

NATIONAL INSTITUTES GRANT

ANU began as a university unique in Australia and the world. After seven decades it remains so, delivering a great legacy of excellence in research, education and public policy.

The University's distinctive history and organisational architecture underpin its capacity to undertake research that continues to meet the needs of Australian society. By remaining unique, ANU will continue to be one of the greatest reservoirs of information, thought and analysis in Australia and the world.

Established by an Act of Parliament in 1946, ANU is endowed by the Australian Government through the National Institutes Grant (NIG) to undertake basic and applied research to address issues critical to the nation. Secure and reliable funding from the NIG has enabled transformational long-term and applied research and has played a significant role in the University's capacity to undertake research of strategic value to the world.

The NIG is an investment in the future of ANU that keeps Australia on the front foot of discovery and is paid back through countless achievements. In 2016, ANU affirmed its reputation as one of the world's finest universities and number one in Australia by achieving 22nd position in the QS World University Rankings.

The NIG is used to seed research projects and develop opportunities, particularly for early career researchers. Development of Australia's research talent is a critical aspect of securing the nation's future, and the NIG gives a unique advantage to ANU to build quality research and education programs in nationally strategic areas. The NIG enables the best and brightest from across the globe to work at ANU in a world-class environment supported by national-level infrastructure.

The NIG has also enabled ANU to make discoveries for Australian and global industries and has given business the confidence to engage with ANU over the long term. From incubating successful start-ups, to working with our industry partners, we are making a difference to the world we live in.

There are many examples of activities, infrastructure and people supported by the NIG. Several have been highlighted in the following eight broad themes. There are others highlighted throughout this report.

1. Asia and the Pacific

The NIG allows ANU to host the largest number of scholars dedicated to work on Asia and the Pacific in the English-speaking world. The University can harness the knowledge of regional experts that cuts across disciplinary boundaries and provides the kind of country-specific policy expertise that our partners in government and the business sector seek.

Australasian Pollen and Spore Atlas

The School of Culture, History and Language maintains the Australasian Pollen and Spore Atlas (APSA) with support from the NIG. The APSA provides free access to the largest collection of pollen and spore information in the Australasian region. Following the tragic deaths and hospitalisations related to a Thunderstorm Asthma event in Victoria in 2016, the School leveraged APSA and its expertise in pollen monitoring and mapping, and convened an expert panel of researchers, meteorologists and public health experts from academia and government to discuss novel approaches to improving community respiratory health before, during and after these events.

2. Public policy and governance

The NIG has enabled ANU to be a critical resource for policymakers across government, industry and non-government organisations, providing expert advice and support. We are a leading voice in national and international policy development, applying expertise to key policy challenges facing Australia and the region.

National Leadership in Policy and Health Inequity

The NIG has underpinned significant returns in the area of health inequities, one of Australia's and the world's major policy challenges. It has led to the establishment of a five-year NHMRC Centre of Research Excellence on the Social Determinants of Health Equity at ANU, in partnership with Flinders University and the University of Sydney. In 2016, this global health equity body of work was used by the World Health Organization, the United Nations Standing Committee on Nutrition, and ministries of health in Australia and across the Asia Pacific. In the context of the rapid development of countries in Asia and the Pacific region and the associated exacerbation of health inequities, this NIG-supported research and the body of evidence developed by this research, position ANU and Australia at the forefront of health equity policy-salient research.

Public policy leadership

ANU engages frequently with policymakers within government, civil society organisations and multilateral agencies. Through this ongoing engagement, ANU policy research has an impact in multiple ways: in shaping the choice of policy, through framing and reframing debates, by identifying problems, and by critically analysing existing policies and identifying shortcomings.

With NIG support, the Crawford School of Public Policy launched the *Policy Forum* (www.policyforum.net), an online platform providing analysis, debate, and discussion on Asia and the Pacific's public policy challenges. The Policy Forum is run as a resource for the University, the nation, and the region, inviting and posting contributions from more than 500 academic staff from around the Asia Pacific in

its first two years. With thriving associated social media channels and a podcast series, its content reached an audience in excess of 12 million over 2016. *Policy Forum* has helped place ANU at the centre of public policy debate, discussion and analysis in the region.

Strategic defence policy

NIG funding continues to support the work of the Strategic and Defence Studies Centre (SDSC), home to the largest concentration of scholars working in Australia on strategic and defence policy issues. SDSC celebrated its 50th anniversary in 2016, making it the oldest centre of its kind in Australia and the broader Asia-Pacific region. In 2016, the University of Pennsylvania's definitive *Global Go To Think Tanks Index* report ranked SDSC as Australia's leading university-affiliated think tank and one of the top 10 think tanks across Southeast Asia.

3. Energy, environment and sustainability

The NIG has enabled ANU to bring together some of the top researchers in the world across multidisciplinary fields to work on the big environmental challenges and opportunities facing contemporary society.

Battery storage and integration

The Energy Change Institute has established a new international research program at ANU to improve ways to store renewable energy that can be integrated into the electricity grid. The program is part of an \$8 million partnership between ANU and the ACT Government. As the proportion of renewables in the grid grows, battery storage and its integration are becoming increasingly important to address intermittency in renewable energy supply. This research program will feed into existing cutting-edge energy research at ANU and in the ACT, facilitating the transition to a broader low-carbon electricity system.

Support for endangered species

The NIG underpins sustained capacities at the University in environmental sciences and applied ecology, particularly through maintaining the science leadership and logistical capacities to establish and support an internationally remarkable suite of research programs. These programs focused on the production of long-term data and capacities to underpin policy development. In 2016, the Fenner School continued to utilise its NIG allocation to have a significant impact on addressing Australia's national extinction crisis through evidence-based science. This included field surveys that discovered previously unknown breeding grounds of the critically endangered Regent Honeyeater, and leadership of an innovative initiative that saw volunteer arborists from Melbourne carving nest hollows in Tasmania for the critically endangered Swift Parrot.

Solar forecasting

2016 saw significant developments in energy research, placing ANU at the forefront of the rapidly evolving field of solar energy forecasting and stimulation. The NIG provided the capacity to help secure a major multi-partner Australian Renewable Energy Agency (ARENA) project that will take the current version of the University's Regional Photovoltaic Simulation System (RPSS) and develop and deploy it as an operational system that provides distribution network service providers (DNSPs)

with real-time distributed photovoltaic simulations and forecasts mapped to their distribution network. Australia's future energy system will be enhanced by a significantly advanced version of the University's existing RPSS software.

4. Science innovations and technology

The NIG has allowed ANU to advance scientific discovery for today and for the future. ANU is ranked among the very top in the world across vital science and technology fields.

Mathematical sciences

The NIG has led to major national achievements in mathematics with current progress towards tsunami and flood modelling. In 2016, a significant collaboration between ANU and Geoscience Australia progressed ANUGA, a free and open source software package capable of modelling the impact of hydrological disasters such as dam breaks, riverine flooding, storm-surge and tsunamis. ANUGA has been used extensively to quantify the risk from tsunamis around Australia's coastline, and to assess the risk of flooding in Manila and the risk from tsunamis in Papua New Guinea.

Engineering leaders of the future

ANU has focused on areas of engineering where our strength in research can make a large contribution on the world stage, focusing on high-impact interdisciplinary research. In 2016, the NIG continued to support the unique Future Engineering Research Leaders (FERL) program, a program that supports a cohort of Australia's brightest engineers to tackle longer term and more impactful research problems and to develop into international leaders in their fields. The five-year fixed-term appointments allow unfettered access to the unique research resources across ANU. Combined with significant start-up funding and research support, the program provides candidates with an opportunity to build their research profile and to develop into international leaders in their fields. The FERL program encourages participants to move on to leading positions at other research institutions and organisations after their tenure at ANU, distributing the benefits of this program across the nation.

Small satellites

During 2016, researchers from around Australia began testing small satellites on the world-leading facilities at the University's Advanced Instrumentation and Technology Centre (AITC) at Mount Stromlo ahead of a mass satellite launch from the International Space Station. The three small satellites are CubeSats, commercial satellite platforms in the form of cubes ten centimetres on a side. They will be launched into space as part of the European Union's QB50 launch of 50 satellites. The QB50 program has 27 countries building satellites for the mass launch from the International Space Station, including China, US, Brazil and Russia. Before heading into space, the satellites are undergoing rigorous tests in the ANU space simulation facility at the AITC to ensure they are space qualified. These first three Australian CubeSats in space will be doing research with significant public good benefits, including looking at space weather and solar activity, which impact on the security of key systems such as GPS, financial systems and electricity grids.

New molecules

The platform created by long-term NIG investment led to a number of research highlights in 2016 that have potential industry applications, including the recently discovered new class of molecules that can synergise with existing insecticides to abolish insecticide resistance in the Australian Sheep Blowfly. This pest costs the Australian wool and lamb industries over \$300 million per year. Only through NIG support was it possible to carry out the initial proof of concept experiments. The technology that this has produced has the potential to significantly reduce the amount of pesticide that is used in Australian agriculture and to prevent the spread of resistant insects. Work is currently underway testing this new class of molecules with disease vectors of relevance to Australia, such as the mosquito *Culex quinquefasciatus*.

5. Health and medicine

The NIG supports life-saving ANU research for a healthier nation and world. ANU plays a pivotal national role in leading research-driven health policy.

Healthcare communication

With NIG support, ANU now hosts the International Research Centre for Communication in Healthcare (IRCCH). This unique and interdisciplinary centre located in the School of Literature, Languages and Linguistics addresses the challenges of healthcare communication and brings together over 70 international experts in medicine, linguistics, health sciences, health communication, nursing, medical education, allied health and sociology, to find relevant strategies and solutions to impact clinician practice and education globally.

Fighting malaria

Malaria continues to be a major threat to the world's health with more than 500,000 people dying every year of the disease. The NIG supported a new partnership in 2016 between ANU and Humboldt University in Germany to deliver a dual PhD program aimed at crossing boundaries to fight malaria. The ANU/Humboldt University Graduate School aims to provide exciting opportunities to traverse some of these barriers and address fundamental problems in preventing malaria through an International Graduate School. Molecular insights into malaria can generate novel evidence-based strategies to develop therapeutic and prophylactic drugs and create immunisation strategies that provide lasting protection.

6. Culture, creativity and societies

The NIG has enabled ANU to maintain a significant reservoir of resources and expertise across the humanities and social sciences. Our success on the world stage would not have occurred without the long-term stable funding afforded by the NIG.

Australian law

ANU has a strong research culture exemplified by high-profile scholarship across multiple fields, including legal systems and governance, Australian, international and public law, social justice, human rights and criminology. There is also considerable cross-disciplinary legal research undertaken at

ANU, a feature that distinguishes ANU from other Australian universities and is supported by the NIG. An example is the ANU College of Law and Fenner School of Environment and Society research on climate change mitigation in the land and agricultural sectors. The research outputs from this interdisciplinary work have included publications in leading multidisciplinary environment and climate journals, including *Nature Climate Change*, *Climatic Change*, *PLOS One*, *Climate Policy* and *Carbon Management*.

Australian National Dictionary

With NIG support, The Australian National Dictionary Centre (ANDC) continued to make national headlines with their Word of the Year in 2016 and published its second edition of the *Australian National Dictionary: Australian Words and their Origins*, exploring the way in which the words that make up the lexicon of Australian English have evolved over time. Published by Oxford University Press (OUP) Australia, this edition is the product of extensive research and editing by ANDC staff, who also research and publish a number of other OUP Australian dictionaries and linguistic monographs.

7. Indigenous Australia

The NIG supports Indigenous research of a size and scope that is unparalleled nationally and vital to the cultural development of this country.

Aboriginal economic policy

Supported by the NIG, the Centre for Aboriginal Economic Policy Research (CAEPR) is Australia's foremost social science research centre focused on Indigenous issues. Indigenous communities and policymakers have used its work since the 1990s to inform the development of policies to improve the economic and social circumstances of Indigenous Australians and to evaluate outcomes of key initiatives. CAEPR maintains a particular focus on education, training, employment and Indigenous businesses. Research in 2016 brought together an interdisciplinary team to examine the design, implementation and impact of the government's Community Development Programme (CDP) on Aboriginal and Torres Strait Islander people across remote Australia. The CDP has become one of the most pressing policy issues in contemporary Indigenous affairs. This research prompted a direct response from the Minister for Indigenous Affairs who indicated publicly that he would address some of the concerns raised by the research in 2017.

8. A resource for the nation

The NIG has allowed ANU to acquire and maintain a range of world-class research facilities and other resources that not only contribute to the significant outcomes of ANU, but are utilised by researchers around the nation and world. Many of these resources are unique within Australia and in some cases rare throughout the world. The value of these resources is immeasurable.

Australian Election Study

The Australian Election Study (AES) is a large-scale survey of the Australian electorate designed to assess the attitudes and opinions of citizens at each federal election since 1987. Led by the School of Politics and International Relations and supported by the NIG and Australian Research Council,

the AES is the most widely used survey in Australian political science to monitor trends in political attitudes and behaviour. The 2016 survey interviewed 2,818 voters nationally, asking a comprehensive range of questions about their political behaviour, interests, beliefs and background. Results showed electoral volatility was at its highest level since academic surveys began tracking in 1967. ANU has also been a leader in forming international consortia to further research in these areas, notably as a founder member of the World Values Survey, the Comparative Study of Electoral Systems and International Social Survey Program.

Astronomical sciences

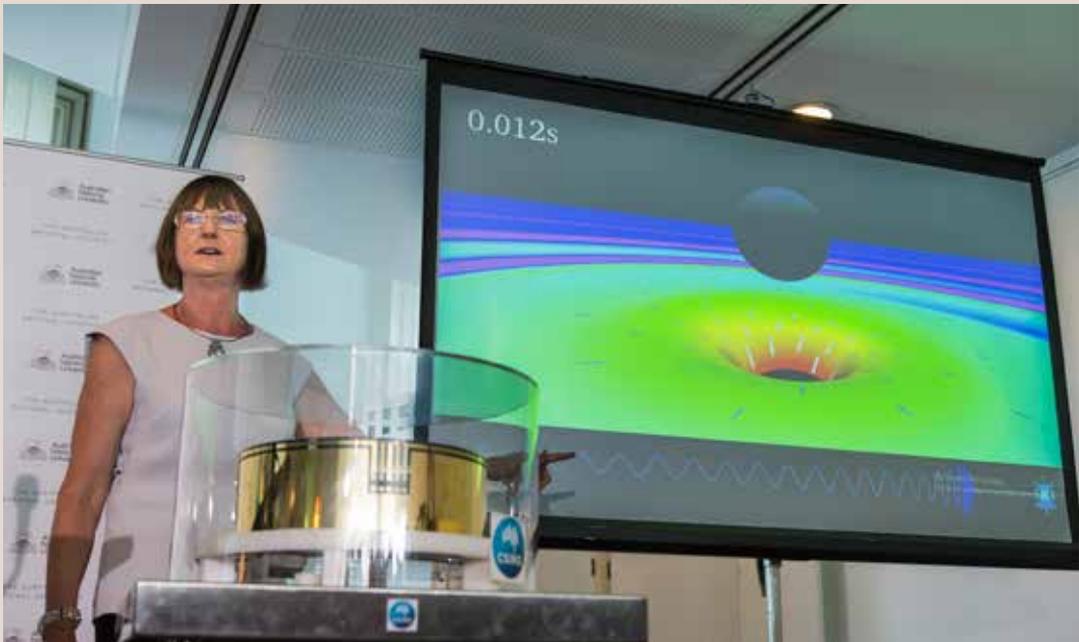
The University's outstanding research record in astronomy and astrophysics is founded on the use of the NIG to provide unique world-class observational facilities to ANU staff and other Australian researchers. In 2016, the NIG supported the University's unique position amongst Australian universities in operating a world-class optical observatory. Siding Spring Observatory near Coonabarabran, NSW, is home to the ANU 2.3-metre telescope, the SkyMapper 1.3-metre telescope, and the 1.2-metre UK Schmidt Telescope. The NIG covers the direct costs of running the observatory and the telescopes are available to all Australian astronomers. Many of these telescopes are instrumented in whole or part by the Advanced Instrumentation and Technology Centre (AITC), which is the only major astronomical instrumentation program at an Australian university.

Supernova sets a geological clock on Earth

New discoveries in physics crucially depend on a long-term technical capability to ensure either novel instrumentation can be developed, or national facilities can be maintained. The NIG has helped drive new discoveries by supporting significant ANU research infrastructure and associated technical and academic capacity. Using the University's world-class particle accelerator, one of the rarest isotopes in nature, iron-60, was detected in sediment and crust samples taken from the Pacific, Atlantic and Indian oceans. Iron-60 is only formed within a supernova. The research has provided geologists with a 'timestamp' in the sedimentary layers that is universal and global, meaning that we can now tie different parts of the world together during major geological or climate events.

Flagship centre in genomics, metabolomics and bioinformatics

The ANU-CSIRO Centre for Genomics, Metabolomics and Bioinformatics (CGMB) was officially opened in 2016. The CGMB is the flagship initiative within the National Agricultural and Environmental Sciences Precinct that was established by ANU and CSIRO in late 2014. The centre brings together two global leaders in the area of plant and agricultural sciences. By educating researchers and stimulating projects in transformational agriculture, the CGMB will foster advances essential to food security and environmental stewardship in the face of climate change, population growth and land degradation.



Gravitational waves

ANU scientists played a key role in the global scientific collaboration which proved the existence of gravitational waves for the first time, 100 years after they were predicted by Albert Einstein's General Theory of Relativity. The announcement was made in February 2016.

The confirmed observation of a gravitational waves, ripples in space caused by the collision of two black holes, is a major discovery and opens up new fields in physics and astrophysics. It will give scientists a new way to study the Universe, black holes, dark matter and gravity.

More than 1,000 scientists around the world have been involved in the research, including a collaboration of Australian universities through the Australian Consortium for Interferometric Gravitational Astronomy (ACIGA).

The gravitational waves were detected by the twin detectors of the Laser Interferometer Gravitational-wave Observatory (LIGO) in the United States, in Louisiana and in Washington State.

Australian scientists and industry are at the forefront of the discovery and are well placed to lead future research and development.

ANU, University of Western Australia and University of Adelaide helped build crucial components of the LIGO detectors used to find the gravitational waves.

The physicists who were involved in the discovery were later part of a team that was awarded two prestigious physics prizes: the \$3 million Special Breakthrough Prize in Fundamental Physics and the \$500,000 Gruber Prize for Cosmology. Professor Susan Scott from the ANU Centre for Gravitational Physics was also elected as a Fellow of the Australian Academy of Science in May.

Spinoffs from this technology are already being used and developed for commercial applications, such as the search for oil and gas and to measure groundwater from space.

Photo: Professor Susan Scott from the ANU Centre for Gravitational Physics at the announcement in Parliament House.



National Dictionary

More than 6,000 new Australian words and phrases, including words from more than 100 Indigenous languages, were officially recognised with the release of the second edition of the Australian National Dictionary at the end of August.

The Australian National Dictionary is the primary repository of Australian English and the custodian of words and phrases unique to Australian history and culture.

It is published by Oxford University Press Australia and New Zealand (OUP) and compiled by the Australian National Dictionary Centre at ANU.

Launched in Parliament House by the Hon Dr Andrew Leigh MP in August, the second edition is the first comprehensive update of the Australian National Dictionary since 1988. It now has definitions and the history of 16,000 words and phrases unique to Australia.

In October 2016, an edition was presented to Prime Minister Malcolm Turnbull and now rests in his Parliamentary office bookcase.

Photo: The Hon Dr Andrew Leigh launches the second edition of the dictionary.