/.

29 The Hovermap case study is available at https://sief.org.au/csiro-gift/what-has-been-funded/what-has-been-funded-experimental-development-program/hovermap/intelligent-lidar-mapping-and-a-navigating-system-for-drones-hovermap/.

Proportion of projects involving more than one organisation

One of SIEF's primary objectives is to improve collaboration across the Australian Innovation System. Collaboration is critical for not just research (fostering communication, interaction and sharing of ideas), but also for improving the effectiveness of translating research outputs into innovation that delivers economic, environmental and social benefits. Since 2009, 116 different organisations have been formally involved in one or more CSIRO Gift-funded projects, representing Australian universities, governments, industry, SMEs and overseas organisations, meaning that 95 per cent of CSIRO Gift-supported activities involve more than one organisation. This collaboration helps Australian industry gain marketplace advantage by fostering creativity, developing new skills, transferring knowledge, managing risk and attracting aspiring investors and partners.

Over the life of SIEF-funded programs, the number of publications emerging directly from SIEF-funded activity has increased. From 2017–18 to 2018–19, publications output increased by 27 per cent, reflecting the maturity of the research projects. Co-authorship of publications reinforces collaboration and shows the strength of the collaborative relationships, as well as demonstrating that all contributing parties recognise the value of the research activity and its outputs.

Use of the research infrastructure as measured through time allocations

The sophisticated and complex sets of equipment funded under the SIEF Major Research Infrastructure Program represent significant infrastructure investments ($31.6 million SIEF). As the equipment is progressively installed, tested and commissioned, use of scheduled operating time has met or exceeded the targets set. Notable highlights include greater than 100 per cent use of scheduled operating time in the Advanced Resource Characterisation Facility (ARCF) in Perth (a measure of greater than 100 per cent is due to after hours and weekend runs). Mass spectrometry equipment in the Centre for Genomics, Metabolomics and Bioinformatics (CGMB) in Canberra has also been in constant use, with more than 90 per cent utilisation.

The Monash MedTech facility is now fully functional, and use of the assets is increasing as projects begin, with operational time for the MR-PET, Hot Lab and tissue bioprinters approximately 50 per cent in 2018.

Collaboration has also been a key feature of the three Major Research Infrastructure projects. The three key acquisitions of the Perth ARCF have been in high demand for collaborative projects, with 40 per cent of projects collaborative and many including international research partners. Thirty-five research articles have been published thus far. Since launching in August, the Clayton MedTech facility has hosted 24 collaborative projects using the full suite of equipment available, and a successful ARC Linkage grant will use the facility's MR-PET equipment. The CGMB in Canberra is showing 20 per cent of equipment usage for collaborative projects with a partner, and an additional five per cent by non-partner collaborators. The CGMB is delivering on expectations that this activity will result in new areas of collaboration between the Australian National University (ANU) and CSIRO and the broader Canberra precinct. For example, a new Centre of Entrepreneurial AgriTech (CEAT) has been established (attracting ACT Government funding) and through this initiative, CSIRO, ANU and the Canberra Innovation Network will work towards a market face for small businesses and start-ups.

The SIEF Medium Equipment Program (MEP) was launched in 2017 and is designed to address a gap in funding for equipment priced in the approximate range of $500,000 to $4 million. Projects funded under this program ($9.9 million) are progressing well and commissioning of assets is ongoing. For example, the Noble Gas Facility at the Waite Campus in Adelaide was a recipient of $550,000 SIEF funding to acquire a high-resolution noble gas mass spectrometer that will be a valuable asset for researchers studying the continent's groundwater systems and contribute to the sophisticated science being applied to understand the effects to groundwater of further development in regional Australia. The new mass spectrometer is integrated within the Environmental Tracer Laboratory, making this a unique noble gas capability for water research in the Southern Hemisphere. It began operations in 2019.

The Marine National Facility received MEP funding from SIEF to purchase a Triaxus, a towed undulating CTD instrument used to collect vertical and horizontal profile measurements of the water column from the sea surface to a depth of 300 metres. Identified as a mission critical asset, this state-of-the-art carbon fibre instrument uses the latest fibre optic technologies and is towed up to two kilometres behind the research vessel *Investigator* (thus avoiding its wake), collecting data not possible with other instrumentation.

The Triaxus is fitted with a standard suite of sensors used to measure temperature, conductivity and depth, and supports an array of auxiliary sensors to measure dissolved oxygen and fluorescences, and to identify and count plankton, providing a highly flexible data collection instrument. The Triaxus is available to all Australian researchers and their international collaborators, who successfully apply for a voyage on *Investigator*.

The Triaxus deployed at sea.

Technologies receiving ongoing commercialisation support from venture capital or industry sources after one year of completing the Experimental Development Program

An impact assessment of the Going for Gold EDP has provided evidence of several outcomes achieved including: demonstrating the effectiveness of CSIRO's thiosulphate-based recovery process; demonstrating the application of technology to a range of ore types; and enabling take-up with a relatively low capital expenditure. An assessment of the Going for Gold EDP identified both commercialisation opportunities and industry support as a result of the success of the project. In June, the industry partner Eco Minerals Research Ltd, negotiated a commercial arrangement to take the Going for Gold technology to market. In addition, several companies have been assessing the technology's efficacy in extracting gold from their ores.

As a result of the Hovermap EDP project, drone autonomy and data analytics company Emesent spun-out of CSIRO's Data61, was successfully established in November. It has raised $4.5 million in venture capital to commercialise its first product – Hovermap. The company has engaged with companies in Australia, the United States, Canada, China and Japan in a variety of applications.

Number of projects where additional STEM+ Business Fellowship funds are spent on research between the company and the STEM+ Fellow's host research team or with others

The STEM+ Business Fellowship program continues to act as a catalyst for collaborative partnerships and investment by SMEs in both research and development, and early-career researchers. This year, 11 projects attracted additional business funds to support further research between the company and the STEM+ Fellow's host research team, or with others.

Participating SMEs have indicated a high level of satisfaction with the program, with many seeking additional projects through the program, and others seeking and engaging in partnerships further afield. Four STEM+ Business Fellowship companies and their partner universities have successfully applied for funding for two Australian Research Council (ARC) Industrial Transformation Research Hubs – an excellent indicator of deepening connections and collaborations between businesses and research organisations. Each of these consortia has been awarded funding of $5 million for the 'ARC Research Hub for Driving Farming Productivity and Disease Prevention', to be administered by Griffith University, and the 'ARC Research Hub for Medicinal Agriculture', to be administered by La Trobe University.

Of the 11 projects which have resulted in additional funding, seven have successfully secured additional STEM+ Business Fellowship funds as SMEs have sought to capitalise on the original SIEF investment by extending fellowships from two to three years, or to create additional STEM+ Business Fellowship projects.

Australian National Audit Office

INDEPENDENT AUDITOR'S REPORT

To the Minister for Industry, Science and Technology

Opinion

In my opinion, the financial statements of the Science and Industry Endowment Fund for the year ended 30 June 2019 gives a true and fair view of the financial position of the Science and Industry Endowment Fund as at 30 June 2019 and its financial performance and cash flows for the year then ended in accordance with Australian Accounting Standards – Reduced Disclosure Requirements and the *Science and Industry Endowment Act 1926*.

The financial statements of the Science and Industry Endowment Fund, which I have audited, comprise the following statements as at 30 June 2019 and for the year then ended:

- Statement by the Trustee and Chief Finance Officer of the Commonwealth Scientific and Industrial Research Organisation (CSIRO) as Service Provider to the Science and Industry Fund;
- Statement of Comprehensive Income;
- Statement of Financial Position;
- Statement of Changes in Equity;
- Statement of Cash Flow; and
- Notes to and forming part of the financial report.

Basis for opinion

I conducted my audit in accordance with the Australian National Audit Office Auditing Standards, which incorporate the Australian Auditing Standards. My responsibilities under those standards are further described in the *Auditor's responsibilities for the audit of the financial statements* section of my report. I am independent of the Science and Industry Endowment Fund in accordance with the relevant ethical requirements for financial statement audits conducted by the Auditor-General and his delegates. These include the relevant independence requirements of the Accounting Professional and Ethical Standards Board's APES 110 *Code of Ethics for Professional Accountants* (the Code) to the extent that they are not in conflict with the *Auditor-General Act 1997*. I have also fulfilled my other responsibilities in accordance with the Code. I believe that the audit evidence I have obtained is sufficient and appropriate to provide a basis for my opinion.

Trustees's responsibility for the financial statements

The Trustee of the Science and Industry Endowment Fund is responsible for the preparation of the financial statements that give a true and fair view in accordance with Australian Accounting Standards – Reduced Disclosure Requirements. The Trustee is also responsible for such internal control as he determines is necessary to enable the preparation and fair presentation of financial statements that are free from material misstatement, whether due to fraud or error.

In preparing the financial statements, the Trustee is responsible for assessing the ability of the Science and Industry Endowment Fund to continue as a going concern, taking into account whether the Science and Industry Endowment Fund's operations will cease as a result of an administrative restructure or for any other reason. The Trustee is also responsible for disclosing, as applicable, matters related to going concern and using the going concern basis of accounting unless the assessment indicates that it is not appropriate.

GPO Box 707 CANBERRA ACT 2601
19 National Circuit BARTON ACT
Phone (02) 6203 7300 Fax (02) 6203 7777

Auditor's responsibilities for the audit of the financial statements

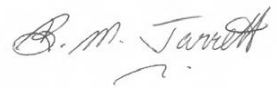
My objective is to obtain reasonable assurance about whether the financial statements as a whole are free from material misstatement, whether due to fraud or error, and to issue an auditor's report that includes my opinion. Reasonable assurance is a high level of assurance, but is not a guarantee that an audit conducted in accordance with the Australian National Audit Office Auditing Standards will always detect a material misstatement when it exists. Misstatements can arise from fraud or error and are considered material if, individually or in the aggregate, they could reasonably be expected to influence the economic decisions of users taken on the basis of the financial statements.

As part of an audit in accordance with the Australian National Audit Office Auditing Standards, I exercise professional judgement and maintain professional scepticism throughout the audit. I also:

- identify and assess the risks of material misstatement of the financial statements, whether due to fraud or error, design and perform audit procedures responsive to those risks, and obtain audit evidence that is sufficient and appropriate to provide a basis for my opinion. The risk of not detecting a material misstatement resulting from fraud is higher than for one resulting from error, as fraud may involve collusion, forgery, intentional omissions, misrepresentations, or the override of internal control;
- obtain an understanding of internal control relevant to the audit in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the entity's internal control;
- evaluate the appropriateness of accounting policies used and the reasonableness of accounting estimates and related disclosures made by the Trustee's;
- conclude on the appropriateness of the Trustee's use of the going concern basis of accounting and, based on the audit evidence obtained, whether a material uncertainty exists related to events or conditions that may cast significant doubt on the entity's ability to continue as a going concern. If I conclude that a material uncertainty exists, I am required to draw attention in my auditor's report to the related disclosures in the financial statements or, if such disclosures are inadequate, to modify my opinion. My conclusions are based on the audit evidence obtained up to the date of my auditor's report. However, future events or conditions may cause the entity to cease to continue as a going concern; and
- evaluate the overall presentation, structure and content of the financial statements, including the disclosures, and whether the financial statements represent the underlying transactions and events in a manner that achieves fair presentation.

I communicate with those charged with governance regarding, among other matters, the planned scope and timing of the audit and significant audit findings, including any significant deficiencies in internal control that I identify during my audit.

Australian National Audit Office



Brandon Jarrett

Senior Executive Director

Delegate of the Auditor-General

Canberra

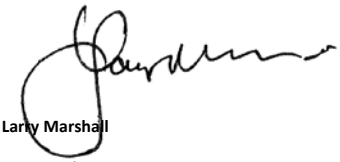
9 August 2019

SCIENCE AND INDUSTRY ENDOWMENT FUND

STATEMENT BY TRUSTEE AND CHIEF FINANCE OFFICER OF COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATION (CSIRO) AS SERVICE PROVIDER TO THE SCIENCE AND INDUSTRY ENDOWMENT FUND

In our opinion, the attached financial report for the year ended 30 June 2019 has been prepared based on properly maintained financial records and in accordance with Australian Accounting Standards and other mandatory financial reporting requirements in Australia, and give a true and fair view of the financial position of the Science and Industry Endowment Fund as at 30 June 2019 and of its performance for the year then ended.

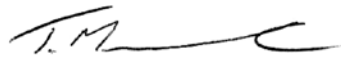
In our opinion, at the date of this statement, there are reasonable grounds to believe that the Science and Industry Endowment Fund will be able to pay its debts as and when they become due and payable.



Larry Marshall

Trustee of the Science and
Industry Endowment Fund

9 August 2019



Tom Munyard

Chief Finance Officer of CSIRO
as service provider to the Science and Industry
Endowment Fund

9 August 2019

SCIENCE AND INDUSTRY ENDOWMENT FUND

STATEMENT OF COMPREHENSIVE INCOME

For the period ended as at 30 June 2019

	Notes	2019	2018
		$	$
EXPENSES			
Scientific research grants	1	**25,609,609**	18,632,420
Service fee under services agreement with CSIRO		**340,189**	352,072
Audit fees		**15,500**	15,500
Other fees		**398**	450
Total expenses		**25,965,696**	19,000,442
LESS:			
REVENUE			
NICTA Gift	2	**20,000,000**	-
Metcalf bequest	2	**1,037,633**	-
CSIRO Gift	2	**-**	10,000,000
Interest	3	**2,001,919**	1,697,666
Total revenue		**23,039,552**	11,697,666
Deficit		**(2,926,144)**	(7,302,776)
Other comprehensive income		-	-
Total comprehensive loss		**(2,926,144)**	(7,302,776)

The above statement should be read in conjunction with the accompanying notes.

SCIENCE AND INDUSTRY ENDOWMENT FUND

STATEMENT OF FINANCIAL POSITION

For the period ended as at 30 June 2019

	Notes	2019	2018
		$	$
ASSETS			
Current assets			
Cash and cash equivalents	4	**65,017,563**	68,181,236
Interest receivable	5	**793,925**	702,647
GST receivable	5	**1,423,500**	199,054
Total assets		**67,234,988**	69,082,937
LIABILITIES			
Current liabilities			
Payables			
Accrued grants payable	6	**1,043,744**	-
Shared service fee payable		**122,270**	87,819
Accrued audit fee		**15,500**	15,500
Total payables		**1,181,514**	**103,319**
Total liabilities		**1,181,514**	103,319
Net assets		**66,053,474**	68,979,618
EQUITY			
Contributed equity		**200,000**	200,000
Retained surplus		**65,853,474**	68,779,618
Total equity		**66,053,474**	68,979,618

The above statement should be read in conjunction with the accompanying notes.

SCIENCE AND INDUSTRY ENDOWMENT FUND

STATEMENT OF CHANGES IN EQUITY

For the period ended as at 30 June 2019

	Retained Surplus		Contributed Equity		Total Equity	
	2019	2018	**2019**	2018	**2019**	2018
	$	$	**$**	$	**$**	$
Opening Balance	**68,779,618**	76,082,394	**200,000**	200,000	**68,979,618**	76,282,394
Net deficit	**(2,926,144)**	(7,302,776)	**-**	-	**(2,926,144)**	(7,302,776)
Closing Balance	**65,853,474**	68,779,618	**200,000**	200,000	**66,053,474**	68,979,618

The above statement should be read in conjunction with the accompanying notes

SCIENCE AND INDUSTRY ENDOWMENT FUND

CASH FLOW STATEMENT

For the period ended as at 30 June 2019

	Notes	2019	2018
		$	$
OPERATING ACTIVITIES			
Cash received			
NICTA Gift		**20,000,000**	-
Metcalf bequest		**1,037,633**	-
CSIRO Gift		**-**	10,000,000
Interest received		**1,910,641**	1,434,755
GST credits received		**1,264,219**	1,850,933
Total cash received		**24,212,493**	13,285,688
Cash used			
Payments to grantees		**27,022,452**	20,516,065
Other payments		**353,316**	392,473
Bank fees paid		**398**	450
Total cash used		**27,376,166**	20,908,988
Net cash used by operating activities	9	**(3,163,673)**	(7,623,300)
Net decrease in cash held		**(3,163,673)**	(7,623,300)
Cash at the beginning of the reporting period		**68,181,236**	75,804,536
Cash at the end of the reporting period		**65,017,563**	68,181,236

The above statement should be read in conjunction with the accompanying notes

SCIENCE AND INDUSTRY ENDOWMENT FUND

NOTES TO AND FORMING PART OF THE FINANCIAL REPORT

For the period ended as at 30 June 2019

Overview

The Science and Industry Endowment Fund (referred to as "the Fund") was established under the *Science and Industry Endowment Act 1926* with the Trustee of the Fund being the CSIRO Chief Executive and is a not-for-profit entity. An appropriation of 100 000 pounds was received at the time the Fund was established. The principal activity of the Fund is to provide assistance to persons engaged in scientific research and in the training of students in scientific research.

In October 2009 the Minister for Innovation, Industry, Science and Research announced a gift of $150 million to be donated by CSIRO to the Fund. The gift is intended to be used for scientific research for the purposes of assisting Australian industry, furthering the interests of the Australian community or contributing to the achievement of Australian national objectives. The gift was made subject to the terms of a Deed of Gift between the Trustee and CSIRO dated 15 October 2009. In June 2018, the CSIRO made a further gift of $10 million to the Fund. This gift was also made subject to the terms of the Deed of Gift between the Trustee and CSIRO dated 15 October 2009. The total cash payments made in 2018-19 under the Deed of Gift was $13,482,202 (GST exclusive).

In June 2017, the NSW Government acting through the NSW Department of Industry provided a $25 million endowment to SIEF to create the NSW Generation STEM Program. The program will be delivered over a 10 year period and will implement activities including research, to increase the supply of STEM (science, technology, engineering and mathematics) skilled labour to meet the current and future needs of New South Wales. The total cash payments made in 2018-19 under the NSW Endowment were $2,038,761 (GST exclusive).

In November and December 2018, National ICT Australia Limited (NICTA), a controlled entity of CSIRO, provided two gifts to SIEF in the total amount of $20m to fund the Future National ICT Industry Platform Program. The program is a scale of research activities and projects that address challenges in the field of information and communications technology (ICT) and it is intended that the outcomes from the Program will benefit Australia by helping create new Australian technology-based industries and/or applied technology platforms that can reach global scale. The total payments made in 2018-19 under the Future National ICT Industry Platform Program were $8,328,507 (GST exclusive).

In April 2019, SIEF received a bequest from the estate of the late David Ross Metcalf for $1 million. The Trustee determined to use the bequest for industry/research engagement programs. The total cash payments made in 2018-19 was $1,037,633 (GST exclusive).

In any one financial year a maximum amount of $25 million exclusive of Goods and Services Tax (GST) can be disbursed from the Fund for the CSIRO GIFT, NSW Generation STEM Program and the Future National ICT Industry Platform Program. The total payments made in 2018-19 were $24,887,103 (GST exclusive).

Basis of Preparation of the Financial Statements

The financial statements for the Fund are general purpose financial statements and are required by section 10 of the *Science and Industry Endowment Act 1926.* They have been prepared in accordance with Australian Accounting Standards and Interpretations – Reduced Disclosure Requirements issued by the Australian Accounting Standards Board (AASB) that apply for the reporting period.

The financial statements have been prepared on an accrual basis and are in accordance with the historical cost convention. No allowance is made for the effect of changing prices on the results or the financial position.

The financial statement is presented in Australian Dollars and values are rounded to the nearest dollar unless otherwise specified.

Significant Accounting Judgements and Estimates and New Accounting Standards

No accounting assumptions or estimates have been identified that have a significant impact on the amounts recorded in the financial statements.

The Fund has reviewed new standards, revised standards and interpretations/amending standards issued prior to the signing of the financial statements. They do not have a material effect to SIEF's financial statements.

Events after the Reporting Period

The Trustee is not aware of any other significant events occurring after the reporting date that could impact on the financial report.

Taxation

The Fund is exempt from all forms of taxation except GST.

SCIENCE AND INDUSTRY ENDOWMENT FUND

NOTES TO AND FORMING PART OF THE FINANCIAL REPORT

For the period ended as at 30 June 2019

Note 1 Scientific Research Grants

	2019	2018
	$	$
Future National ICT Industry Platform Program	**9,333,057**	-
Research Infrastructure Investment	**6,615,000**	10,357,000
Special Research Program	**1,440,000**	-
Experimental Development Program	**3,010,767**	4,270,293
NSW Endowment Grant	**2,000,000**	650,000
Research Project Grants	**400,000**	888,224
Scholarships and Fellowships	**2,810,785**	2,167,022
Macquarie University Joint Chair In Wireless Communication	**-**	299,881
Total	**25,609,609**	18,632,420

The Fund is a subsidiary entity of the Commonwealth Scientific and Industrial Research Organisation (CSIRO). For the 2018-19 financial year, the Fund has recognised $25.1m in grant expenses as transferred directly to CSIRO to support scientific research and infrastructure projects within CSIRO and/or collaborative projects with external organisations (2017-18: $16m).

Note 2 Contributions Income

Contributions are recognised as income when the Fund obtains control of the contribution and the amount of the contribution can be measured reliably. Contributions are recognised at fair value of the contributions received or receivable. In 2017-18, the Fund received $10m in contributions from the CSIRO. In 2018-19, the Fund received $20m in contributions from NICTA and $1.0m from the bequest from the estate of David Ross Metcalf. Further details about these contributions have been disclosed in the overview.

Note 3 Interest Revenue

Interest revenue is recognised using the effective interest method as set out in AASB 9 *Financial Instruments.*

Note 4 Cash and cash equivalents

	2019	2018
	$	$
Cash at bank	**3,878,631**	11,302,841
Term deposits	**61,138,932**	56,878,395
Total	**65,017,563**	68,181,236

Cash and cash equivalents include cash on hand and demand deposits in bank accounts with an original maturity of twelve months or less that are readily convertible to known amounts of cash and subject to insignificant risk of change in value. Cash is recognised at its nominal amount.

SCIENCE AND INDUSTRY ENDOWMENT FUND

NOTES TO AND FORMING PART OF THE FINANCIAL REPORT

For the period ended as at 30 June 2019

Note 5 Trade and other receivables

	2019	2018
	$	$
Interest receivable	**793,925**	702,647
GST receivable	**1,423,500**	199,054
Total receivables	**2,217,425**	901,701
Less impairment loss allowance	-	-
Total trade and other receivables	**2,217,425**	901,701

Trade receivables are financial assets held for collecting the contractual cash flows of the asset, where the cash flows are solely payments of principal and interest that are not provided at below-market interest rates. They are subsequently measured at amortised cost using the effective interest method adjusted for any loss allowance.

Note 6 Grants payable

Grants payable relates to grants where the milestone has been met, but are yet to be paid. These items will be paid in the first quarter 2019-20.

Note 7 Financial Instruments

	2019	2018
	$	$
Categories of Financial Instruments		
Financial assets under AASB 9		
Financial assets at amortised cost		
Cash and cash equivalents	65,017,563	68,181,236
Interest receivable	793,925	702,647
GST receivable	1,423,500	199,054
Total financial assets at amortised cost	**67,234,988**	**69,082,937**
Total financial assets	**67,234,988**	**69,082,937**

On implementation of *AASB 9*, there was no change in the measurement of financial assets under any category. Cash and cash equivalents and interest receivable were previously classified as held-to-maturity financial assets. GST receivable was previously classified as loans and receivables.

	2019	2018
	$	$
Financial liabilities		
Financial liabilities at amortised cost		
Grants payable	1,043,744	-
Shared service fee payable	122,270	87,819
Accrued audit fee	15,500	15,500
Total financial liabilities at amortised cost	**1,181,514**	**103,319**
Total financial liabilities	**1,181,514**	**103,319**

SCIENCE AND INDUSTRY ENDOWMENT FUND

NOTES TO AND FORMING PART OF THE FINANCIAL REPORT

For the period ended as at 30 June 2019

Note 8 Schedule of Commitments

The below table shows the monies SIEF is committed to pay on its executed grant funding agreements as at 30 June 2019, subject to grantees meeting funding milestones.

	2019	2018
	$	$
BY TYPE		
Grants commitments payable	**34,639,956**	14,111,011
GST receivable on grants payable	**(3,149,087)**	(1,282,819)
Total net commitments by type	**31,490,869**	12,828,192
BY MATURITY		
Grant commitments payable		
One year or less	**11,163,299**	10,191,852
From one to five years	**15,831,657**	3,259,159
More than five years	**7,645,000**	660,000
Total grants payable	**34,639,956**	14,111,011
GST commitments receivable		
One year or less	**(1,014,845)**	(926,532)
From one to five years	**(1,439,242)**	(296,287)
More than five years	**(695,000)**	(60,000)
Total commitments receivable	**(3,149,087)**	(1,282,819)
Net commitments by maturity	**31,490,869**	12,828,192

Note 9 Cash Flow Reconciliation

	2019	2018
	$	$
Reconciliation of operating surplus to net cash from/(used by) operating activities:		
Operating deficit	**(2,926,144)**	(7,302,776)
Changes in assets and liabilities		
(Increase) in receivables	**(1,315,724)**	(295,623)
Increase/(decrease) in payables	**1,078,195**	(24,901)
Net cash used by operating activities	**(3,163,673)**	(7,623,300)

Note 10 Contingent Assets and Liabilities

No contingent assets or liabilities existed as at 30 June 2019 (2018: nil).

Note 11 Related Party Disclosures

The fund is a wholly controlled subsidiary of CSIRO. The trustee is the Chief Executive Officer of CSIRO who is remunerated through CSIRO and not paid an additional salary for his role as trustee of the fund. There were no transactions during the reporting period between the trustee and the fund. Related parties to this entity other than the trustee are other Australian Government entities.

Significant transactions with related parties can include the payment of grants, the purchase of goods and services. Given consideration to relationships with related entities, and transactions entered into during the reporting period by the entity, it has been determined that there are no related party transactions required to be separately disclosed. Grants are awarded based on assessment against a set of established selection criteria prior to approval. All eligible applications are assessed equally.

We collaborated with the National Gallery of Victoria and used flow chemistry to create a new varnish that will protect paintings from ageing (read the case study on page 37).

Image courtesy of National Gallery of Victoria.

Part 7
Indexes

Our sites

At 30 June 2019, we had 55 sites across Australia and three sites located overseas.

Australian Capital Territory

- Acton
- Black Mountain
- Crace
- Ginninderra
- Tidbinbilla
- Yarralumla

New South Wales

- Armidale
  - Chiswick
  - University of New England (UNE)
- Boorowa
- Mopra
- Myall Vale
- Narrabri
- Newcastle
- Parkes
- Sydney
  - Eveleigh
  - Kensington
  - Lindfield
  - Lucas Heights
  - Marsfield
  - North Ryde

Northern Territory

- Alice Springs
- Darwin

Queensland

- Atherton
- Bribie Island
- Brisbane
  - Coopers Plains
  - Dutton Park
  - Fortitude Valley
  - Herston
  - Pullenvale
  - St Lucia
- Cairns
- Gatton
- Toowoomba
- Townsville
  - Townsville Australian Tropical Science and Innovation Precinct (ATSIP)
  - Woodstock

South Australia

- Adelaide
  - Kintore Avenue
  - South Australian Health and Medical Research Institute (SAHMRI)
  - Waite Campus

Tasmania

- Hobart
- Sandy Bay

Victoria

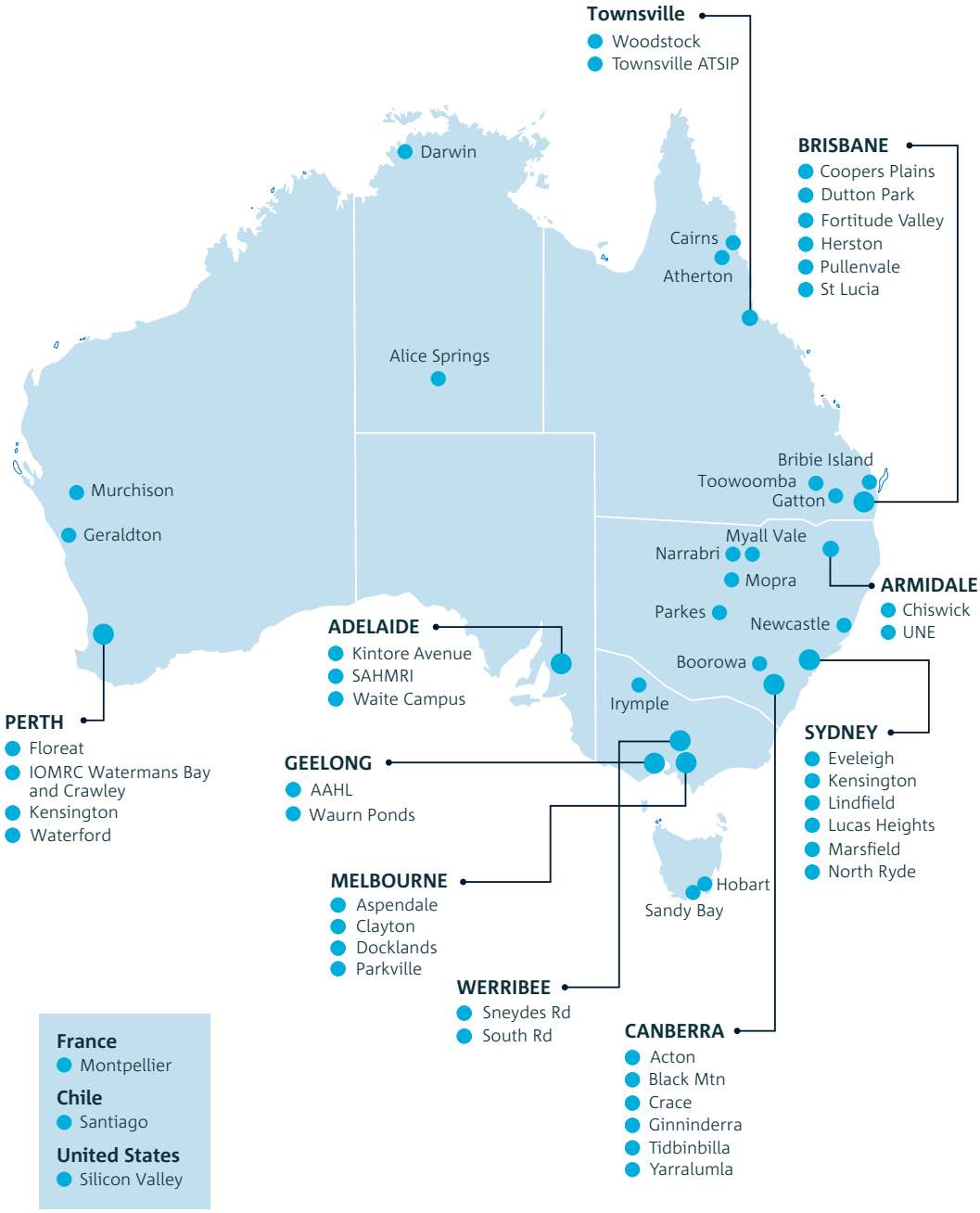
- Geelong
  - Australian Animal Health Laboratory (AAHL)
  - Waurn Ponds
- Irymple
- Melbourne
  - Aspendale
  - Clayton
  - Docklands
  - Parkville
- Werribee
  - Sneydes Road
  - South Road

Western Australia

- Geraldton
- Murchison
- Perth
  - Floreat
  - Indian Ocean Marine Research Centre (IOMRC), Watermans Bay and Crawley
  - Kensington
  - Waterford

International

- France
  - Montpellier
- Chile
  - Santiago
- United States
  - Silicon Valley


Townsville
Woodstock
Townsville ATSIP
BRISBANE
Coopers Plains
Dutton Park
Fortitude Valley
Herston
Pullenvale
St Lucia
Darwin
Cairns
Atherton
Alice Springs
Bribie Island
Toowoomba
Gatton
Murchison
Geraldton
Myall Vale
Narrabri
Mopra
ARMIDALE
Chiswick
UNE
Parkes
Newcastle
ADELAIDE
Kintore Avenue
SAHMRI
Waite Campus
Boorowa
Irymple
SYDNEY
Eveleigh
Kensington
Lindfield
Lucas Heights
Marsfield
North Ryde
PERTH
Floreat
IOMRC Watermans Bay and Crawley
Kensington
Waterford
GEELONG
AAHL
Waurn Ponds
Hobart
Sandy Bay
MELBOURNE
Aspendale
Clayton
Docklands
Parkville
WERRIBEE
Sneydes Rd
South Rd
CANBERRA
Acton
Black Mtn
Crace
Ginninderra
Tidbinbilla
Yarralumla
France
Montpellier
Chile
Santiago
United States
Silicon Valley

Acronyms

AAHL	Australian Animal Health Laboratory
ALA	Atlas of Living Australia
ANACC	Australian National Algae Culture Collection
ANFC	Australian National Fish Collection
ANH	Australian National Herbarium
ANIC	Australian National Insect Collection
ANU	Australian National University
ANWC	Australian National Wildlife Collection
APS	Australian Public Service
ASKAP	Australian square kilometre array pathfinder
ASX	Australian Securities Exchange
ATCA	Australia Telescope Compact Array
ATNF	Australia Telescope National Facility
ATSC	Australian Tree Seed Centre
CCSBT	Commission for the Conservation of Southern Bluefin Tuna
CDSCC	Canberra Deep Space Communication Complex
CERC	CSIRO Early Research Career
CGMB	Centre for Genomics, Metabolomics and Bioinformatics
CO_2	Carbon dioxide
CO_2-e	Carbon dioxide equivalent
CPRs	Commonwealth procurement rules
CRC	Cooperative Research Centre
CREST	Creativity in Research, Engineering, Science and Technology
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DoA	Department of Agriculture
EDP	Experimental Development Program (SIEF)
ESD	Ecological Sustainable Development
ET	CSIRO Executive Team
fishIDER	fish Identification Database and Educational Resource
FOI Act	Freedom of Information Act 1982
FSP	Future Science Platform
FTE	Full-time equivalent
ICT	Information and communication technology
IP	Intellectual property
KPIs	Key performance indicators
LBA	Long baseline array
LiDAR	light imaging, detection and ranging
MCC	Male Champions of Change
MEP	Medium Equipment Program (SIEF)
MNF	Marine National Facility
MOU	Memoranda of understanding
NASA	National Aeronautics and Space Administration
NAWRA	Northern Australia Water Resource Assessment
NCI	Normalised Citation Impact
NCRIS	National Collaborative Research Infrastructure Strategy
NPS	Net Promoter Score
NRCA	National Research Collections Australia
PCT	Patent cooperation treaty
PGPA Act	*Public Governance, Performance and Accountability Act 2013*
PID Act	*Public Interest Disclosure Act 2013*
PV	Photovoltaic
R&D	Research and development
RI	Responsible Innovation
SAGE	Science in Australia Gender Equity
SBT	southern bluefin tuna
SIEF	Science and Industry Endowment Fund
SIR Act	*Science and Industry Research Act 1949*
SME	Small to medium-sized enterprise
STEM	Science, engineering, technology and mathematics
WLAN	Wireless local area network

Glossary

Blue water: The open sea; deep water.

Conference papers: Includes published conference papers and edited proceedings.

Ecosystem services: The important benefits for human beings that arise from healthily functioning ecosystems, notably production of oxygen, soil genesis, and water detoxification.

Granted patents: Once a patent application has been examined and satisfies various patentability criteria, it becomes a granted patent. It remains a granted patent until the end of the patent period (normally 20 years), provided renewal fees are paid.

Inventions: This is the number of inventions where one or more patent/applications are current. Accordingly, an invention might include a granted patent that is near the end of its life (for example, 20 years), or it might include a provisional patent application that has only recently been filed. Further, one invention might relate to a patent application in one country only, or it might relate to over 20 patents/applications in different countries covering the one invention.

Journal articles: Includes journal articles and other items published as part of a journal (for example, an editorial or book review).

Live patent cases: A live patent case is where either a patent application or a granted patent exists. It does not include cases that have lapsed, expired or been withdrawn. Applications may include provisional applications, Patent Cooperation Treaty (PCT) applications and applications pending in Australia or foreign jurisdictions.

New inventions: This is the number of new inventions where an application (normally an Australian provisional application) is filed for the first time to protect that invention. A major implication of filing the provisional application is that it provides the applicant with an internationally recognised priority date. A small percentage of CSIRO's new inventions are filed as United States provisional applications.

PCT applications: International PCT applications are a 'temporary' phase in any international patenting process and these have a life span of 18 months. This type of application is very common in major international corporations and is used by CSIRO when it considers its invention may have wide commercial application. In view of the 18-month time span, it is reasonable to approximate that two-thirds of the reported number were filed in the previous 12-month period.

Pulsar: A rotating neutron star that emits a focused beam of electromagnetic radiation.

Recordable Injury Frequency Rate: This is calculated as the sum of Lost Time Injuries per million hours worked plus Medical Treatment Injuries per million hours worked.

Science excellence: An assessment of the competitiveness of CSIRO's research capabilities. It recognises CSIRO's science (for example, total citations) and excellence (for example, citation rates). It tends to be output-oriented and includes lagging metrics relating to research publication performance (bibliometrics), esteem measures, such as awards, and expert-peer reviews.

Scope 1, 2 and 3 greenhouse gas emissions: Greenhouse gas emissions are organised into scopes to avoid double-counting emissions and indicate those that organisations can control (Scope 1) versus those that they can influence (Scope 3). Scope 1 are emissions from sources that are owned or controlled by the organisation. Scope 2 are emissions from the consumption of purchased electricity, steam, or other sources of energy generated upstream from the organisation. Scope 3 are emissions that are a consequence of the operations of an organisation, but are not directly owned or controlled by the organisation.

Sponsored students: Students are deemed to be sponsored if they receive a full or partial scholarship paid from CSIRO funds to pursue a research project leading to a PhD, master's or Honours degree. This excludes CSIRO employees, whose study expenses are considered to be training and development.

STEM X Academy: A professional learning experience that develops hands-on, inquiry-based lessons and activities.

STEM+ Business Fellowship program: Run through the Science and Industry Endowment Fund, the program embeds early career researchers into an industrial workplace over a two-to-three-year period.

Supervised students: Students are deemed to be supervised if they have a CSIRO staff member appointed officially by the university a co-supervisor for their research project. Normally, CSIRO staff are joint supervisors in conjunction with a university academic.

Technical reports: Includes individually authored chapters as well as whole reports that are subject to peer review and usually publicly released.

Technological output: An assessment of the organisation's excellence in delivering relevant research results to its users. This involves working on the right problems, doing projects well and excellence in transferring our research results. One metric for this, given this context, is CSIRO's patenting activity, as this provides an understanding of its technological output and potential impact.

Telehealth: The use of electronic information and telecommunications technologies to support long-distance clinical health care, patient and professional health-related education, public health and health administration.

Wide-field phased-array feeds: Radio telescopes use specialised cameras, called receivers, to detect and amplify radio waves from space. Receivers with a larger field-of-view are called wide-field. 'Phased array feed' receivers are made up of 188 individual receivers, positioned in a chequerboard-like arrangement. Alongside the receivers are low-noise amplifiers, which greatly enhance the weak radio wave signals received.

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Compliance index: statutory reporting requirements

The index below shows compliance with information requirements contained in section 46 of the *Public Governance and Accountability Act 2013* (PGPA Act), *Public Governance, Performance and Accountability Rule 2014* and the *Science and Industry Research Act 1949* (SIR Act).

This annual report complies with parliamentary standards of presentation and printing, and uses plain English and clear design.

REQUIREMENT	SOURCE	PAGE
Public Governance, Performance and Accountability Act 2013		
The accountable authority of the entity must prepare and give an annual report to the entity's responsible Minister, for presentation to the Parliament, on the entity's activities during the period, by 15 October; or the end of any further period granted under subsection 34C(5) of the *Acts Interpretation Act 1901*. The annual report must comply with any requirements prescribed by the PGPA Rule.	Section 46	1-186
Includes a copy of the annual performance statements in the entity's annual report that is tabled in the Parliament. The annual performance statements must: (a) provide information about the entity's performance in achieving its purposes (b) comply with any requirements prescribed by the rules.	Section 39 (1) and (2)	27-87
Includes a copy of the annual financial statements and the Auditor-General's report must be included in the Commonwealth entity's annual report that is tabled in the Parliament. The annual financial statements and the audit report must comply, and must state whether, in the accountable authority's and the Auditor-General's opinion respectively, whether, they: (a) comply with the accounting standards and any other requirements prescribed by the rules (b) present fairly the entity's financial position, financial performance and cash flows. If the financial statements do not comply, the accountable authority of the entity must add the information and explanations required to present fairly those matters. Similarly, for the audit report, the Auditor-General must state the reasons, quantify the financial effect and state the amount if possible.	Section 42(1)(b) and 43(4)	106-149
Public Governance, Performance and Accountability Rule 2016		
The annual report must be approved and signed by the accountable authority and include details of how and when approval was given. It must state that the accountable authority is responsible for preparing and delivering the annual report in accordance with the section 46 of the PGPA Act.	Section 17BB	ii
The annual report complies with the guidelines for presenting documents to the Parliament.	Section 17BC	188
The annual report uses plain English and clear design.	Section 17BD	188
The annual report must specify the entity's enabling legislation, including a summary of the entity's objects and functions and the purposes of the entity as included in the entity's corporate plan.	Section 17BE (a)-(b)	i, 28, 90

REQUIREMENT	SOURCE	PAGE
The responsible Minister is specified.	Section 17BE (c)	90
The annual report provides details of: • any direction issued by any Minister under an Act or instrument during the period • any government policy orders that applied to the entity under section 22 of the PGPA Act • particulars of non-compliance with any of the above directions or orders.	Section 17BE (d)-(f)	90
The annual report must include the annual performance statements for the entity for the period in accordance with paragraph 39(1)(b) of the Act and section 16F of this rule. If such a statement is included, the annual report must include an outline of the action that has been taken to remedy non-compliance.	Section 17BE (g)	27-87
The annual report must include a statement of any significant issue reported to the responsible Minister under paragraph19(1)(e) of the Act that relates to non-compliance with the finance law in relation to the entity.	Section 17BE (h)-(i)	90
Information about directors is provided, including names, qualifications, experience, attendance at Board meetings and whether the director is an executive or non-executive member.	Section 17BE (j)	91-91, 134
The annual report provides an outline of: • the organisational structure (including subsidiaries) • the location of major activities and facilities and provides a statement on governance practices, including details on – board committees and their responsibilities – education and performance review processes for directors – ethics and risk management policies.	Section 17BE (k)-(m)	24-25 172-173 91-99
The annual report discloses the decision-making process undertaken by the Board in relation to transactions with other Commonwealth entities or companies, or if the transaction is more than $10,000 (inclusive of GST). • If the annual report includes any of the above information: • if there is only one transaction—the value of the transaction must be included; and • if there is more than one transaction—the number of transactions and the aggregate value of the transactions must be included.	Section 17BE (n)-(o)	97
The annual report details any key activities and changes that affected the operations or structure.	Section 17BE (p)	ii, 87
The annual report includes particulars of: • judicial reviews and decisions of tribunals that have had or may have a significant effect on its operations • reports about the authority made by the Auditor-General (other than one made under section 43 of the PGPA Act), a Parliamentary committee, the Commonwealth Ombudsman, or the Office of the Australian Information Commissioner.	Section 17BE (q)-(r)	100

REQUIREMENT	SOURCE	PAGE
The annual report includes an explanation if information is missing from a subsidiary that is required to be included in the annual report and states the effect of not having the information in the annual report.	Section 17BE (s)	n/a
The annual report includes details of any indemnity that applied during the period given to an officer against a liability, including premiums paid, or agreed to be paid, for insurance against the officer's liability for legal costs.	Section 17BE (t)	98
The annual report provides an index of annual report requirements identifying where relevant information can be found in the annual report.	Section 17BE (u)	177-186
The annual report includes details of executive remuneration for key management personnel.	Section 17CA	131
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Contact us

Location

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Clunies Ross Street, Black Mountain ACT 2601

Postal address

GPO Box 1700, Canberra ACT 2601

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1300 363 400
+61 3 9545 2176
csiroenquiries@csiro.au
csiro.au/enquiries

CSIRO Enquiries provides a single point of contact for industry, teachers and students, the research community and the general public.

Media enquiries

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