GROUP OF EIGHT AUSTRALIA

Enabling Australia's **Economic Recovery**

Through Supporting Research Excellence

THE UNIVERSITY OF WESTERN AUSTRALIA

MONASH University

Australian National University

THE UNIVERSITY of ADELAIDE

THE UNIVERSITY OF MELBOURNE

UNSW SYDNEY

THE UNIVERSITY OF QUEENSLAND AUSTRALIA

THE UNIVERSITY OF SYDNEY

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3. Transparent and full costing of research to ensure effective expenditure

Enabling Australia's economic recovery through supporting research excellence

If COVID-19 has driven one long-desired outcome from Government, industry, media and the Australian community more widely, it is the knowledge that without the research capacity in Australian universities, the nation cannot successfully emerge from this pandemic with a robust economic future.

> Federal Minister of Education Dan Tehan:
>
> ***The research done by our universities can lead to the development of new products and innovations that drive job growth, business opportunities and productivity gains.***

Without research – Australian research – the world would have lacked the knowledge that stomach ulcers can be treated with antibiotics[1], that young women could be protected from 70 per cent of the strains of virus that lead to cervical cancer through a simple vaccination[2], that skin damaged through burns or acne scars can be repaired through a substance called tropoelastin[3].

Discoveries such as these have helped to create the world we have.

But the pace of change is rapid and we must continue to strive for excellence, to remain at the pinnacle of research. Past breakthroughs do not fuel our future. Research will help Australia to keep abreast of developments in national priority areas such as cyber security, advanced manufacturing, energy

1 https://www.science.org.au/learning/general-audience/history/interviews-australian-scientists/professor-barry-marshall/teacher

2 https://www.tga.gov.au/alert/gardasil-human-papillomavirus-vaccine

3 https://www.sydney.edu.au/news/84.html?newscategoryid=1&newsstoryid=14943

and resources. These developments will be the foundation of new industries, new jobs, and new prosperity.

Australia faces a moment in time – a moment which can lead to the rebuilding of a research-led economic recovery and prosperous future.

Australian universities conduct the majority of Australia's research. We underpin the economy through the graduates we produce and the discoveries we make.

The issues our nation is facing are well known. Any recovery must ensure a more sovereign Australia; one that is more capable, more productive, even more innovative than it already is. We must look to lift our leading medical research and outcomes, developing more advanced technologies to support Space, AI, and Defence capability. We need to establish ourselves post COVID-19 as a very different, more independent, productive economic entity in the world order.

Unless Government extracts the very best from the vast capability within our universities in both teaching and research, and vitally in partnership with Government and industry, it will not happen; because it cannot. **Consistent excellence in research at scale within Australian Universities is fundamental to the nation's success.**

We underpin the economy through the graduates we produce and the discoveries we make

This paper sets out the Go8's views on how Australian universities that embrace and deliver research excellence at scale can contribute through our research capacity and capability to strengthening our economy and building the nation our community deserves.

Prime Minister Scott Morrison:

Research plays a critical role in ensuring Australia maintains its world-class health system and is particularly important as the world responds to coronavirus.

Enabling Australia's economic recovery through supporting research excellence

The Go8 is committed to producing the highest-quality graduates, the leaders of tomorrow, who can also drive the economy forward. This is a core responsibility. This paper is focussed on our other core responsibility to develop our research strengths and to assist the Australian Government make informed decisions on how to support a research-centred future through its current research reform process.

Seven of our eight members are ranked in the world's top 100 universities for our research strengths, more than 99.6 per cent of which are assessed by Excellence in Research Australia (ERA) as world class or above

The Go8 draws on its members for this advice, based on the overall depth and quality of its research and its contribution to the next generation of researchers. Seven of our eight members are ranked in the world's top 100 universities for our research strengths, more than 99.6 per cent of which are assessed by Excellence in Research Australia (ERA) as world class or above. This includes through the Go8 awarding almost half of the research doctorates in Australia.

And here Australia is also exceptionally fortunate; because our Government already has, and relies on, one of the world's most respected research quality rating measures – the Excellence in Research in Australia (ERA) framework, mentioned above. The Go8 supports the current review to enable ERA to continue to help the Government make policy decisions on research with confidence.

Federal Minister for Science Karen Andrews:

From the work happening to find a vaccine through to research to track community spread of the disease - our science and research community are among our greatest assets in our efforts to beat this pandemic

It is the Go8's aim that this paper will assist Government to deliver a targeted set of reforms that can support the foundations upon which excellent research and innovation is built for the benefit of Australia:

1. Supporting excellent research at scale to maximise benefit to the nation
2. Sustainable translation and research infrastructure funding across national economic priority areas
3. Transparent and full costing of research to ensure effective expenditure

1. Supporting excellent research at scale to maximise benefit to the nation

The Go8 proposes that the economic and societal benefit enabled by major funding agencies, such as the Australian Research Council (ARC) and the National Health and Medical Research Council (NHMRC), which support Australia's world-leading research excellence, are maximised by the upcoming policy decisions. If we can do this, then we can maintain and enhance the capacity of our world-leading research teams and deliver the sustainable outcomes Australia must have.

What cannot be ignored (and is too often forgotten) is that there is **nothing more portable than a human brain. That is where research resides and works. If it is undervalued; if it is not funded as is required; if it is made redundant (as is already happening to many university early career researchers and their associated teams) then numerous other nations are waiting with the funding, the labs and the standard of living to pounce on that brain and secure it. It will leave us, be disenchanted by us, and take with it a valuable slice of Australia's future research capability.*

2. Sustainable translation and research infrastructure funding across national economic priority areas

The Go8 suggests that we can drive industry/university collaboration harder. This is vital to economic recovery and can be done in two ways:

- By building on the success of the Medical Research Future Fund (MRFF) in non-health priorities
- By bolstering nationally significant research infrastructure.

Research is far more than much needed discovery. Discovery is most beneficial when it is translated into outcomes (short and long term) that deliver economic benefit. However, too often discoveries go unrealised due to lack of translational funding to help that process.* ***For example, it is little recognised that without the royalties the University of Queensland receives from the discovery of Gardasil some three decades ago, there would have been no funding for 2020 research into a COVID-19 vaccine – and the University of Queensland vaccine research still remains local drug manufacturer CSL's favoured candidate.*

Internationally accepted measures that assess globally excellent research make clear Australia has **pioneering research capability in fields including chemistry and chemical sciences, computer and information sciences, earth sciences, engineering, health sciences and physical sciences.** This includes a world-leading **national share of the top one per cent most-cited articles in these fields as compared to countries such as US, UK and China. These strengths are the foundations upon which Australia is able to create the industries and discoveries needed for our future.**

3. Transparent and full costing of research to ensure effective expenditure

The Go8 proposes more openness around research expenditure by introducing a sensible mechanism that transparently tracks the cost of research. This is needed to ensure a sustainable funding system into the future.

Excellent research has a very high Return On Investment judged economically and socially.

**Through the Government's planned reform process for research we can introduce mechanisms to show how excellence at scale within a university delivers the "best bang for taxpayer buck". It is an opportunity that Australia cannot afford to let slip away. Adequate transparently costed funding ensures a high value return in dollar terms and for the community.*

These measures proposed by the Go8, in partnership with Government, seek to leverage existing and future investments to deliver maximum benefit for all Australians. The introduction of transparent research costing will guide and enable government and industry investments in research deliver sustainable research now, and into the future.

Through the Government's planned reform process for research we can introduce mechanisms to show how excellence at scale within a university delivers the "best bang for taxpayer buck"

Excellent research has never been more vital to Australia's economic and social future.

Threat to research

Issues currently deleterious to research that must be addressed

- Loss of research workforce across key areas of national priority – once lost, impossible to replace
- Loss of university funding reduces ability to co-fund competitively won research projects – this discretionary funding has fallen away
- Australia's excellent research is well above world-standard – now we must keep this to deliver a post COVID-19 economic recovery
- Excellent research underpins industry collaboration successes – therefore must be nurtured or the national economy suffers

Loss of research workforce across key areas of national priority – once lost, impossible to replace

Australia faces the potential loss of nearly 10,000 top quality researchers who are likely to be snapped up by other nations willing to put a premium on their research abilities. They have been engaged in excellent, high-quality research in areas where Australia is world-leading, and which are deemed nationally significant.

It is this workforce which leads to new products and discoveries, and which, in turn, creates the jobs and the productivity vital to Australia's post COVID-19 future.

Given universities' significant losses of international student income; and the volume of already-announced university job losses as a consequence; the threat to our very best 10,000 researchers is exacerbated by the likelihood that **over 4,000 on fixed-term contracts *will* end** between December 2020 and March 2021.

Table 1: Go8 Excellence Delivering on National Priorities

National Priority	Research Income: National (All ERA Ratings)	Research Income: Go8 ERA Rating 5 as % of National (All ERA Ratings)
Advanced Manufacturing	$2,559,745,548	42%
Artificial Intelligence & Cybersecurity	$1,332,700,267	50%
Defence	$2,076,140,029	47%
Energy & Resources	$2,700,493,238	44%
Environmental Change; Food; Soil & Water	$4,315,202,662	44%
Space	$1,975,458,666	50%
Transport	$1,881,989,978	42%
Priorities Total	**$6,804,124,347**	**38%**
Health & Medical Totals	**$4,232,511,408**	**54%**
HASS Discipline Totals	**$1,783,588,313**	**32%**
Total	**$10,951,474,655**	**44%**

While medical researchers and teams are supported through the Government's investment in the NHMRC and the MRFF, the research workforce in areas of national capability and priority face the risk of much job loss.

Research is also a job *generator* both directly and indirectly. For example, ResMed, world famous for its work on sleep apnoea, has its foundations in research undertaken at the University of Sydney and now employs more than 4000 people. Less known are the jobs that research generates or supports along the value chain – from the miners that source the titanium used in Monash University based additive manufacturing at Amaero,

... the threat to our very best 10,000 researchers is exacerbated by the likelihood that ***over 4,000 on fixed-term contracts will end***[5] *between December 2020 and March 2021*

to the many service employees that support researchers in labs, in libraries, in freight industries.

Loss of university funding reduces ability to co-fund competitively won research projects – this discretionary funding has fallen away

Our capacity to apply university discretionary funds to support competitively won research funding

In 2018, the Go8 spent $6.5 billion on research, of which only $2.3 billion (35 per cent) was funded by Government

– including research that has been specifically selected by a Government funding agency like the ARC to deliver benefit to the Australian community – has been significantly reduced, exacerbated by the downturn in international student revenue. Currently close to 60 per cent of university expenditure on overall research activity is sourced from untied university funds. Collectively the **Go8 is facing an estimated $2.2 billion revenue reduction** this year alone. Much of this would previously have been used to support research awarded through competitively won grants from the ARC and NHMRC. This is no longer possible.

In 2018, the Go8 spent $6.5 billion on research, of which only $2.3 billion (35 per cent) was funded by Government. **The Go8 universities spent $3.1 billion of their own funds to support research the nation needed and wanted, but only partially funded.** Some support also came from industry and philanthropy. What discretionary funding remains in Go8 universities will be used to meet their contractual commitments to co-invest in National Research Infrastructure (NRI) facilities they host or partner in, as well as in research collaborations with industry, such as through the ARC Centres of Excellence.

Sustaining our world leading research excellence – currently under pressure

COVID-19 has shone a light on the vulnerability of Australia's research funding system. It is time to consider how to fund our research effort as an essential economic pillar of our sovereign nation. If we fail to do so, our position as a leading economic nation is at risk.

It is critical for Australia's future that we can maintain our high-quality research as demonstrated through national and internal excellence measures. They show that Australia, led by our research intensive universities, has strong national capacity in the very areas of research that will fuel post-COVID-19 success: such as chemistry, computer science, engineering, clinical medicine, material sciences, physics and space sciences.

Table 2: Share of S&E publications in the top 1% most-cited articles in disciplines (of overall national output): 2016

	Australia		
Chemistry	**2.38%**	United States – 1.83%	United Kingdom – 1.47%
Computer and information sciences	**2.58%**	United Kingdom – 2.24%	Canada – 2.22%
Engineering	**2.45%**	Iran – 2.27%	United Kingdom – 1.95%
Geosciences, atmospheric and ocean sciences	**3.08%**	United Kingdom – 2.80%	Canada – 2.46%
Materials science	**3.78%**	United States – 2.67%	United Kingdom – 2.55%
Biological and biomedical sciences	2.17%	**United Kingdom – 2.35%**	France – 2.03%
Mathematics and statistics	1.89%	**Italy – 2.17%**	United Kingdom – 1.86%
Physics	2.87%	**Canada – 2.96%**	Spain – 2.79%
Agricultural sciences	1.91%	France – 2.24%	**United Kingdom – 2.60%**
Astronomy and astrophysics	3.30%	Canada – 3.71%	**Brazil – 5.14%**
Health science	2.50%	Canada – 2.51%	**United Kingdom – 2.65%**

Threat to research

But this is increasingly under pressure. Australia faces a choice: to support the capacities that will support our future; or to see them wither away and be snapped up by competitor nations.

Australia's remarkable research strength is the bedrock on which innovation and translation occurs in industries that are vital to our future ...

Australia's excellent research is well above world-standard – now we must keep this to deliver a post COVID-19 economic recovery

As stated above, the majority of Australia's excellent research (some 70 percent) is carried out within the Go8 (99.6 per cent assessed by the Government's own ERA exercise as world class or above).

The areas of world-leading strength, and where support is required for such excellence to be maintained, closely align with Australia's national priorities including the Government's National Research Infrastructure Initiative, and the Industry Transformation Priorities.

ERA also demonstrates Australia's research strength in the areas that make a direct contribution to the delivery of public services, building future workforce and capability and developing policy across significant areas such as family violence, cybersecurity, defence and industrial relations.

It also reinforces the views of the 2017 Productivity Commission "Shifting the Dial" report, aimed at boosting national productivity in key industry sectors including healthcare, transport and infrastructure.

Australia's remarkable research strength is the bedrock on which innovation and translation occurs in industries that are vital to our future, including in advanced manufacturing, health, energy, defence and transport.

> ***In the commercial world you have the problem that the amount of research you can do in a company is based on how well your current business is going, whereas there actually should be an inverse relationship where when things are going worse you should do more research***
>
> Alan Kay

As Group of Eight universities demonstrate excellence across most disciplines, they are also well poised to apply their capability across new priorities and emerging scientific fields.

It also positions Australia as an attractive location for talented world-class researchers and attracts R&D focussed businesses.

Australia's excellent research at world leading capacity is closely aligned to achieving the Government's nine National Science and Research Priorities where there is also a significant concentration of industry investment.

Industry and the Go8 have been focussed on investing in research and development where there is significant commercial potential, including in health, plant production and energy.

As Group of Eight universities demonstrate excellence across most disciplines, they are also well poised to apply their capability across new priorities and emerging scientific fields

However, there remain clear opportunities to further maximise investment in areas where business is investing heavily, such as manufacturing and information media and telecommunications[4].

4 Australian Bureau of Statistics 2019, Research and Experimental Development, Businesses, Australia, 2017–18

Threat to research

As Australia's response to the pandemic has demonstrated there is huge potential for advanced manufacturing to play a more significant role in Australia's economy, and for ground breaking research to galvanise the development of new products[5]. Researchers now have access to greater volumes and diversity of information than ever before – from that collected to track people's movements in COVID-19, to the gigantic datasets emerging from molecular biology or astronomy research, meaning that new research and technologies created to handle, disseminate and protect such information can potentially have broader industry application[6]. These are only two examples of areas where increased research could lead to the large productivity gains Australia has been seeking, and which will become even more critical for the nation post COVID-19.

Federal Education Minister Dan Tehan:

... So we're now working with the sector to see what we can do to support that research capability through the next 12 to 18 months.

Because that is going to be vital to our economic outcomes going forward, vital for our economic outcomes for the next five to 10 years. It's that research capability which will drive innovation and jobs.

5 Minister Karen Andrews, National Press Club Address (20 May 2020) 'Science and technology are the enablers of industry. For advanced manufacturing in the modern, competitive world, they are more crucial than ever before.'

6 'In order to continue our run of over 27 years of uninterrupted economic growth, Australia must seize the significant economic and social opportunities that digital technologies bring.' Minister Karen Andrews, Australia's Tech Future strategy

The Go8 research reform proposals in detail – excellence is key

The proposed reforms

1. Supporting excellent research at scale to maximise benefit to the nation
2. Sustainable translation and research infrastructure funding across national economic priority areas
3. Transparent and full costing of research to ensure effective expenditure

A prosperous Australia can be enabled through future-proofing investment in excellent research. The proposed reforms set out to achieve exactly this ambition for our nation. Sustainable research funding should build and maintain areas where Australia has significant research capability and which drive collaboration with industry to contribute to national productivity.

A prosperous Australia can be enabled through future-proofing investment in excellent research

1. Supporting excellent research at scale to maximise benefit to the nation

Government has a comprehensive suite of initiatives focussed on driving excellent research, including research clusters such as ARC Centres of Excellence and the Industrial Transformation Research Hubs and Training Centres. Notably, the Government has implemented a range of measures through the NHMRC and the MRFF that have built world-leading health and medical research.

However, the Go8 asserts that the funding being directed to drive these initiatives will not maximise economic benefit in current circumstances unless underlying concentrations of excellence are protected.

The Go8 research reform proposals in detail – excellence is key

To maximise these existing initiatives, prevent the deterioration of areas in which Australia is world-leading, plus sustain excellence in areas of national priority, the Go8 proposes **Government establish a dedicated fund to support and concentrate investment in research excellence as a way to drive the best value for the nation from a taxpayer contribution and boost sovereign capability.**

Go8 institutions lead nearly 70 per cent of the 18 ARC Centres of Excellence funded from 2017 and more importantly most CoEs feature three or more of our members

Such an approach would reward and therefore further build universities for research excellence, with a specific focus on industry translation, while paralleling several such international initiatives such as Canada's Excellence Research Chairs initiatives and Germany's Clusters of Excellence approach.

Such reform could drive collaboration and innovation across key industry sectors and support concentrations of excellent research in Australian universities, within and outside the Go8. There are pockets of such concentration in Australia, for example seven of the Go8 universities collaborate with leading institutions and researchers in the Bushfire and Natural Hazards CRC. Go8 institutions lead nearly 70 per cent of the 18 ARC Centres of Excellence funded from 2017 and more importantly most CoEs feature three or more of our members. This is no coincidence – by default, such initiatives attract excellence. Systemising the contribution that excellent research can make is what the Go8 seeks.

The German Clusters of Excellence initiative involves researchers from a variety of disciplines and institutions working on a collaborative project. The focused approach to funding enables researchers to intensively engage in research activity, train young scientists and recruit highly qualified international researchers. Annually, the German Government spends €533 million euros (approximately $870m AUD) in support of its Clusters of Excellence. Australia's funding of ARC and NHMRC Centres of Excellence, Industrial Transformation Research Hubs, Fellowship schemes and related measures are a similar form of identifying and supporting research in Clusters of Excellence, however, as noted above, they are unlikely to be sufficient to fuel Australia's greater economic needs in a post-COVID environment. Projects funded through the Clusters of Excellence initiative include research into machine learning, controlling microbes to fight infections, and precision medicine in chronic inflammation[7].

More than 55 per cent of Go8 research was assessed at the highest level of excellence – **well above world class** in the Australian Government's Excellence in Research for Australia 2018 round. Internal modelling shows that this concentration of capability also maps strongly against priorities for the nation such as advanced manufacturing, defence, energy and resources, food, soil and water. We found that 9,662 or just under a third of our total Go8 researchers worked in disciplines contributing to national priorities[8] at this level of excellence. In emerging areas such as artificial intelligence and cybersecurity, Go8 researchers numbered over 2,000 at this level, demonstrating the capacity to bring excellence at scale to new priorities.

7 https://www.research-in-germany.org/en/research-landscape/excellence-universities/clusters-of-excellence.html

8 Priorities were limited to Advanced Manufacturing, Artificial Intelligence and Cybersecurity, Defence, Energy and Resources, Environmental Change; Food; Soil and Water, Mental Health, Space, Transport, Health and Medical

2. Sustainable translation and research infrastructure funding across national economic priority areas

The Go8 proposes to drive industry-university collaboration hard through sustainable translation funding. We see this as vital to economic recovery because sustainable translation funding will bolster innovation capacity, spinout and start-up outcomes, and existing industry and business productivity gains, and the platforms for collaborative innovation across our national priorities.

As evidenced by the MRFF, the Commonwealth Government's valuable support for translation activity in the area of health has been sustainably funded and is delivering world-class successful outcomes

The Go8 is therefore keen to see Australia build on its MRFF success in non-health areas using the MRFF as a template. It has been a much appreciated fund by universities, and the community more generally. Its commitment to funding health research has it noted as a world leader. Without the MRFF to support COVID-19 research, Australia's response would have been impaired.

As evidenced by the MRFF, the Commonwealth Government's valuable support for translation activity in the area of health has been sustainably funded and is delivering world-class successful outcomes. If we build on such a successful model as a nation, we can surely commit to further develop essential translation capability in areas such as engineering, plant biology, and materials science, to maximise economic and societal benefits of excellent research in national priorities such as defence, agriculture and advanced manufacturing.

The Go8 also notes that opportunities clearly arise from bolstering investment in research translation and through research infrastructure

platforms that enhance collaboration between industry and universities. The Go8 hosts nine, or just under half, of the research-critical National Research Infrastructure (NRI) facilities. As lead agents and being the conduit for almost 30 per cent of the funding ($320m) for this infrastructure they carry a significant responsibility for the nation.

The design of the translation funding should concentrate on enhancing the absorptive capacity of industry and universities to identify, nurture and scale new ideas and enterprises. This will enable stronger understanding of supply chains, business needs and skills, providing the basis for deeper, longer-term collaboration.

3. Transparent and full costing of research to ensure effective expenditure

Introducing a transparent costing mechanism, such as the UK's Transparent Approach to Costs (TRAC), could help to make Government research expenditure more sustainable by providing a high level of visibility on actual costs. This would also show the value Government puts on research to benefit lives and future standard of living.

Through TRAC, all UK Research Councils pay a fixed percentage of the full economic costs of grant proposals. In most instances, this is set at 70 per cent. In the case of equipment, items up to a set procurement threshold are funded at around 50 per cent[9]. Australia currently lags well behind, with only 30 per cent of all university R&D costs covered by Australian Government investment[10].

9 While there have been some unintended operational effects reported within TRAC, its core principles have been validated by a quality assurance program and it is subject to ongoing review

10 ABS 2020, Research and Experimental Development, Higher Education Organisations, Australia, 2018

The Go8 research reform proposals in detail – excellence is key

The Go8 suggests adopting this approach initially with the MRFF. If successful, it could then be leveraged to create research system efficiencies across other public research funding schemes.

These reforms proposed by the Go8 will drive deeper collaboration with industry – a long-term government goal, highlighted in the Productivity Commission's "Shifting the Dial" report

Such a national approach would enable more focussed, sustainable spending; and ensure costs are consistently paid across the research system, whether by Government or by other non-Government funding sources.

Relatedly, it should be noted that the existing Research Block Grants (RBG) scheme is under pressure. It was introduced to contribute towards the unfunded costs of all competitively won research projects. But as it is now used to cover the costs of the MRFF, the funds available for non-health research projects have been reduced; at exactly the time the nation can ill-afford it.

These reforms proposed by the Go8 will drive deeper collaboration with industry – a long-term government goal, highlighted in the Productivity Commission's "Shifting the Dial" report.

As can be illustrated by the research case studies in the following section, research of global excellence from Australian universities has been at the heart of many of Australia's advancements. It must continue and never has it been more crucial.

How excellent research can drive economic activity – case studies

Advances in farm irrigation yielding efficiencies in the consumption of water, energy and labour

Cooperation between the University of Melbourne's School of Engineering and Rubicon Water has resulted in a ground-breaking technology to meet irrigation demands.

- Research into hydraulic control of channels resulted in significant breakthroughs including in flow measurement and control theory.
- The irrigation system developed improves the water management in open channel distribution systems and provides a more accurate allocation of water from the irrigation.
- This better management and control help to meet a plant's through sensors. It results in better water availability for users, enabling farmers to grow higher-value crops using less labour, water, and energy.
- Rubicon has designed, built, and installed over 25,000 control and measurement devices in systems sold to more than 50 customers in 10 countries.
- In early 2019, Rubicon secured a sale worth A$200 million to a subsidiary of the Government of Karnataka (a state in India). It is one of the company's largest ever contracts.
- This project will see Rubicon work in partnership with Medha Servo Drives of Hyderabad.

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Transforming mining and stevedoring industries through robotics and Intelligence systems

The University of Sydney's Australian Centre for Field Robotics (ACFR) research is improving human safety, operational efficiency and cost effectiveness in mines and ports.

- The university's researchers are world leaders in the development of autonomous robotic systems and help Australian industry maintain global competitiveness.
- The ACFR is one of the largest robotics and autonomous systems research institutes in the world, developing intelligent system operating 24/7 in outdoor environments.
- Energy intensive industries such as stevedoring and mining have collaborated with the ACFR to improve safety, predictability, precision and efficiency.
- Patrick Stevedores started using AutoStrads (unmanned machines that move containers using high integrity navigation technology) in the Ports of Brisbane and Botany in 2005 and 2015 respectively, delivering massive savings and improving employee safety.
- The Rio Tinto Centre for Mine Automation at the university has developed the MAS picture compilation technology to deliver real time tracking of surface equipment and ore deposits located well beneath the earth's surface. This pinpoint accuracy mapping reduces waste and operating costs. The technology was deployed in 75 per cent of Rio Tinto's open cut Australians mines in 2016 and is increasing towards 100 per cent deployment.

The ACFR is one of the largest robotics and autonomous systems research institutes in the world, developing intelligent system operating 24/7 in outdoor environments

Australia is a global leader in advanced manufacturing

Monash University has built one of the strongest capabilities in laser-based additive manufacturing processes (3D printing) in the world through the Monash Centre for Additive Manufacturing (MCAM), and helped to form Amaero Engineering to commercialise this technology.

- Amaero International launched on the ASX in December 2019, raising $8 million on a heavily subscribed IPO, with market value of nearly $35 million.
- Specialising in additive manufacture of metallic components, Amaero focuses on the aerospace sector where quality standards are extremely high and delivers aviation and military specification 3D-printed alloy critical operation components.
- The company has secured approval for several ITAR-regulated projects and works with the world's leading aerospace and defence companies (including six of the world's top 10 defence contractors). Partners include Boeing, Airbus, Raytheon, Northrup Grumman, BAE Systems, Safran, Thales Group and Virgin Australia.

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- El Segundo facility was also awarded AS9100 Aerospace Certification by the International Aerospace Quality Group. AS9100 is a standardised international quality management system for the Aviation, Space and Defence (AS&D) industries, and a requirement of major aviation and aerospace manufacturers, including Boeing and Airbus.
- Amaero partners with another Go8 member at its South Australian manufacturing site, which builds on a facility originally established by the University of Adelaide.

How excellent research can drive economic activity – case studies

A world leading solution to cervical cancer

In the two decades since University of Queensland researchers (aided by an acclaimed Chinese researcher) discovered Gardasil® and Cervarix® vaccines, cervical cancer in Australia has decreased by more than 90 per cent. The vaccines were patented by UniQuest; its research and development was funded by CSL then on-licensed to global drug giant Merck.

In the two decades since University of Queensland researchers … discovered Gardasil® and Cervarix® vaccines, cervical cancer in Australia has decreased by more than 90 per cent

- Cervical cancer is one of the few cancers to be caused by a virus. Worldwide, it is the second most common cause of cancer death in women. The researchers produced "virus-like particles" that could activate the immune system and form the basis of a HPV vaccine.
- The university's commercialisation arm, UniQuest Pty Ltd filed a patent application in the early 90s.
- Industry funding was provided by CSL which later on-licensed the vaccine technology to Merck while retaining the rights to market the vaccine in Australia and New Zealand.
- Merck subsequently funded the successful Phase II and Phase III clinical trials. Additionally, CSL entered into a cross licensing and settlement agreement with GlaxoSmithKline (GSK) in 2005.
- More than 205 million doses of the Cervarix and Gardasil vaccines have distributed in 130 countries, reducing the number of deaths by cervical cancer by around 250,000 each year.
- It is now used for a range of other cancers and both teenage girls and boys benefit greatly from the vaccination.

Go8 Research – highly responsive in a crisis

The 2020 summer bushfire disaster and the arrival of COVID have led to a number of urgent research priorities for Go8 universities, a small number of which are listed below. They demonstrate how excellent research universities – such as the Go8 – can pivot our high calibre research to the national benefit in its time of need.

- The University of Melbourne has worked with Western Health to develop a personal (transportable, moveable) ventilation hood for hospital beds to help contain the droplet spread of COVID-19 in ICUs – the research excellence and specialisation involves fluid mechanics expert Professor Jason Monty from the University's School of Engineering.

... to develop a simple, low cost ventilator solution using 3D technology. The "CoVida" ventilator can be rapidly manufactured

- The University of Sydney has worked with NSW Health Infrastructure to develop a simple, low cost ventilator solution using 3D technology. The "CoVida" ventilator can be rapidly manufactured.
- Monash University is studying the effects of COVID-19 restrictions on the functions of a large city (The Melbourne Experiment). The Melbourne Experiment will use its findings to develop new approaches for sustainable urban growth, emphasising social cohesion and environmental conservation alongside economic prosperity. A core aim is to explore the question: 'What will Melbourne look like in 2050?' if there is insufficient action to grow sustainably and inclusively.

- University of Sydney researchers have led a global team to map socio-economic losses and environmental gains of the COVID pandemic – findings including a loss of 4.2 per cent of the global workforce, and a 4.6 per cent reduction of greenhouse gases.

University of Queensland researchers working with CSIRO colleagues successfully demonstrated in April 2020 … the possibility of tracking communal COVID-19 prevalence via raw sewage, leading to the development of surveillance methods that could be applied by every suburb

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  **This seminal work not only helped confirm waste water monitoring as a cheaper and faster monitor than clinical screening, but has helped refine extraction and monitoring methods such that it can take only 15 to 30 minutes to process samples. The work is being shared with a new worldwide collaboration in water-based epidemiology (WBE), the COVID-19 WBE Collaborative, which will share methods and data on waste-water surveillance.*

- ANU's MakerSpace has been coordinating the production of face shields and masks, producing 2,000 face shields by May 2020 to supply health workers, and developing a prototype face mask that can be sewn by volunteers and returned to the ANU for sterilisation and readiness for non-frontline health workers.

- Monash University has honed understanding of employment impacts by showing which locations in Australia's capital cities show the greatest impact on employment due to COVID-19 restrictions – such as Chadstone and Southbank in Melbourne, Paddington in Sydney, university districts and cultural and recreation precincts. The research also identifies the most vulnerable employment communities (arts, entertainment and education in inner suburbs).

- University of Sydney Brain and Mind Centre's unique modelling has shown that eight to 10 per cent reductions in suicide, self-harm hospitalisations, and ED presentations can be achieved through investment in a combination of specialised mental health services, IT-enabled coordinated care, and post-suicide attempt assertive aftercare. Over five years, up to 2,650 lives could be saved, 33,450 suicide attempts averted, and 225,800 fewer presentations to EDs would result nationwide. The modelling was released in advance of the National Cabinet meeting on 15 May that endorsed the Mental Health and Wellbeing Pandemic Plan developed by the National Mental Health Commission.

Over five years, up to 2,650 lives could be saved, 33,450 suicide attempts averted, and 225,800 fewer presentations to EDs would result nationwide

- Leading Go8 researchers came together twice in 2020 to develop key advice to the Australian Government – firstly on suitable, informed and Australia-specific approaches to social distancing during the COVID-19 pandemic; and secondly to provide evidence-based comprehensive advice on options for Australia's COVID-19 exit and recovery phase. Both the Go8's collaborative strengths and the readiness of our researchers to contribute in a focussed, urgent way to the nation's welfare drove these outcomes.

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