THE UNIVERSITY of ADELAIDE

2022

Future making research for the nation

GROUP OF EIGHT AUSTRALIA

make history.

National outcomes through research excellence

As a nation and a region, we face complex social, technological, and environmental challenges.

Increasingly research and innovation are enabling creative solutions for the greatest challenges of our time. Universities, working in deep collaboration with government, business, and the community, are well placed to address these complex issues and maximise their associated opportunities.

Since its founding, the University of Adelaide has had a strong commitment to research excellence. As South Australia's sole member of the Group of Eight, we seek to drive innovation and prosperity through the translation of research and new knowledge. We have been central to the creation and dissemination of knowledge locally, nationally and internationally for the socio-economic advancement of South Australia and Australia.

This document showcases some of the University of Adelaide's globally impactful research, highlighting the strategic alignment with national and state priorities. Analysis identifies the University's leading and aligned research strengths as being in five key sectors: Defence, Cyber and Space, Health, Minerals and Resources, Energy and Sustainability, and Agrifood and Wine. These strengths have demonstrable research excellence and alignment to current and emerging priorities. In addition, three leading research strengths that underpin a range of sectors are identified.

The University is home to comprehensive research activity that helps us understand the greatest challenges of our time and develop the transformative solutions required. Our translational research across Arts, Business, Law and Economics is key to supporting the wider mission of the University. The University's unique research ecosystem has built a culture of multidisciplinary innovation that values the true extension of knowledge and the application of research.

The University of Adelaide engaged external expertise to validate, through an analytical framework, the University's leading research strengths. The use of key metrics including Category 1-4 income, top 1% cited publications, income per research FTE, annual HDR completions and the number of global and industry research partners helped to distinguish leading strengths. An external overlay was then applied using State and Federal strategies to align these leading strengths to national and state priorities.

Our comprehensive research ecosystem

The University of Adelaide is a world leader in fields that underpin innovation across industries that are critical to our future.

Our comprehensive research ecosystem showcases our unique and cross-disciplinary approach to drive research to develop the solutions for the major challenges of now.

Our leading research priorities in Defence, Cyber and Space, Health, Minerals and Resources, Energy and Sustainability, and Agrifood and Wine are demonstrably excellent and align with current and emerging priorities.

Our multi-sector research strengths of Mathematics, Sensors and Sensing, and AI and Machine Learning are transforming traditional methods of research and providing ground-breaking innovation across many or all of these sectors.

In addition to our leading research priorities, the University conducts research that is advancing business, regulatory policy, and creative futures for our State and nation. Working within and across boundaries in new and novel ways, this research is generating impact for government, industry and society.

Defence, cyber and space

Australia and the Indo-Pacific are experiencing a period of significant economic and security transformation.

With heightened regional tensions, Australia's reliance of the rules-based global order has never been more important. The University of Adelaide has a long and proud history of partnering with Australia's defence and space sectors.

The University of Adelaide is one of the leading research facilitators of defence, cyber and space capabilities in Australia. Our involvement has ranged from co-developing Australia's first satellite and rocket-launch capability in the 1960s, to working with Defence and industry on game-changing systems research and radar technology.

The University is uniquely placed to deliver highest-quality research and translation for our partners. We are the only Australian university to have been a contributor to the recent three big physics discoveries – the Higgs Boson, Gravity Waves and Astrophysical Neutrinos.

Also, we are the lead university for the $240M Defence Trailblazer – Concept to Sovereign Capability, and home to the $20M Centre for Augmented Reasoning.

Our Defence, Cyber and Space research teams are actively working with other researchers from all disciplines across the University, including in the areas of law and health to drive new, cross-disciplinary ways of thinking that lead to transformative innovations for the sector.

The University of Adelaide is committed to using its extensive research capacity, in partnership with government and industry, to meet the global and national challenges of our time.

The Defence, Cyber and Space research sector has been included in this document on the basis of an independent analysis. That analysis identified 'Category 2 to 4 research income', 'number of global research partners', and 'number of industry research partners' as key metrics that identified research strengths aligned with this sector.

Our research in Quantum Physics, Astronomical and Space Sciences, and Atomic, Molecular, Nuclear, Particle and Plasma Physics is strengthening our domestic defence capabilities and safeguarding Australia's way of life.

These research areas all demonstrate strong alignment with current and emerging State and national priorities, including the *National Manufacturing Priorities* and the *Blueprint for Critical Technologies*.

Quantum technologies

Quantum technologies have been globally identified as one of defence's most important and disruptive enabling technologies. Innovations in quantum technologies will not only enhance current defence capabilities, but will provide new capabilities in sensing and computing. One of the greatest opportunities for quantum technologies is in the application of sensing and positioning.

The University of Adelaide is driving innovations through our world-class capabilities in quantum materials research. New materials born out of the University's research have supported the development of new electronics and optics for electric and automated vehicles and in a variety of other defence applications.

Astronomical and space sciences

Researchers across the University of Adelaide are actively involved in driving astronomical and space research. The University's multi-disciplinary team across science, engineering, health, policy and law are helping build domestic capabilities and driving commercialisation opportunities for industry.

The University's research seeks to directly address the current challenges faced by the sector, such as developing algorithms for space exploration, and the means for sustaining life off Earth through the provision of foundation services. The University's research is helping make Australia's space capabilities world-class.

Our researchers work closely with the Federal Department of Defence, the Australian space industry, and the South Australian Government. The formation of the Defence Space Command presents the latest opportunity to leverage Australian-based research for space capabilities.

Particle physics

Experimental particle physics is driving a greater understanding of the universe and space at its most fundamental level. Through innovative, cutting-edge technologies, we can build a better understanding of dark matter, which makes up 80% of the mass of our universe.

The University of Adelaide is at the forefront of research in theoretical particle physics. Our research is driving advances in the understanding of subatomic matter and providing a theoretical framework. By driving a better understanding of dark matter and particle cosmology, our researchers are generating new knowledge and technologies for creative solutions to our greatest global challenges.

Our University has a long history of working with leading global research institutes. Our cross-institutional work at the Large Hadron Collider is putting Adelaide and Australian science innovation on the global stage.

Health

Health research touches everyone. Through innovations in health, we are living longer and more fulfilled lives.

However, increasing societal expectations and changing technological influences are having a profound impact on our health and our healthcare systems. Novel scientific discoveries and their applications can help us respond to these external influences and strengthen our health for the long-term.

The University of Adelaide is a leader in health and medical research. Across the University, we conduct world-class health research that is consistently ranked in the top 1% of universities internationally.

The University's health research has vastly improved the lives and wellbeing of our communities. As part of supporting our community, we are investing in sovereign, Australian-made medical solutions. This is represented in our South Australian Immunogenomics Cancer Institute (SAiGENCI) which is producing world-leading cancer research, and our partnership with industry in developing domestic mRNA vaccines as part of a Cooperative Research Centres Project (CRC-P) with BioCina Ltd.

Through our network of partners in government and industry, we apply our research to make a real difference. We have a strong history of driving commercialisation of innovations for our partners including the founding of one of Australia's most successful fertility clinics Repromed, which has helped more than 40,000 couples in their efforts to conceive.

Across key areas of priority activity, our researchers work collaboratively across the University, including with the health economics, social sciences and social housing research disciplines, to support the translation of our research for real societal benefits.

The Health research sector has been included in this document on the basis of an independent analysis. That analysis identified 'Category 1 research income' and 'number of global research partners' as the key metrics that supported the inclusion of specific research strengths aligned to the sector.

Our research across Cancer Biology and Clinical Oncology, Respiratory and Vascular Health, Paediatrics and Reproductive Medicine, Surgical Health Systems, Nutrition and Dietetics, and Neurosciences is delivering new technologies, treatments and therapies for the health of all, across generations and communities.

These research areas all demonstrate strong alignment with current and emerging State and national priorities, including the *National Preventive Health Strategy 2021–2030* and the *Australian Medical Research and Innovation Strategy*.

Cancer biology and clinical oncology

The University of Adelaide's leading research strengths in Cardiovascular Medicine and Haematology, and Oncology and Carcinogenesis are helping build a better understanding of the fundamental mechanisms by which cancers arise, progress and respond to treatment. By understanding the causes of cancer, our research is enabling the development of innovative approaches to treat both liquid cancers and solid cancers.

Our Adelaide-based network of industry and government partners allows for our research success to be translated for benefits for all. Our partnerships with the Royal Adelaide Hospital and The Central Adelaide Local Health Network are helping build strong collaborative links between clinical and research communities to drive real results.

Reproduction and early life health

The health trajectory of every child is profoundly influenced by their parents' health and wellbeing, as well as the early days of a child's life.

The University is driving research on defining the biological and social factors that manifest before pregnancy which influence conception and early childhood health. We seek to understand the mechanisms underlying the link between parent health and wellbeing prior to conception, during pregnancy and in early postnatal life that determines the quality of this crucial early environment.

Our research is helping maximise fertility and pre-conception health to reduce the incidence of infertility and related reproductive conditions and diseases. Our collaborative relationship with industry representatives like Fertility SA is helping apply our ground-breaking research to help Australian families.

Health translation

High-quality preclinical and clinical research is the foundation stone of optimised health care capability that serves to improve the quality of life of patients.

Translational health research applies basic scientific findings to enhance health and wellbeing. By taking findings from 'bench to bedside', the University is able to drive innovative new treatment and improved health policy. Our researchers are developing new and innovative ways to transfer new knowledge to health service professionals, to change practice; improve skills; and influence policy and procedures system wide.

Through our research in Public Health, Health Services and Clinical Sciences, we seek to drive improvements for all who rely on our health system.

Minerals and resources

The Minerals sector is central to Australia's identity and economic success, as it is to the University of Adelaide.

In particular, the University knows that the ongoing and secure supply of critical minerals is essential to the transition to a high-tech and clean energy world.

Through our comprehensive research, the University of Adelaide has supported and strengthened Australian mining since 1889; and we will continue to act as a catalyst for its success well into the future. The University's expertise and experience encompasses every aspect of the minerals value chain – from exploration, extraction and processing to site planning and management, transport, and delivery of key resources.

The sustainable transition of the global mineral and resources sector is a crucial step for securing its future. Our commitment to supporting the future of mining is evident by our involvement as the Founding Member of the $175 million Heavy Industry Low-carbon Transition Cooperative Research Centre, which is bringing together industry, government, and researchers to accelerate the transition toward zero net-carbon emissions.

Our size, capability and research history makes the University one of the most comprehensive research centres of mining in Australia. We are fiercely committed to ensuring our research has a positive impact – for our partners, our community, and our planet.

The Minerals and Resources research sector has been included in this document on the basis of an independent analysis. That analysis identified 'Category 2 to 4 research income' and 'number of industry research partners' as the key metrics that supported the inclusion of specific research strengths that aligned to the sector.

Our research in Geology, Geochemistry, Resources Engineering and Extractive Metallurgy, Electrical and Electronic Engineering, and Civil Engineering is providing the next generation of solutions for the sector's multiple challenges that will increase trust among the ecosystem of stakeholders.

These research areas all demonstrate strong alignment with current and emerging State and national priorities, including the *Australia's Critical Mineral Strategy* and the *National Resources Statement*.

Exploration

The University's research in critical minerals is end-to-end, from prospective analyses to resource definition, waste utilisation, supply chain economics and exports. Our research in geochemistry, geology and mineralogy is consistently recognised as leading in Australia.

Our exploratory research is driving new ways of mineral discovery deep under the Earth's crust without penetrating the surface. Through imaging technology, our researchers can identify mineral systems and deposits without damaging our precious environment, thus reducing overall exploratory waste.

The University's researchers are working with the mining and resources industry in developing new tools and technologies that are supporting the next generation of mineral exploration. We are working with key industry leaders including BHP, Anglo American and Santos to see the true benefit of our research translation to support a more sustainable and efficient exploratory process.

Extraction and processing

The University is leading research to improve the competitiveness, productivity, and sustainability of Australia's mining industries. Our mineral recovery knowledge is helping the industry adapt to global challenges and thrive.

Our extraction and processing researchers are creating new technologies and methods that are supporting the decarbonisation of heavy industry and the challenges that come from a high-risk work environment. By incorporating data and algorithmic modelling, our researchers are creating an evidence-driven extraction process, allowing miners to test proposed extraction plans and reduce waste and externalities of extraction.

Through the University's innovation in extraction technologies and processes, we are adding value to Australia's mining sector, producing national benefits for all.

Transport and infrastructure

Transportation and site infrastructure makes up some of the biggest outlays for the mining sector. New technologies are helping reduce costs and increase efficiency for the sector.

The University's researchers are some of the most innovative and in-demand experts in site construction, function, and security. Our expertise in civil engineering and experience in both the civil and mining industries gives our research teams a unique edge. We are focused on providing practical solutions to existing and future infrastructure problems.

With strong partnerships with industry and government bodies, our researchers provide a range of services, including modelling and simulation methods, which is supporting the productivity and efficiency of the sector.

Energy and sustainability

As we mitigate and adapt to a rapidly changing environment, we will need to transition to a renewable, low-waste world.

The University of Adelaide has established a global reputation as a comprehensive research hub for energy innovation that will drive this global transition to a more sustainable world.

The University of Adelaide is dedicated to help develop a more environmentally-sustainable world. In the pursuit of the achievements of the United Nations 2030 Sustainable Development Goals, we recognise the responsibility that research has in providing a pathway to achieve sustainability.

The University is supporting the transition from traditional energy production to less emissions-intensive sources through producing breakthrough research across the energy life cycle. Ground-breaking innovations like our Australian-made Lithium-CO_2 and Zn-Fe batteries are a fundamental part of moving the sector to a sustainable future. We are also supporting green business and delivering new innovations for the market, including the development of green hydrogen technology with our partners Sparc Technologies and Fortescue Future Industries. These innovations will drive greater choice for the Australian and global economies in low-emission, energy production technologies.

Our researchers combine science and engineering innovation to bring together solutions that facilitate resilient and sustainable futures for Australian and global environments. Working with industry, government and across the University, including with our social sciences, law reform and economics experts, we are facilitating the transition to a more sustainable world.

The Energy and Sustainability research sector has been included in this document on the basis of an independent analysis. That analysis identified 'top 1% cited documents' and 'number of global research partners' as the key metrics that supported the inclusion of specific research strengths that aligned to the sector.

Our research in Chemical Engineering, Macromolecular and Materials Chemistry, Mechanical Engineering, Environmental Engineering and Nanotechnology, is providing the next generation of energy solutions to improve our environmental, economic and social sustainability.

These research areas all demonstrate strong alignment with current and emerging State and national priorities, including *Australia's Long-Term Emissions Reduction Plan* and the *Technology Investment Roadmap: First Low Emissions Technology Statement*.

Future energy technologies

Clean energy is crucial to overcoming the many challenges that our society faces. As our world changes from the effects of climate change, we need new methods of energy production that allow our industries to be productive as well as sustainable.

Our world-class researchers in technology, engineering and chemistry are creating new innovations in hydrogen, solar and wind energy production that is allowing our communities to thrive into the future. Our energy materials research is also developing high-performance energy materials that increase the efficiency of fuel cells, batteries and other electromechanical devices.

Our diverse research teams have been collaborating and engaging with industry and government in delivering innovative outcomes for our economy and society. Our experience and expertise makes the University a reliable partner for transformative energy production.

Decarbonisation and energy transition

As part of its commitment to the Paris Climate Agreement, Australia has set national targets for reducing greenhouse gas emissions. Decarbonisation of electricity is critical to meeting these targets.

The University of Adelaide, through our research strengths in Materials Chemistry and Mechanical Engineering, is leading the way in decarbonisation of industry and transition to a clean, modern energy system. By developing affordable ways to produce materials, such as steel and aluminium, and using greener sources of energy, we can significantly reduce the impact of energy production on the environment.

By investing in and building a low-carbon energy supply chain, we are transforming our heavy industries with new technology, and supporting Australia in becoming a global player in the low-carbon new economy.

Sustainable futures

The warming of our planet and its associated climatic events have significantly impacted the human and natural systems on which we have come to depend.

The University's multidisciplinary research team is united in providing the tools and policy guidance needed to maintain a resilient ecosystem in the face of a shifting climate. Our researchers in Environmental Engineering and Evolutionary Biology specialise in identifying problems and delivering actionable solutions to mitigate the effects of climate change and future-proof urban environments and protected areas.

Driving solutions with industry and local communities is key to overcoming the ecological, economic, or social barriers of building a sustainable future. Through our network of business and societal stakeholders, our researchers are driving real translational benefits for our environment and our communities.

Agrifood and wine

Increasing volatility in the production and distribution of agricultural goods requires a new age of thinking for the global agricultural sector.

The University of Adelaide is internationally-recognised as a global leader of agriculture, food and wine research.

Australia is well-placed to enhance its position as a global leader in Agrifood and Wine innovation. By seeking transformational solutions to the challenges facing the entire sector, Australia can lead new-age research that delivers benefits for industry and communities.

The University of Adelaide is home to the largest concentration of Agrifood research capability on a campus in the southern hemisphere. Our researchers are bringing deep agricultural expertise together with new innovations to drive the future of global food and wine production. Through our capabilities, the University is breaking new ground, including producing new varieties of wheat, almonds, barley and canola with some of Australia's most innovative companies, including Australian Grain Technologies. As a result of our extensive research partnerships, we have the largest range of plant breeder royalties of any Australian university.

Our Agrifood and Wine researchers are collaborating across the University, including with our economics, marketing and biology research teams, to help translate our research findings into high-value new products and services with real commercial impact.

Our researchers work closely with the food and wine industry and in partnership with PIRSA - SARDI to build Australia's capability and competitiveness in agriculture, food and wine. In partnership with government and industry, we regularly tackle significant global issues.

The Agrifood and Wine research sector has been included in this document on the basis of an independent analysis. That analysis identified 'Category 1 research income' and 'income per research FTE' as the key metrics that supported the inclusion of specific research strengths that aligned to the sector.

Our research in Crop and Pasture Production, Plant Biology, Genetics, Horticultural Production, and Applied Economics is helping bridge the gap between new innovations developed by our experts and the take up of new practices by food producers.

These research areas all demonstrate strong alignment with current and emerging State and national priorities, including *Delivering Ag2030* and the *National Soil Strategy*.

Dryland agriculture

Managing the effects of climate change is one of the greatest challenges to Australian farmers. The University of Adelaide is supporting the future and sustainability of Australian agriculture industry through research in dryland agriculture.

The University's leading research in plant genetics, plant biology, and horticultural production is helping build better and sustainable agricultural systems through new approaches. Research in innovative techniques such as carbon sequestration and natural capital is helping improve farm productivity.

By optimising productive farming environments, the University's research is helping strengthen the economic, environmental, and social resilience for future droughts and making Australian producers more productive, competitive, and sustainable.

Agrifood value chain

Global consumer demands are rapidly changing. Increasingly consumers are seeking healthier and ethically sourced and produced foods. The integration of innovation into the agricultural value chain will produce new disruptive opportunities that can enhance the value of our agricultural products, and open new markets for producers and businesses.

The University of Adelaide has established itself as a trusted industry partner, working with the sector in driving innovations across food safety, AgTech, sustainability and environmental management, and producing integrity to enhance the value of our agricultural goods.

By accessing well-established collaborative networks that extend across the globe, the University is collaborating with industry to help develop a range of new higher-value food and beverage products to meet the ever-changing global market.

Wine and viticulture

South Australia is a critical wine producer in Australia, representing almost 50% of the national annual production. Our diversity and quality of wine has allowed us to become global leaders of wine production.

The University of Adelaide's wine research is aimed at understanding the wine-making process and how to improve the quality of Australia's wine. Our research expertise spans the entire wine production chain bringing together wine chemistry, viticultural management, and marketing and horticultural production.

The University of Adelaide works closely with key food industry groups including the world-leading Australian Wine Research Institute. Our eminence in Wine and Viticulture derives from working with others and bridging the gap between innovation and the take-up of new practices by producers.

Enhancing research through cross-cutting capabilities

Our cross-cutting capabilities highlight how our leading research strengths can be applied across all areas of our economy and community.

The University of Adelaide has built a global reputation of research excellence in Mathematics, Sensors and Sensing, Artificial Intelligence (AI) and Machine Learning that is supporting research in all areas of the University. Through our world-class, cross-cutting capabilities, we are solving industry's most challenging problems.

Mathematics

As one of Australia's foremost universities in mathematics, the University of Adelaide is leading research that is supporting decision-making and modelling across a range of sectors.

Our leading strengths in Pure Mathematics, Applied Mathematics and Statistics play a vital role in the University's research activity and unlocking new solutions to the challenges for our industry partners.

We collaborate with a range of global institutes and government departments in providing modelling, solution methodology and decision-making assistance.

Sensors and sensing

The University is a global hub of sensing research. Our multidisciplinary team of physicists, chemists, engineers, biologists and medical researchers are creating new sensing and measurement technologies.

We have established a global reputation for our world-class research and connection with industry and government across defence, health, mining and manufacturing.

Through our leading strengths in Photonics, Optical Physics and Image Processing, we are enhancing our community's safety, health and prosperity.

AI and machine learning

The University of Adelaide is a world-leader in the application of machine learning methodologies. With over 100 researchers, we are Australia's largest university-based research institute in machine learning.

Our research in AI spans health, space, mining, defence, agriculture, construction and environmental sectors, and is enhancing the processes, practices and efficiency of these industries.

We work collaboratively with small-to-large enterprises to help them get the most of their data and realise the opportunities that machine learning technology offers.

Future making research

This document is an element of the *Research that Shapes the Future* pillar of our Strategic Plan, *Future Making*.

Through our *Future Making* Strategic Plan, we drive multidisciplinary research collaboration and funding opportunities through FAME Research Strategies, and connect with partners through our Industry Engagement Priorities. Through our world-leading research institutes and globally-connected researchers, we pursue multidisciplinary, large-scale research and innovation.

Research excellence and impact

The University constitutes a vibrant community with over 25,000 students and over 3,500 members of staff. Our three world-class academic faculties and nine institutes underpin a comprehensive and collaborative approach to research generation.

The **Faculty of Arts, Business, Law and Economics** is committed to exploring the key contemporary issues of our times to create a better world. For more information on the Faculty, go to **able.adelaide.edu.au**	The **Australian Institute for Machine Learning** is driving globally-competitive research in machine learning. For more information, go to **adelaide.edu.au/aiml**	The **South Australian Immunogenomics Cancer Institute (SAIGENCI)** is SA's world-class cancer research hub delivering life-changing outcomes. For more information, go to **adelaide.edu.au/saigenci**
The **Faculty of Health and Medical Sciences** is a world-leader in health education and research that seeks to improve health care in Australia and internationally. For more information on the Faculty, go to **health.adelaide.edu.au**	The **Institute for Sustainability, Energy and Resources'** interdisciplinary research is addressing scientific, technological, and environmental challenges. For more information, go to **adelaide.edu.au/iser**	The **Stretton Institute** facilitates stronger links between government, industry, and communities by bringing together policy researchers and experts to address key policy issues. For more information, go to **adelaide.edu.au/stretton**
The **Faculty of Sciences, Engineering and Technology** is committed to delivering outstanding research that helps solve complex global problems and contributes to national priorities. For more information on the Faculty, go to **set.adelaide.edu.au**	The **Institute for Photonics and Advanced Sensing** brings together researchers to create new sensing and measurement technologies. For more information, go to **adelaide.edu.au/ipas**	The **Waite Research Institute** stimulates and supports research and innovation for our partners that builds capacity for Australia's agriculture, food and wine sectors. For more information, go to **adelaide.edu.au/waite-research-institute**
The **Environment Institute** is providing outstanding research across environmental sciences. For more information, go to **adelaide.edu.au/environment**	The **Robinson Research Institute** is producing internationally-recognised research in reproduction and child health. For more information, go to **adelaide.edu.au/robinson-research-institute**	The **Defence and Security Institute** brings together those elements of strategic University activity that have a Defence or Security focus. For more information, go to **adelaide.edu.au/research/defence**

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Kaurna acknowledgement
We acknowledge and pay our respects to the Kaurna people, the original custodians of the Adelaide Plains and the land on which the University of Adelaide's campuses at North Terrace, Waite, and Roseworthy are built. We acknowledge the deep feelings of attachment and relationship of the Kaurna people to country and we respect and value their past, present and ongoing connection to the land and cultural beliefs. The University continues to develop respectful and reciprocal relationships with all Indigenous peoples in Australia, and with other Indigenous peoples throughout the world.