Connecting Research Business Industry Government

UNSW
THE UNIVERSITY OF NEW SOUTH WALES

Research@UNSW
2012.13

Never Stand Still

Introduction

Welcome to the latest issue of *Research@UNSW*, a biennial publication highlighting the breadth of important research taking place across the University of New South Wales.

We've focused this issue on our industry, business, government and community partnerships that are so vital to our research effort – whether it be in medicine, science, engineering or the arts.

As you would be aware, UNSW is one of Australia's top universities – a member of the Group of Eight and of the prestigious international network U21. The only Australian research-intensive university established with a scientific and technological focus, UNSW continues to build on its reputation for world-class research in areas critical to the future, with close links to industry and an emphasis on practical application and impact.

If you are already involved in research collaboration with our institution, you may see opportunities for further involvement – if not, you may see an opportunity to become involved. The publication is also aimed at keeping key stakeholders in government and the higher education sector informed, as well as outlining opportunities for students interested in pursuing postgraduate research at UNSW.

There are contact details at the back of the publication for anyone interested in pursuing a partnership or collaboration, or postgraduate study. You are also more than welcome to contact the individual researchers whose work is highlighted in these pages.

UNSW shares with its many partners a commitment to pioneering research and innovation, so important to the long-term welfare of the nation. I hope you find *Research@UNSW* an inspiring showcase of some of the outstanding examples of our research partnerships in action.

Les Field
Vice-President and Deputy Vice-Chancellor (Research)
The University of New South Wales

"We've focused this issue on our industry, business, government and community partnerships."

Photo: Grant Turner, Mediakoo

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Connecting

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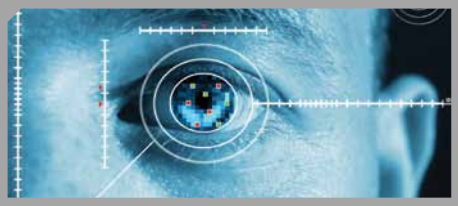

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www.research.unsw.edu.au/research-magazine

The hope for a better future lies in new technology. To ensure research breakthroughs translate into real-world applications, UNSW has forged partnerships with some of the world's leading players, from NASA to China's solar power giant, Suntech.

Partners in...

Technology

technology

Atomic action

Brave new world ... Professor Michelle Simmons, Director, ARC Centre of Excellence for Quantum Computing and Communication Technology

Photo: Anthony Johnson, fairfaxphotos.com

Exponentially faster and far more secure. These are the exciting promises of quantum computing and communications, which could revolutionise the future of information processing beyond anything we can imagine.

By harnessing the unusual properties of quantum physics and building atomic-scale electronic devices, researchers at UNSW are making major inroads towards developing a scalable quantum computer.

"We aim to develop quantum computers with the potential to fundamentally transcend the limitations of conventional supercomputers," says Scientia Professor Michelle Simmons, Director of the ARC Centre of Excellence for Quantum Computing and Communication Technology (CQC2T) at UNSW.

Together with Scientia Professor Andrew Dzurak, Professor Sven Rogge and Dr Andrea Morello, she is leading a team of researchers working at the forefront of physics, nanotechnology and engineering. And the vision extends further – CQC2T researchers based at the Australian National University, Griffith University and the University of Queensland are laying the groundwork for an ultra-secure quantum "internet" that will link these computers of tomorrow around the world.

Quantum communication uses particles of light called photons to transmit information, similar to the way today's internet uses optical fibres, with one key difference: the quantum nature of single photons will make this transmission totally secure.

While early systems allow point-to-point data transmission along dedicated optical fibre lines over distances nearing 100 kilometres, researchers in the Centre are looking to extend this to the national and global scale. Working with an Australian company called Quintessence Labs, the Centre's aim is to develop a multi-party network.

The unique combination of secure communications and ultra-fast computation has garnered interest from military and government, as well as multinational corporations and financial institutions that want to safeguard valuable information.

Of course, the need for a quantum internet hinges on the successful development of a practical quantum computer.

UNSW researchers are also leading this race, embedding single phosphorus atoms in silicon to create quantum bits, or qubits, which are the fundamental components of quantum computers.

Silicon offers the advantage of being widely used and understood by computer manufacturers and should be easier to transfer to industry. In addition, electron spins can be maintained for much longer in silicon than other materials, meaning more calculations can be performed before the information encoded on that spin is lost.

In silicon quantum computing, data is encoded on the rotational spin of an electron, bound to a single phosphorus atom. A clockwise spin represents a zero and a counter-clockwise spin represents a one – but in the slippery quantum realm, particles exist in two different states at the same time, meaning they can represent both numbers simultaneously.

"[Our] device represents the ultimate in precision engineering. It's the first time anyone has been able to show this level of control of a single atom."

Professor Michelle Simmons
Director, ARC Centre of Excellence for Quantum Computing and Communication Technology

This is the key advantage of quantum computers. Current supercomputers work by wiring up thousands of individual processor chips, with each processor working on one possible solution to a given problem.

"In contrast, quantum computers have an inherent ability to solve problems in a parallel way, trying out trillions of different solutions at the same time, with the same physical processing unit," says UNSW's Australian National Fabrication Facility Director Andrew Dzurak, from the School of Electrical Engineering and Telecommunications.

It means they're perfectly suited for solving extremely complex, data-intensive problems, with implications for disciplines ranging from medicine to finance.

International attention on work at the CQC2T is growing with the recent publication of critical breakthroughs in the field by Centre researchers.

In January 2012, PhD student Bent Weber was first author on a study in *Science*, detailing the creation of the world's narrowest silicon wire – just four atoms wide and one atom tall.

Despite having a diameter roughly 10,000 times thinner than a human hair and being invisible to the naked eye, the wire can conduct electricity as well as copper.

This is an important find, as future atomic-scale electronic circuits needed for quantum computers will require similarly sized interconnecting wires that maintain their functionality.

Following on this success, researchers in the Centre developed the world's first atomically precise single-atom transistor, which was detailed in the journal *Nature Nanotechnology*.

While a few single-atom devices had been developed previously, these had a relatively large error in the positioning of the atoms, an essential drawback limiting their overall functionality.

"[Our] device represents the ultimate in precision engineering," says Simmons, who was named the 2011 NSW Scientist of the Year. "It's the first time anyone has been able to show this level of control of a single atom."

In addition to gaining recognition from high-profile international journals, the research has also spawned some promising industry partnerships.

The Centre is working with US-based Zyvex Labs to transition these single-atom fabrication technologies to an industrial scale.

"There are easier paths to demonstrate qubits, but the path chosen by Simmons, while extremely ambitious, is in our opinion the most likely to succeed beyond laboratory demonstrations and become a technology with dramatic capabilities," says Zyvex Labs president John Randall.

The Centre also has a strong partnership with Sandia National Laboratory in the US, a government laboratory specialising in defence science.

"The collaboration with Sandia is important because it maintains a silicon microfabrication plant … that can help us move technologies from the concept phase to prototypes and real systems," says Dzurak.

"The path is most likely to succeed beyond laboratory demonstrations and become a technology with dramatic capabilities."

John Randall
President, Zyvex Labs

Developing feasible, cost-effective manufacturing processes for these devices is a significant challenge that must be overcome. These collaborations are an important bridge to moving the technologies forward. "Working with industry partners allows us to observe how industrial processes work so that we can use their tools and engineer their scalable designs into our architectures," says Simmons.

"At the same time it allows our industry partners access to the latest technologies in fabrication, measurement and design. We're developing systems that are roughly 10 to 100 times smaller, that simply don't exist in their production lines."

PROJECT PARTNERS:
Professor Simmons partners with:
Quintessence Labs // Zyvex Labs // Toshiba // IBM
Professor Andrew Dzurak partners with:
Sandia National Laboratory

"The Sun King"... UNSW alumnus and Suntech founder, Dr Zhengrong Shi

Photo: David Mariuz, fairfaxphotos.com

Solar flair

Once thought of as an expensive and shaky source of power, solar energy is making a charge as a reliable and increasingly competitively priced option for countries seeking to reduce their reliance on fossil-fuel-driven forms of power generation.

And UNSW is at the cutting edge of solar-cell research, working with a global set of industry leaders to build on its established successes and create the next-generation low-cost, high-efficiency solar-power technologies.

For over two decades, the University has held the world record for solar-cell efficiency. The team at UNSW's ARC Photovoltaics Centre of Excellence has a track record in developing world-leading, high-performance laboratory technologies, and collaborating with quality industry partners to put these innovations into real-world use.

The potential of the solar-electricity industry is enormous. Analysts report a 140 per cent increase in photovoltaic solar-panel production worldwide in 2010, and a 60-fold increase in the decade since the year 2000. The uptake of solar power is tipped to grow most strongly in the developing world, among fast-growing nations such as China and India.

One of UNSW's key industry partnerships is with solar-energy giant Suntech Power, based in China. Suntech was founded by UNSW alumnus Dr Zhengrong Shi, utilising expertise developed on campus at the University.

"Suntech has been very innovative in its commercialisation processes," says Centre Director, Scientia Professor Stuart Wenham. "It is very good at adapting our laboratory technology to suit commercial-type processes, based on the use of industrial equipment."

Dr Shi says the partnership between Suntech and UNSW has been a major step forward in the global search to find renewable energy.

"Through our unique collaboration, UNSW students and staff are involved in the complete technology-development process, and we are able to transfer new technologies to commercial production in a relatively short time," he says.

Another key industry partnership is with Sunrise Global Solar Energy in Taiwan. UNSW offers special intellectual property (IP) rights to the company, allowing Sunrise to use the IP for free in exchange for access to the company's production facilities. Wenham says this "win-win" partnership allows the University to tailor its technologies to suit commercial equipment and the commercial environment.

These partnerships are in addition to other relationships where companies have approached UNSW to develop solar-cell technologies to suit their specific commercial needs. Such collaborative research programs can be worth several million dollars and have delivered further boosts to the progress of the solar industry worldwide.

> "Through our unique collaboration, UNSW students and staff are involved in the complete technology-development process..."
>
> Dr Zhengrong Shi
> UNSW alumnus and Suntech founder

PARTNERS IN THE CENTRE OF EXCELLENCE:

Suntech Power // Roth & Rau // Guodian Solar // Centrotherm // Tianwei // Optomec // Sunrise // Global Solar Energy // Sunergy // CSG Solar // E-Ton Solar // Coherent // Spectraphysics // Hyundai Heavy Industries // LG Electronics // Meyer Burger // Apollon Solar // DuPont // Heraeus // Chinalight // Corum Solar // Advent Solar // Shinsung // JA Solar // Yunnan Tianda

Riding a wave ... (l-r) Dennis Else, Brookfield Multiplex and Professor Graham Davies, Engineering Dean at the Tyree Energy Technologies Building

Photo: Paul Henderson-Kelly

A living laboratory

Standing as an architectural focal point at UNSW's main entrance on Anzac Parade, the Tyree Energy Technologies Building (TETB) is a world-leading facility in terms of its environmentally friendly design and its state-of-the-art laboratories.

The facility is part of a holistic approach at UNSW to developing renewable energy technologies, and integrating them into Australia's power grid so they are cost-effective and overcome the challenge of intermittent generation.

"The aim is for UNSW to be the first point of contact for any issues relating to energy – its supply, use, economics and policy," says Engineering Dean Graham Davies. "This facility will be a beacon for renewable energy."

The building is named after UNSW alumnus and philanthropist Sir William Tyree, who gave $1 million towards the building and has pledged an additional $10 million. The TETB, which also received $75 million in funding from the Federal Government's Education Investment Fund, will support ongoing research into record-breaking solar photovoltaic technologies, smart grids, energy storage, carbon capture and storage, and importantly, energy economics and policy analysis, says Professor Vassilios Agelidis, Director of the Australian Energy Research Institute at UNSW.

> "The aim is for UNSW to be the first point of contact for any issues relating to energy – its supply, use, economics and policy."
>
> Graham Davies
> Engineering Dean

It will also provide a forum for new, multidisciplinary research collaborations across these areas.

"We've moved away from the old model of having people confined to school-specific buildings and sectioned-off research silos," says Agelidis. "We now have a wide open space where people can connect more."

The TETB will house the School of Photovoltaics and Renewable Energy Engineering, the School of Petroleum Engineering, the Centre for Energy and Environmental Markets and the newly formed Cooperative Research Centre (CRC) for Low Carbon Living. It will also support new research into geothermal energy and biofuels.

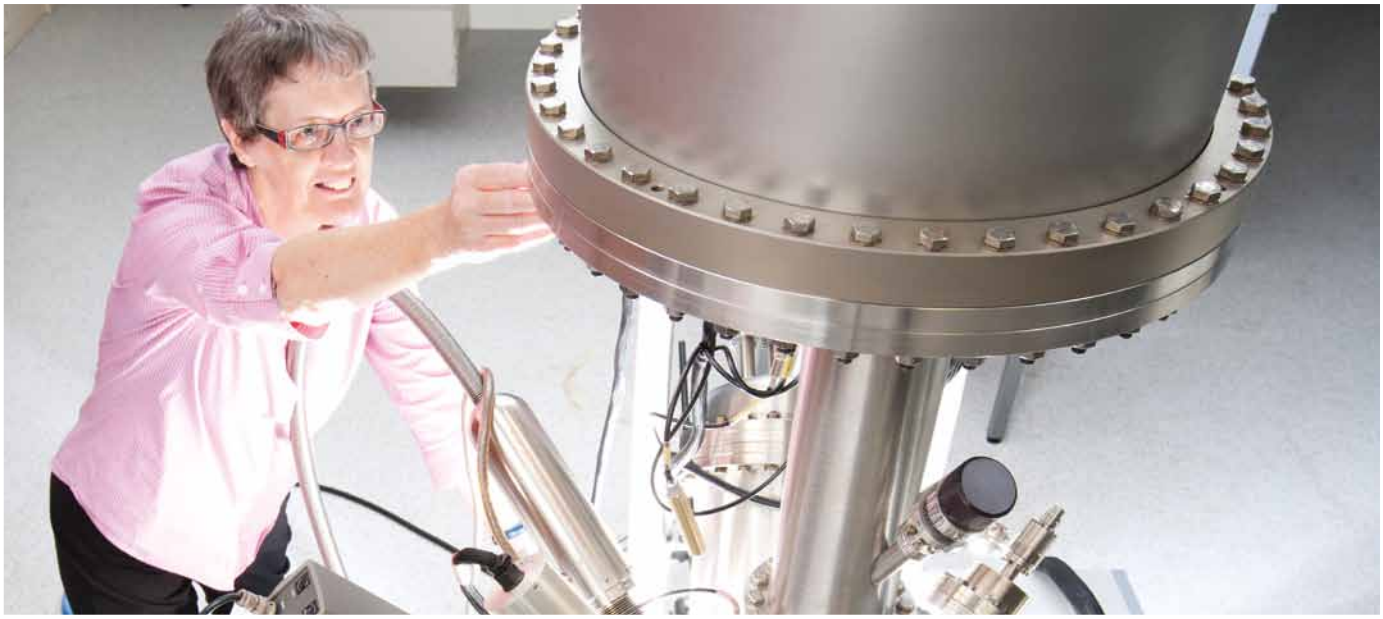
The building, designed by architects Francis-Jones Morehen Thorp, boasts a six-star energy-efficiency rating and incorporates a suite of renewable energy technologies developed by UNSW researchers in its design. These include a roof-mounted solar photovoltaic array, sustainable construction materials, and innovative heating, cooling, lighting and ventilation systems.

But TETB is more than an environmentally friendly research hub; it collates data on energy efficiency and occupant behaviour that researchers and students can interact with and ultimately learn from.

By measuring things like temperature, comfort level, power consumption and productivity in these so-called living laboratories, the building's occupants can gauge their environmental impact and explore ways to improve these systems in future designs.

The builders, Brookfield Multiplex, introduced this idea during construction as a means to help students engage with the site, and witness the theories they were taught in the classroom in action.

"Our challenge is to apply this evidence base to create buildings that not only consume less energy but also deliver measurably higher human performance in terms of health, collaboration and productivity," says Professor Dennis Else, General Manager, Sustainability, Safety and Health at Brookfield Multiplex.



Professional touch ... Associate Professor Grainne Moran, Mark Wainwright Analytical Centre

Photo: Paul Henderson-Kelly

Top tech for hire

Sometimes, even a global leader like Cochlear needs a bit of help.

The company, an innovator in hearing implants, has been a regular visitor to UNSW's Mark Wainwright Analytical Centre, using cutting-edge technology to assist the development of its unique products.

Cochlear's Implant Technology Group Manager is Martin Svehla, a former PhD student at UNSW. He says the UNSW Centre provides valuable research expertise and facilities, which have been integral to certain projects.

"One part is having access to the equipment," Svehla says. "We've got some capability in-house, although in some cases we don't have the right equipment."

Another benefit is having access to world-leading experts.

"It's actually having someone there who understands the equipment, can run it and help us interpret the data," he says. "Some samples are quite small and quite challenging to measure. It's not just a matter of putting a sample into a piece of equipment and pressing a button."

The activities Cochlear has undertaken at the Centre range from using the electron microscope unit to investigating how certain materials behave in the company's products, to looking at alternative ways of making things.

Mark Wainwright Analytical Centre Executive Director Associate Professor Grainne Moran says the motivation behind the Centre was to have a facility for expensive equipment that could be utilised by researchers across the University.

"Because the instrumentation is complex and you need support staff, it doesn't always make sense for people to have their own equipment in their own research lab," Moran says. "If we could bring together equipment previously scattered around the University, we would have a critical mass, and instead of each of us having to look for money, we'd all be working together."

The Centre now consists of six areas, including the electron microscope unit, a nuclear magnetic resonance facility, a mass spectrometry facility, and the solid state and elemental analysis unit. The most recent growth has been in biomedical research with the Centre taking on the management of instrumentation ranging from cutting-edge fluorescence microscopy to magnetic resonance imaging.

"Our role is about coordinated access, it's about training and support for students, researchers and industry," Moran says. Industry can access the facility through the Centre's commercial arm, the Chemical Consulting Laboratory and through collaborations with academic staff.

> "[The benefit] is having someone there who understands the equipment, can run it and help us interpret the data."
>
> Martin Svehla
> Cochlear

"A lot of our instrumentation makes measurements that are very valuable to industry," Moran says, adding the Centre is often approached to do complex analyses, particularly where multiple techniques are required to solve the problem.

Cochlear's Svehla says his company prefers to conduct extra analysis locally, rather than working with overseas institutions. "There are significant benefits communications wise, and with turnaround times, in dealing with a local centre," he says.

Up, up and away ... UNSW Canberra links with NASA to launch balloons as big as the Melbourne Cricket Ground

Photo: AFP

Out of this world

Long-term collaborations with NASA are helping to unravel the mysteries of our universe.

In the search for life on other planets, the Mars meteorite ALH84001 was as exciting as it gets. Aged about 4 billion years, the softball-sized rock was found in Allan Hills, Antarctica in 1984 by a team of US meteorite hunters. More than a decade later it was reported to carry with it evidence of former life on Mars.

So extraordinary was this finding, NASA established the NASA Astrobiology Institute in California to answer the two big questions: what is the origin of life on Earth and is there anything else out there?

At the same time, NASA also turned to Australia for help: our land boasts convincing evidence of the oldest life on Earth – fossils in the Pilbara dating back 3.5 million years and the world's most-ancient living organisms, microbes still found today in Shark Bay, Western Australia.

Ironically, the theory that ALH84001 contained evidence of life has since been largely disproved, but the collaboration between UNSW and NASA has thrived, says UNSW's Professor Malcolm Walter, an expert in geological evidence of early life on Earth.

> "There has been a fruitful exchange of personnel, with students and researchers spending time in the laboratories of the other."
>
> Dr Carl Pilcher
> NASA Astrobiology Institute Director

Projects are underway in the Pilbara and at Shark Bay. Research on the organisms in Shark Bay could reveal markers that may be used to identify life on other planets, says Walter, the Director of the Australian Centre for Astrobiology.

"What the collaboration with NASA brings to UNSW is that we can mount much bigger projects, for example, core drilling is very expensive but we can do this in the Pilbara together," says Walter.

The collaboration between NASA and UNSW dates back more than 30 years, spanning the study of hypersonics, the use of high-altitude stratospheric ballooning, the sharing of expertise on space shuttle flights and the development of missions to probe new planets.

"There has also been an extremely fruitful exchange of personnel over the years, with students as well as early-career and senior researchers from each partner spending time in the laboratories of the other," says Dr Carl Pilcher, Director of NASA's Astrobiology Institute.

Ballooning partnership

Associate Professor Ravi Sood, of the School of Physical, Environmental and Mathematical Sciences at UNSW Canberra has long collaborated with NASA to launch massive balloons from Alice Springs to carry instruments to the top of the atmosphere.

The two-tonne balloons, with skins as thin as plastic wrap but the size of the Melbourne Cricket Ground, enable heavy instruments to be taken to a height of 40 kilometres, where they measure gamma rays and X-rays to further astrophysics research.

Space travel

UNSW researchers piggyback on the flights to study black holes, supernovas and fast-spinning neutron stars, some of which emit very little visible light but can be observed in gamma rays and X-rays.

Associate Professor Andrew Nealy, of the School of Engineering and Information Technology at UNSW Canberra, is also part of a collaboration investigating the physics of hypersonic-separated flow with personnel at NASA's Langley Research Center.

It is a project that could one day inform the development of spacecraft and space planes for scientific and military missions and even space tourism.

Future perfect ... Professor Dennis Del Favero in the virtual-reality mine

Photo: Paul Henderson-Kelly

Safety in 3D

China has a new weapon in the fight against mine disasters: a virtual-reality "mine" developed by UNSW's iCinema Centre for Interactive Cinema Research.

Once reliant on textbooks, trainees at the Shenyang Research Institute of the China Coal Technology & Engineering Group (SYCCTEG) will now learn to recognise the signs of impending disaster in an underground mine almost identical to the one they will be working in – except mistakes here are not fatal.

The "mine" combines a wraparound 360-degree screen with 3D graphics and interactive film technology to create a life-size, walk-through, virtual-reality cinema called an Advanced Visualisation and Interaction Environment or AVIE.

The purchase by one of China's leading mine-safety institutes is the first in what is expected to be a series of sales under a deal struck between SYCCTEG and iCinema's commercial arm, Immersive Realisation. The Chinese deal also follows the installation of four of the 360-degree simulators and a further 13 smaller systems on mine sites across NSW.

> "We see the sale to China as demonstrating how high-tech art can yield export success for Australia."
>
> Professor Dennis Del Favero
> iCinema Director

Zhao Jiancun, an assistant engineer with SYCCTEG, says iCinema's AVIE is "exactly the product we wanted" because its advanced technology made "people think they were truly underground". SYCCTEG hopes to roll out AVIE systems to mines across China "in order to better guarantee people's safety," says Zhao.

UNSW's School of Mining Engineering head Professor Bruce Hebblewhite says the technology represents a "quantum change" in mine-safety training.

The mine-safety AVIE was built by the iCinema Centre in collaboration with the UNSW School of Mining Engineering and the Australian mining industry.

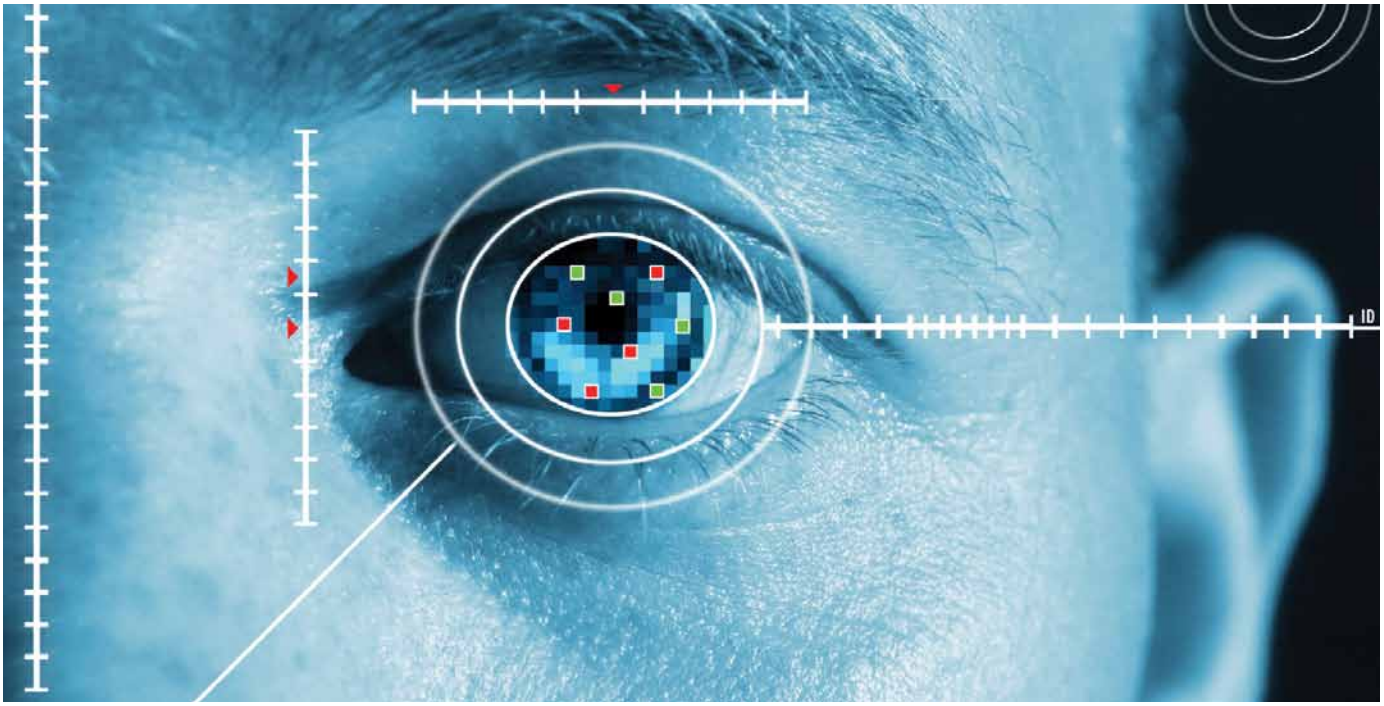
Such partnerships are characteristic of the Centre, a joint venture between UNSW's College of Fine Arts and the Faculty of Engineering, that brings together academics and students across digital art, artificial intelligence, computer science and engineering to push the bounds of the possible.

iCinema Director Professor Dennis Del Favero says interest is growing in interactive visualisation systems.

"We see the sale to China as demonstrating how high-tech art can yield export success for Australia," Del Favero says.

AVIEs have also been used in the ABC's *Voyage to the Planets* series, by the Dutch Broadcasting Company VPRO for the Biennale of Architecture Rotterdam and have been bought by the City University of Hong Kong, Museum Victoria and ZKM Germany.

iCinema researchers are also working on other applications including a joint proposal with Brookfield Multiplex for an AVIE that will replace traditional architectural models with life-size, virtual-reality buildings that can be modified before their real-life counterparts are complete.



Sharing the vision ... the bionic eye should be ready for use by 2013

Eye on the future

It's one of the most anticipated projects in modern science – the creation of an implantable electronic device that could restore the sight of patients with degenerative vision loss.

Australian researchers have been working on the bionic eye for more than a decade, and it should be ready for use in patients by 2013, says Associate Professor Gregg Suaning from the Graduate School of Biomedical Engineering.

There are two bionic eye prototypes – the high-acuity neurostimulator device, which will help those with macular degeneration and be implanted in patients in 2014 and the wide-view neurostimulator device, which helps patients with retinitis pigmentosa and will be launched first.

"That initial implantation will be a massive milestone, but beyond that we have to prove the device does what we hope it will do. That might be a long road because we may not yet have discovered how best to stimulate the retina using the device," says Suaning, who leads the wide-view device program with Bionic Vision Australia (BVA).

The BVA consortium involves researchers from UNSW, the Centre for Eye Research Australia, the Bionics Institute, the University of Melbourne, the National ICT Australia (NICTA) and the University of Western Sydney.

The University of Melbourne's Professor Anthony Burkitt says the research, which received $42 million from the Federal Government in 2009, has the potential to help hundreds of thousands of people.

"The first-generation device will be used in people with retinitis pigmentosa who have no light perception at all. But as the technology develops, the improved implants are going to be able to help a wider group of blind people," he says.

Healing wrapped up

Another bioengineering partnership at UNSW involves the US biotech company, Synedgen. It builds on work developed by medical company HemCon, which found one of its bandages designed to stop bleeding on the battlefield also seemed to improve wound healing. But no-one was sure why.

A collaboration with Professor John Whitelock from the Graduate School of Biomedical Engineering revealed that when blood cells soaked into the bandage – which is made up of chitosan, a molecule sourced from prawn shells – it encouraged the cells performing the healing to live longer and make more collagen.

As well as helping patients who can't heal themselves, this discovery may lead to a better understanding of conditions where the healing process is out of control such as fibrosis or cirrhosis of the liver, says Whitelock.

Robots to the rescue

In another project that has the potential to save lives, Professor Claude Sammut, head of the Artificial Intelligence Research Group in the School of Computer Science and Engineering, is creating robots that sense the environment around them and make decisions about what to do, without the need for human control. This will allow them to be used in disaster zones that are too dangerous for humans to explore.

PROJECT PARTNERS:
Associate Professor Gregg Suaning's team partners with:
Centre for Eye Research Australia // Bionics Institute // University of Melbourne // National ICT Australia // University of Western Sydney
Professor John Whitelock's team partners with:
Synedgen // HemCon

From monitoring the effects of climate change in the Antarctic to investigating bugs that clean up pollution, UNSW researchers are working with key environmental players to secure the planet's health.

Partners in...

The environment

the environment

Let all the rivers run

Water wise ... Professor Richard Kingsford, Director of the Australian Wetlands and Rivers Centre

Photo: Grant Turner, Mediakoo

Living in one of the world's driest continents, Australians understand the value of water conservation, and in parts of the country have also felt the wrath of dangerous floods and coastal erosion.

At UNSW researchers are examining water from every angle to ensure the best management strategies possible are employed to keep our communities safe, protect the integrity of our water resources and environment, and promote sustainability. With climate change threatening the availability of water resources, the Federal Government has implemented a comprehensive reform program called *Water for the Future*.

The top priority is to restore the environmental balance of the Murray–Darling Basin. Its 23 rivers span four states and sustain roughly 39 per cent of the country's agricultural production, but important wetland ecosystems that rely on the basin's water are under considerable pressure due to over-extraction.

To counteract this, the Government has committed $3.1 billion for the purchase of water entitlements from irrigators, which can be used as environmental flows to help restore rivers and wetlands. Additional funding will help build more efficient irrigation infrastructure.

"The Government is spending billions of dollars on restoring the Murray–Darling through water buy-backs and building more efficient infrastructure," says Professor Richard Kingsford, Director of the Australian Wetlands and Rivers Centre. "We want to ensure the money is being well spent in terms of the environmental outcomes."

Kingsford and colleagues from the School of Biological, Earth and Environmental Sciences (BEES) at UNSW have been conducting fieldwork on the basin's Macquarie River, which flows into the Macquarie Marshes in central northern NSW – an ecosystem Australia has promised to safeguard under a

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> Professor Richard Kingsford
> Director of the Australian Wetlands and Rivers Centre

global environmental treaty known as the Ramsar Convention.

Working in partnership with the NSW Office of Environment and Heritage, NSW Office of Water and the Murray–Darling Basin Authority, UNSW scientists are examining key ecological indicators such as fish, frogs and waterbirds to gain a better understanding of how these organisms respond to different water regimes.

And this year there was cause for optimism. The result of an annual aerial waterbird survey Kingsford has been leading for nearly 30 years, revealed widespread flooding throughout the Murray–Darling had rejuvenated rivers and wetlands, causing an explosion of life.

With more than a million waterbirds counted, it was the third-highest tally on record, and also showed significant diversity of species – another good sign.

"We have got data for the past 30 years on 2000 wetlands," says Kingsford. "We surveyed again in 2011 and 2012 and found there has been an incredible bounce-back in numbers. In the Murray–Darling Basin a lot are going back, but not to the same level as the 1980s."

But managing visible surface water is only half the battle; Australia also has vast groundwater resources contained in subterranean aquifers that need to be carefully studied before they can be sustainably harvested.

Going to ground

The Connected Waters Initiative (CWI) at UNSW has received multi-million-dollar funding to investigate groundwater and explore the extent of its connectivity with surface water hydrology.

In collaboration with the National Centre for Groundwater Research and Training, the UNSW team is characterising Australia's aquifers to get a better understanding of how water travels through these systems and how long they take to replenish.

One project involves the use of an environmental "time machine" known as a geotechnical centrifuge, which measures the hydraulic conductivity of aquitards – these are dense beds of silt and clay that often separate and surround aquifers. Water can pass through them but only very slowly, making it difficult to assess recharge rates.

By taking a sample from a borehole and spinning it on the centrifuge, researchers can essentially speed up time by increasing the force of gravity.

"It means we can drain water from an aquitard in a few hours, speeding up a process that could take hundreds of years in reality," says Professor Ian Acworth, Director of the CWI.

This offers a preview of how aquifers might respond over the long term to activities such as coal seam gas mining and will help inform future management strategies.

When it rains

The Water Research Laboratory (WRL) in Manly Vale has a 53-year track record of expertise and cutting-edge research in coastal engineering, environmental modelling and hydraulics, and continues to forge major partnerships with government and industry.

"We're solving the key contemporary water-related problems in Australia through a combination of professional engineering expertise, research and innovative education programs," says Associate Professor Bill Peirson, Director of the WRL.

One such problem that has weighed heavily on the Australian psyche in recent times is flooding. Researchers at the lab have constructed a physical model of a Newcastle neighbourhood hard hit by flash flooding that followed the June 2007 storm that led to the grounding of the *Pasha Bulker* container ship.

Representative of urban settings across Australia, the 3D model has helped validate numerical models, which are commonly used to map flood plains and offer crucial information about flow behaviour, and hazards such as rising water levels and velocity.

The research is part of a $20 million overhaul of the Australian Rainfall and Runoff Guidelines, funded by the Federal Department of Climate Change and Energy Efficiency and coordinated by Engineers Australia. It will inform future policy around residential construction, planning in flood plains, and emergency management protocol.

Story continues page 18

Continues story from previous page

Recycling water

Researchers at UNSW are also looking at ways that water can be recycled using advanced treatment processes.

A high-pressure membrane filtration process known as reverse osmosis makes it possible for high-quality water to be produced from treated sewage, which can be used for farming, industrial purposes, and even to supplement drinking water supplies – a major selling point for a country prone to extended periods of drought.

An added bonus is that it keeps all the pollutants in treated sewage from being discharged into the aquatic environment, says Dr Stuart Khan, an environmental engineer at the UNSW Water Research Centre.

Khan is studying how trace chemicals, including pharmaceuticals and pesticides, behave during treatment under different operating conditions. The goal is to refine the reverse osmosis process to build greater confidence in the outcome.

"Reverse osmosis has a much lower energy cost than thermal distillation, making many water recycling projects more financially viable," Khan says.

The research has already paid dividends for Sydney Water, which enlisted Khan in 2006 to help with a project where recycled water would be introduced to the Hawkesbury-Nepean River to boost natural flows.

> "The project effectively doubled the amount of recycled water going into the river."
>
> Peter Cox
> Sydney Water

> "This has a much lower energy cost, making water recycling more financially viable."
>
> Dr Stuart Khan
> Water Research Centre

"During the last drought, the NSW Government decided there was a very clear need for putting water back into the river to maintain its health," says Peter Cox, Sydney Water's Program Manager for water quality and public health. "We called Stuart [Khan] in because at the time this was something that had never been done before and we needed an expert in chemical risk assessment."

Through work that spanned four years, Khan's team helped identify the critical points in the treatment process where chemicals of concern could enter the system if it were not carefully managed and where they needed to be removed.

He also offered professional advice around the construction of the new advanced recycled water treatment facility at St Marys, and on its completion, successfully transitioned the monitoring of that plant from UNSW engineers over to the team at Sydney Water.

The project effectively doubled the amount of recycled water going into the river, freeing up water that would have otherwise been sourced from Warragamba Dam, says Cox.

PARTNERS:
Professor Richard Kingsford partners with:
NSW Office of Environment and Heritage // NSW Office of Water // Murray–Darling Basin Authority
Professor Ian Acworth partners with:
National Centre for Groundwater Research and Training, Flinders University // Cotton catchment communities CRC // NSW Department of Primary Industries
Dr Stuart Khan partners with:
Sydney Water
Associate Professor Bill Peirson partners with:
Engineers Australia // Australian Wetlands and Rivers Centre

Recycling water ... Peter Cox, Sydney Water with Dr Stuart Khan, Water Research Centre

Photo: Paul Henderson-Kelly

Cleaning up … Associate Professor Mike Manefield at Botany Bay, one of the contaminated sites where his work is being used

Photo: Paul Henderson-Kelly

Toxic terminators

UNSW researchers are at the forefront of collaborations to keep our land, food and water free of toxins, harnessing naturally occurring bacteria and the sun to deliver cost-effective cleaning tools.

In a partnership between Dow Chemical, Coffey Environments Australia, Orica and UNSW, the destructive power of bacteria is being used to clean up contaminated land and groundwater through a process known as bioremediation.

"There are bacteria out there that were born to break these pollutants down," says Associate Professor Mike Manefield, Deputy Director of the Centre for Marine BioInnovation (CMB) at UNSW and a world leader in bioremediation technology.

Up until a few years ago, the right bacteria had not been identified in Australia. But using molecular techniques, Manefield and his group tracked down suitable cultures and bred them, creating an army of home-grown, pollutant-eating bacteria.

"Ten years ago we weren't thinking about bioremediation, but … today it's a very promising option – it should be more cost-effective, provide a better environmental solution and help reduce clean-up times," says Bryan Goodwin, Remediation Manager at Dow Chemical.

Food safety

Companies in water, meat and dairy industries have also chosen to partner with the CMB. Centre Co-Director Professor Staffan Kjelleberg is looking at how biofilms – naturally occurring, surface-associated communities of bacteria – can be removed from equipment without the use of toxic chemicals.

Biofilm communities have traits that give them an advantage over single bacteria. They can be beneficial and dangerous and Kjelleberg is working to understand how to harness their power for good.

Clean water

Purifying drinking water is another challenge, and South Australia Water has partnered with Professor Rose Amal at the School of Chemical Engineering to develop a more efficient method of removing organic matter.

At present a process known as coagulation is used, but it only removes around 20-30 per cent of organic matter in water and leaves a sludge that then needs to be put into landfill.

Amal and her team are working to combine coagulation with a technique known as photo-catalysis, which converts the energy from sun-light into energy that destroys organic matter.

She believes the approach will increase the percentage of organic matter removed to 50 per cent or more.

The Water Corporation in Western Australia is also collaborating with Amal's team, which is looking at ways to control nitrifying bacteria in water pipes with the regulated release of zinc particles.

> "[Bioremediation] should be more cost-effective, provide a better environmental solution and help reduce clean-up times."
>
> Bryan Goodwin, Dow Chemical

Marine life

On a larger scale, the NSW Government has partnered with the CMB to restore the health of Sydney's coastal marine life.

CMB Co-Director Professor Peter Steinberg and his team have transplanted populations of kelp – large, habitat-forming seaweeds – back along sections of Sydney's coast where it has been absent for 30 years.

This could help to restore entire marine communities, including valuable species such as lobster and abalone, says Steinberg.

PROJECT PARTNERS:
New South Wales Government // Dow Chemical // Coffey Environments Australia // Orica // Water Corporation of Western Australia // South Australia Water // Organisations in the meat and livestock industry

Leading the way ... Professor Andy Pitman, from the ARC Centre of Excellence for Climate System Science

Photo: Belinda Mason

Climate collaborators

From an increase in the intensity of tropical cyclones to rising sea levels and the problems marine ecosystems face as oceans acidify, climate change is a global issue that requires cooperation between national and international experts to understand its full impact.

At the forefront of this effort are two centres based at UNSW: the ARC Centre of Excellence for Climate System Science (CECSS) and the Climate Change Research Centre (CCRC).

CECSS is led by UNSW in partnership with the Australian National University, Monash University, the universities of Melbourne and Tasmania, alongside partner institutions such as the CSIRO and the Bureau of Meteorology locally, and NASA and major laboratories in the UK and France internationally. Its research focus is on atmosphere, ocean and land, and the interactions between those three.

CCRC has a broader focus, extending its research from the underpinning science into the effects of climate change and aspects of how we might adapt to the changing environment.

“We have formally partnered with world-leading groups, but we are [also] working to extend partnerships with institutions that have particularly refined capacity in certain aspects of the science that we’re doing.”

Last year, for example, CECSS, the CSIRO’s Centre for Australian Weather and Climate Research and the Laboratoire des Sciences du Climat et l’Environnement in France combined forces to study the climate implications of land-cover change, where they made “ground-breaking progress”, according to the CSIRO’s Professor Ying-Ping Wang.

Using the Mk3L climate model designed by Dr Steven Phipps, a scientist in the Centre of Excellence, the team demonstrated that in order to accurately understand the impact of land-cover change on a region’s climate, one must first accurately simulate how rainfall changes with increasing carbon dioxide levels.

Another climate-modelling tool, the Australian Community Climate and Earth-System Simulator (ACCESS), also highlights the important role research partnerships play.

Most of its sub-models – of oceans, atmosphere, land and ice – were drawn from separate international partners and adopted by the Australian climate change community to build one complete model of the climate system. The land sub-model, however, builds on a decade of Australian research led by CSIRO and aided by university researchers.

CCRC Deputy Director Professor Matthew England currently has an ARC Laureate Fellowship to research the impacts of climate change on the oceans. His work and many other projects undertaken by the CCRC benefit from the widespread partnerships that helped bring about the ACCESS model.

“A lot of our research uses [the ACCESS] model to understand projections of future climate change,” says Professor England. “The partnership reaches across the United Kingdom, the United States and Europe. Nationally, it brings in the CSIRO, the Bureau of Meteorology and also the university sector into a world-class team.”

Research partnerships enable the scale of research to be greatly expanded. “Climate science has for at least a decade been beyond the capacity of one country,” says Professor Pitman. “Without internationalising our science, we simply aren’t relevant. It is the only way 21st century climate science can operate.”

THE CENTRES’ PARTNERS:

Monash University // University of Tasmania // The Australian National University // The University of Melbourne // Australian National Data Service // The Centre for Australian Weather and Climate Research (CAWCR) – A partnership between the CSIRO and the Bureau of Meteorology // National Computational Infrastructure // NSW Department of Environment and Heritage //Geophysical Fluid Dynamics Laboratory, Princeton // Met Office Hadley Centre, UK // Laboratoire de Meteorologie Dynamique/Centre National de la Recherche Scientifique, France // NASA Goddard Space Flight Center, US // National Center for Atmospheric Research, US // National Centre for Atmospheric Science, UK // University of Arizona, US

The spots are changing ... the leopard seal's environment is undergoing transformation

Photo: Nathalie Michel, Getty Images

Change by a whisker

Antarctica is a vast scientific resource, helping solve problems as diverse as climate change and the birth of stars.

The leopard seal's whiskers are providing a window to the past. Associate Professor Tracey Rogers, from UNSW's Evolution and Ecology Research Centre, has partnered with biologist Dr Dave Slip, from the Taronga Conservation Society, to examine the effects of climate change on these creatures, using their whiskers to look back 100 years to identify changes in their diet, size and population.

By extracting the stable isotopes found in the whiskers of the leopard seals in captivity at Taronga Zoo, they were able to reconstruct the animals' diets. They then applied this technique in the wild, comparing leopard seal populations in Western Antarctica, where the impact of climate change has been significant, with those in Eastern Antarctica, where the change has been minimal.

"We found that in the East there hasn't been much change, while in the West the leopard seals are not eating at the top of the food chain anymore, they're eating krill," says Professor Rogers, indicating that climate change is destabilising the Antarctic ecosystem.

"We benefit from the expertise at the University and we have a facility that's of benefit to the University," says Dr Slip. "If you work on marine mammals in the field, often your answers are difficult to interpret. It's nice if you have a captive animal on which you can validate your interpretation of your results."

"[The partnership] has made our research very strong," says Professor Rogers, who also partners with the Argentinian Antarctic Division, Cambridge University and the Environmental Isotopes commercial laboratory.

On thin ice

Most of the West Antarctic Ice Sheet (WAIS) is grounded on seabed. If the seawater was to warm just a few degrees centigrade, the entire ice sheet could be destabilised.

The Climate Change Research Centre's Professor Chris Turney and Dr Chris Fogwill have commenced field research to reconstruct the changes to ice sheets in the past and also to retrieve climate records to see what drove those changes.

They use exposure-rock dating to calculate the size of the WAIS. This involves collecting rocks from the mountain's surface, which have a different geology to the local bedrock.

These displaced rocks – erratic rocks – have arrived in the foreign locale due to ice melting. When deposited on the surface, they absorb high-energy particles from space, changing their chemical composition to eventually develop rare elements.

"You can work out how long those rocks have been exposed to the surface," says Professor Turney. "You can then work out the change in the ice sheet over time by the rocks' different ages."

With no research station based on the WAIS, the team relies on logistics tour operator Antarctic Logistics & Expeditions (ALE) to fly them directly onto the ice.

They visited the region in January 2011 and 2012, and additional visits are planned over the next five years as part of an Australian Research Council Linkage Grant with ALE.

Antarctica is also central to the work of Professor Michael Ashley from the School of Physics. Working with the University of Arizona, his team has installed and deployed an unmanned telescope in the remote Ridge A region of Antarctica to monitor the skies throughout 2012, giving new insights into how stars are formed.

PROJECT PARTNERS:

Associate Professor Tracey Rogers partners with: Taronga Conservation Society // Argentinian Antarctic Division // Cambridge University, UK // Environmental Isotopes

Professor Chris Turney partners with: Antarctic Logistics & Expeditions

Professor Michael Ashley partners with: University of Arizona // Hatz Australia (diesel-engine distributor) // Tritium (Australian high-tech electronics company) // Astronomy Australia Limited // Fibreglass Engineering Industries

With support from industry, government and the not-for-profit sector, our researchers are making remarkable progress in the fight against debilitating diseases as well as pioneering breakthroughs such as the bionic eye.

Partners in...

Health

health

Kids cancer: the good fight

New approach ... (l-r) Peter Neilson, Kids' Cancer Project CEO and Professor Peter Gunning, Oncology Research Unit, School of Medical Sciences

Photo: Paul Henderson-Kelly

Researchers have known for 40 years that a missing link in cancer treatment was the ability to target the architecture of the cancer cell. In an extraordinary collaboration between UNSW, a small biotech company and a charity, that missing link has been found.

Professor Peter Gunning, head of the Oncology Research Unit in the School of Medical Sciences, has developed a family of drugs that potentially have the capacity to treat any form of cancer. Currently in pre-clinical tests, these drugs could one day offer an entirely new type of chemotherapy.

"Attacking the architecture of the cancer cell has long been an obvious target, but attempts always failed because the building blocks of the architecture of the cancer cell are also used to build the heart and muscle, and so the toxicity was unacceptable," says Gunning.

Through basic science conducted in the laboratory, he discovered a handful of these building blocks – called tropomyosins – were common to all cancer cells but did not exist at the same levels in other cells in the body. "We realised that cancer cells become highly dependent on them, and if you compromised them the cancer cell would be in big trouble," he says.

Once that discovery had been made, the next logical step was to develop drugs to target tropomyosins in cancer cells. The central problem was that of funding: previous attempts to attack the architecture of the cancer cell had been unsuccessful, so nobody was willing to take the chance.

The Kids' Cancer Project (formerly the Oncology Children's Foundation) took a risk and agreed to fund the research. The next stage was forging a commercial partnership with the biotech company Genscreen, which provided access to the drug design capability that turned the project into reality.

"Childhood cancer is the largest killer of Australian children from disease today, but it's not well funded," says Peter Neilson, CEO of the Kids' Cancer Project.

"The survival rate has increased to about 80 per cent, but three children a week are taken by cancer in Australia. The only way to cure them is through research; this project promised a whole new way of treating cancer, so we had to support it."

Collaborations such as this will become increasingly important as the pharmaceutical industry finds it harder to fund the development of blockbuster cancer drugs.

"Three children a week are taken by cancer in Australia. This project promised a whole new way of treating cancer, so we had to support it."

Peter Neilson
Kids' Cancer Project CEO

Microscopic detail

Pharmaceutical companies are now looking more and more at early-stage collaborations with academics in universities and institutes to find new cancer therapeutics, says Lowy Cancer Research Centre Director Professor Philip Hogg.

"Forging relationships with industry, government and other universities nationally and internationally is part and parcel of our business," he says.

A recent example of this has resulted in the installation at the Lowy Centre of a super-resolution fluorescence microscope, developed in partnership with the company Carl Zeiss.

The microscope has enabled scientists to see the workings of cancer cells as never before, resulting in a major breakthrough last year, published in the journal *Nature Immunology*, that overturned prevailing understanding of how T-cells influence the immune system.

"This partnership worked for us and for them: it meant we got to develop the sort of machine we needed for our research and the company got the chance to work with some of the best researchers in the field," says Hogg.

The Lowy Cancer Research Centre operates with a broad range of partners to translate discoveries made in the laboratory to clinical practice. It has recently partnered with other universities, oncologists and teaching hospitals across the state to win two of four coveted Translational Cancer Research Centres offered by the NSW Government, which will boost research into both adult and childhood cancer.

National and international collaboration between researchers has always been central to the development of new treatments: it is the only way to gain the numbers of participants studies need to achieve significant findings.

Switching off cancer genes

One such collaboration with universities and family cancer clinics across Australia has resulted in a better understanding of why some people develop cancer at a young age.

The study, led by Professor Robyn Ward, head of the Prince of Wales Clinical School, has found that predisposition to cancer is not purely due to genes, but to the cellular environment in which those genes exist. It's this environment that activates the gene to develop cancer.

"Your genes are hard-wired, you can't undo your genes. But the local cellular environment can be modified by drugs," says Ward.

"If we can use drugs in the future to stop these chemicals attaching to the bad DNA, we might mitigate the risk of cancer developing."

While the study was conducted among people who had developed bowel cancer at a young age, the information will inform the way all cancers are managed.

"The family cancer clinics are able to use our findings immediately," says Ward.

Helping survivors

Community engagement is also an important plank of the work of the newly formed NSW Cancer Survivors Centre based at UNSW.

The Centre is working with the Cancer Council NSW and other partners to foster awareness of, and research into, cancer survivorship issues, including the high incidence of problems such as fatigue and mental cloudiness associated with treatment, as well as long-term "survivorship" problems such as infertility, osteoporosis and cardiovascular disease.

"We realised that cancer cells become highly dependent on [these building blocks] and if you compromised them the cancer cell would be in big trouble."

Professor Peter Gunning
Oncology Research Unit

Cancer survivors are offered assessment and lifestyle interventions, while they enable the Centre to research a range of issues. One recent large prospective cohort study published in the *Journal of Clinical Oncology* mapped out the natural history of fatigue in women who have been cured of early-stage breast cancer.

"This study helped us to identify those who are most likely to be troubled by persistent fatigue," says Cancer Survivors Centre Director Professor Andrew Lloyd.

PROJECT PARTNERS:
Professor Peter Gunning partners with:
Kids' Cancer Project // Genscreen
Professor Philip Hogg partners with:
Carl Zeiss // NSW Government
Professor Andrew Lloyd partners with:
Cancer Council NSW

Pointing the way ahead ... Professor Maria Kavallaris with Peter French , Benitec CEO

Photo: Paul Henderson-Kelly

The silent assassin

Collaborations between nanotechnology researchers at UNSW and industry partners are driving the development of smarter treatment methods.

By the age of 85, half of all Australians will be diagnosed with cancer. And while survival rates are increasing, common treatments such as chemotherapy can cause severe side effects and do not work on all types of the disease.

Drugs are therefore needed not only to destroy cancers resistant to current therapies, but also to reach diseased cells directly, in order to reduce harm to the rest of the body that untargeted treatments such as chemotherapy cause.

While most researchers focus on just one of these challenges, the Australian Centre for NanoMedicine at UNSW (ACN) – a unique research centre that brings chemists, medical researchers and engineers together – is working with industry to develop a product capable of overcoming both.

Together with biopharmaceutical company Benitec and the Children's Cancer Institute Australia (CCIA) based at UNSW's Lowy Cancer Research Centre, ACN is developing a product targeting the most common type of lung cancer.

> "The discovery fits perfectly with our technology."
>
> Peter French, Benitec CEO

Using gene-silencing technology, it aims to put a stop to the production of disease-causing genes, such as those responsible for chemotherapy resistance.

While Benitec had already developed the appropriate technology, it was Professor Maria Kavallaris, ACN Co-Director and head of the Tumour Biology and Targeting Program at CCIA, who identified and created the short strand of RNA (one of the three major macromolecules, along with DNA and proteins, essential for all known forms of life) that would turn off the drug-resistant gene and make lung tumours more responsive to chemotherapy.

"The discovery fits perfectly with our transformational gene-silencing technology," says Benitec CEO Peter French. "Lung cancer is the most prevalent cancer worldwide and the combination opens the door to the development of a novel therapeutic approach and could eventually bring new hope to the very large number of sufferers."

Clinical trials in humans are planned for the near future and this technology could eventually be developed to treat other cancers.

"I see amazing opportunities here not only to improve survival rates but also to develop less toxic, more targeted therapies for cancer medicine," says Professor Kavallaris.

Testing times

In another ACN-industry partnership, Co-Director Professor Justin Gooding aims to make diagnostic tests cheaper and more efficient by using nanotechnology to manufacture biosensors to detect low levels of disease cells or molecules.

Working with a prominent sensing company, he is developing more-detailed diabetes tests that provide results on the spot. In future, these biosensors may also be used to detect cancer cells.

Finally, combining forces with the Westmead Millennium Institute, ACN Co-Director Professor Tom Davis and his team are currently engineering vehicles for inside the body to deliver drugs directly to the cells responsible for causing cirrhosis of the liver.

PROJECT PARTNERS:

Professor Maria Kavallaris partners with:
Benitec // Children's Cancer Institute Australia
Professor Tom Davis partners with:
Westmead Millennium Institute

In the wake of a catastrophe ... checking for radiation after the Japanese tsunami and nuclear crisis

Photo: Asahi Shimbun via Getty Images

Radiation rescue

When the Fukushima nuclear reactor disaster occurred in March 2011, an immediate concern centred on the level of radiation exposure of nearby residents.

While dosimeters can be brought in to measure radiation, the technology has serious limitations: it can be very expensive, can be damaged by water and has to be sent away to a centralised laboratory for testing. This can mean a period of weeks between obtaining a reading and receiving details of radiation exposure.

Professor Hans Riesen and his team at UNSW Canberra have been working on a quicker way to assess radiation exposure and through a partnership with Dosimetry & Imaging, the commercialisation of the technology could soon be realised.

Riesen has developed a dosimeter the size of a USB stick. One end of the stick measures X-rays; the other end measures gamma rays. The dosimeter is then plugged into a reader unit about the size of a netbook, allowing an instantaneous reading of radiation exposure.

Considering current dosimeter readers can be the size of a cabinet, the innovation represents a huge leap in providing a manageable radiation-monitoring device to large numbers of people.

> "Industry partners are essential in getting a project commercially ready."
>
> Professor Hans Riesen, UNSW Canberra

Riesen says defence forces in Australia and the US have been interested in the development, which could provide crucial early detection of radiation exposure.

"The defence forces are interested in something which is very light, and can be carried around," he says. "If you get to a place where there's possibly been some contamination, including dirty bombs, you can quickly get an assurance that you didn't get exposed, or you could check your potential exposure."

In 2007 NewSouth Innovations (NSi), UNSW's commercialisation company, founded Dosimetry & Imaging to bring Riesen's development to market. The company was established with the backing of two venture capital firms.

NSi General Manager Graham Morton, a Director of Dosimetry & Imaging, says NSi is continuing to work with the company to see the research fulfil its commercial potential.

Riesen and Dosimetry & Imaging also secured an ARC Linkage Grant to explore how the technology can be applied in radiotherapy and industrial applications.

"Industry partners are essential in getting a project commercially ready," Riesen says. "In a university we like to talk about how difficult it is to get money from the Australian Research Council, but the commercial world is much tougher."

Consultant Anthony Ujhazy was Dosimetry & Imaging's founding chief operating officer and CEO for 18 months.

He says the company played an important role in forming linkages with established firms in the marketplace and has also worked closely with Riesen to align his work to the needs of the market.

"This has been in terms of tuning and targeting his R&D efforts," Ujhazy says.

PROJECT PARTNERS:
Dosimetry & Imaging // NewSouth Innovations

A quick delivery ... texting and social media are giving dealers a much wider market

Photo: George Logan, Corbis

Cracking the drug culture

In today's world of internet, social media, smartphones and text messaging, illicit-drug dealers have found a new niche. It has become an international cause for concern, as highlighted by the European Monitoring Centre for Drugs and Drug Addiction in Lisbon recently.

"It's an emerging trend governments will need to take into account in their monitoring systems," says Dr Lucy Burns, a senior lecturer with the National Drug and Alcohol Research Centre (NDARC) at UNSW.

Collaboration between NDARC, the Federal Government, research funding bodies and service providers nationally results in high quality research that can be used to develop better approaches to the prevention and treatment of addiction-related problems and inform policy under Australia's national drug strategy.

NDARC's monitoring of patterns of drug use in Australia has found that while heroin use continues to fall, new designer drugs such as the stimulant methadrone and psychotropic 2C-B are becoming more popular, along with prescription opioids such as oxycodone.

To counter these new issues requires international cooperation, and NDARC collaborates widely with international bodies including the World Health Organisation and the United Nations Office on Drugs and Crime to research and monitor drug and alcohol trends.

"[Our] teams collaborate with service groups across Australia to monitor drug patterns and to get a picture of where we need to focus our energies; to determine where are the developing problems," says NDARC's Director, Professor Michael Farrell.

For example, one new project will look at whether offering financial counselling to smokers could help them quit; another will see how parental supply of alcohol influences teenagers' drinking patterns.

NDARC has recently partnered with Mission Australia to evaluate *The Michael Project*, an initiative that provided core services to address the health, accommodation, literacy and individual practical needs of 250 homeless men in greater metropolitan Sydney. The work ties in with NDARC's focus on substance use due to the high rates of drug and alcohol problems among the homeless.

"We found the group's demographic profile is not just in one environment, they move between couch surfing to supported accommodation to rough sleeping on the street," says Dr Burns.

The results showed that many of those recruited to the study had better housing and employment prospects, as well as improved health and less social isolation 12 months after taking part in the study.

"This is a groundbreaking research project and the results are being communicated to Government to influence national approaches to reducing homelessness in the future," says Eleri Morgan-Thomas, General Manager of Social Advocacy and Public Affairs for Mission Australia.

> "[Our] teams collaborate with service groups across Australia to monitor drug patterns and get a picture of where we need to focus our energies."
>
> Professor Michael Farrell
> National Drug and Alcohol Research Centre

"It has broadened our own understanding and given us the ability to understand how our clients compare with the population. It's no surprise our clients experience considerable trauma and distress, and now we are able to show measures of that distress."

CENTRE PARTNERS:

National Drug Research Institute at Curtin University // The National Centre for Education and Training on Addiction // The World Health Organization // The UN Office on Drugs and Crime // The Joint UN Program on HIV/AIDS // The European Monitoring Centre for Drugs and Drug Addiction // Mission Australia and other NGOs throughout Australia

Human rights defender ... Professor David Cooper with an artwork created by his daughter about the HIV epidemic

Photo: Tamara Voninski, fairfaxphotos.com

HIV's stolen decade

Anti-retroviral treatments mean people with HIV are no longer likely to die of infections – but as the affected population ages, a new problem is emerging.

People with HIV are more likely to die of cardiovascular, liver and kidney disease and cancer, though no-one knows why. Accelerated development of the diseases of older age is also being seen in HIV populations in Europe and North America.

"There's about 10 years shaved off their life expectancy compared to the non-HIV-affected population ... the average HIV-positive man is living, or is expected to live, to about his late 60s, compared to the late 70s for his HIV-negative opposite number," says Professor David Cooper, the Director of the Kirby Institute, which is based at UNSW.

One theory is the treatment for HIV predisposes patients to other diseases, another is that living with the virus for many years, even though it's suppressed, could have some biological effect that causes ill health in later years.

It's an issue of great concern to Australia's HIV-affected community, which approached the Kirby Institute to investigate the issue using its large databases, containing information on many aspects of the disease collected since the epidemic began.

> "We have a really strong collaboration with the Kirby [Institute] and have done for the course of the epidemic."
>
> Jo Watson
> National Association of People Living with HIV/AIDS

The Kirby Institute has a long partnership with the National Association of People Living with HIV/AIDS (NAPWA), which represents the community around the country.

"This is of great interest to us because our population is ageing and we have one of the world's most treatment-exposed and longest-living populations," says NAPWA Executive Director Jo Watson.

"We have a really strong collaboration with Kirby and have done for the course of the epidemic. It's important that community participation is seen as more than a token consultative process."

The Institute and NAPWA are collaborating to set up an ageing cohort of people with HIV and to match them with HIV-negative people of the same age, lifestyle and sexuality.

The study will look for biomarkers for the diseases affecting people with HIV, and then will use linkage and other national databases to look at their outcomes. "We expect this study will take about five years to get sufficient data to allow valid conclusions," says Cooper.

The findings will enable state governments to project the health needs of HIV-positive people as they age. The health departments of NSW, Victoria and Queensland, the states with the highest numbers of people living with HIV, are also partners in the project.

The Kirby Institute coordinates national surveillance programs, clinical research and trials. In 2011, it was given a $10 million donation from Chuck Feeney, founder of the US-based charity The Atlantic Philanthropies and it receives Commonwealth funding. It is directly affiliated with the UNSW Faculty of Medicine.

The Institute also conducts collaborative programs in Thailand and Cambodia and works with a wide range of partners in Australia and internationally.

THE INSTITUTE PARTNERS:
UNSW Faculty of Medicine // National Association of People Living with HIV/AIDS (NAPWA) // Queensland Health // NSW Health // Health Department of Victoria

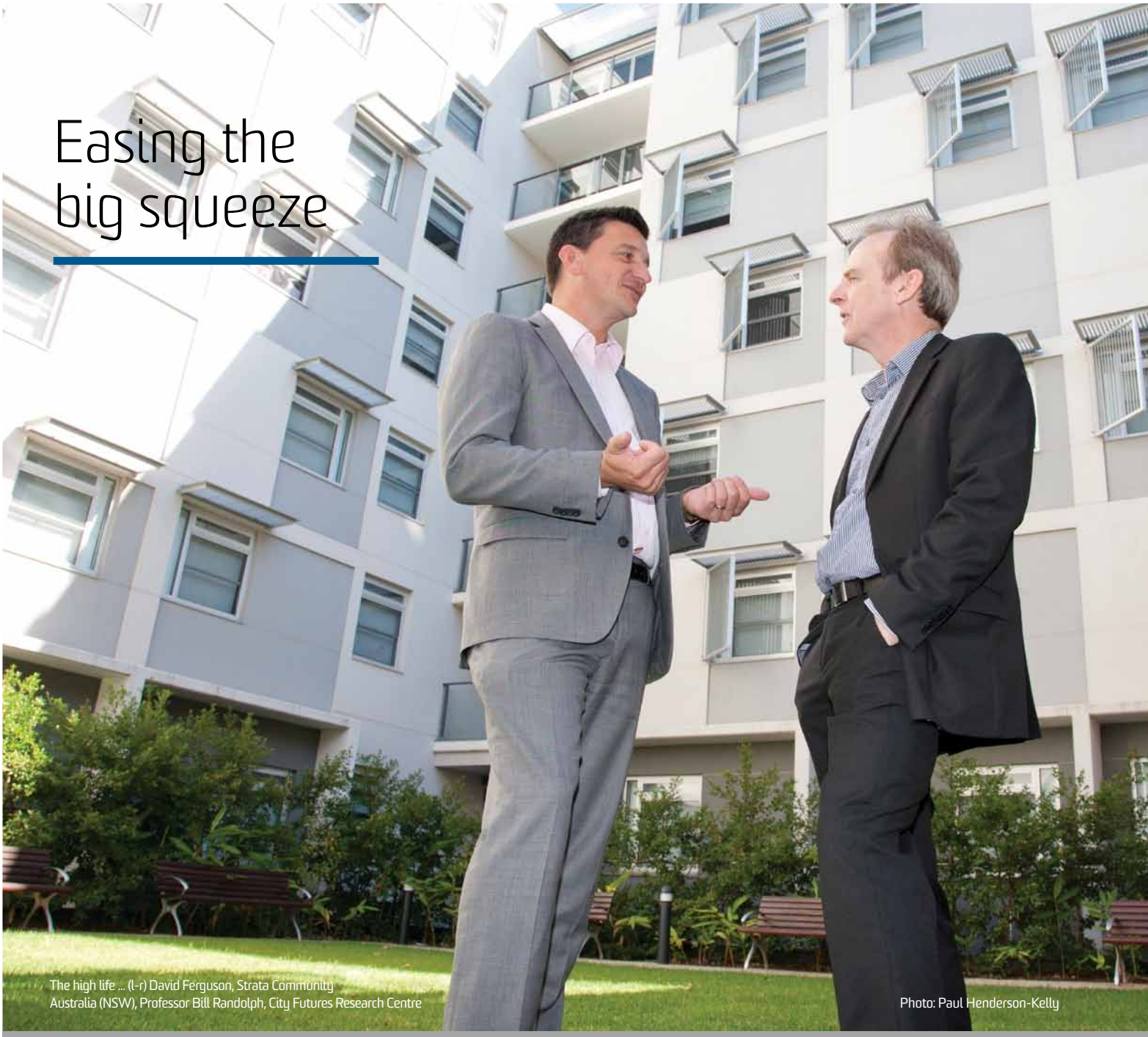
How to make the cities of the future sustainable? Could Australia play a role in preventing another global financial crisis? UNSW is working with business, government and the community to find solutions to complex social and economic challenges.

Partners in...

Society and the economy

society and the economy

Easing the big squeeze



The high life ... (l-r) David Ferguson, Strata Community Australia (NSW), Professor Bill Randolph, City Futures Research Centre

Photo: Paul Henderson-Kelly

As Australia's highly urbanised population nudges 23 million, questions about how to house people comfortably, while still keeping the environment in mind, become more pressing.

The City Futures Research Centre (CFRC) in UNSW's Faculty of Built Environment is focused on providing practical solutions by working with leading universities, government agencies, industry stakeholders and community groups.

"You have to talk to the key stakeholders," says Professor Bill Randolph, who heads the CFRC. "Our role is to provide better information about how our cities are performing. There are multiple problems, such as high-density living, economics of land use, housing affordability, and sustainability."

Urban planning, housing, design, development and social policy are all part of the Centre's brief.

More recently it has partnered with groups such as Macquarie Bank, the Department of Planning (NSW), the City of Sydney and Strata Community Australia (NSW) to research the issues affecting strata management in high-density residential developments. The project explores how effective owners' body corporates and strata managers are in managing and governing property.

One of the most striking findings was the extent of concerns around building defects. In the survey of owners, almost three-quarters of people report one or more major problems at some stage. The situation is worse for buyers of buildings constructed since 2000, with 85 per cent of them reporting one or more defect and of that group, 75 per cent say the defects have still not been fixed. The most common of these were internal water leaks, cracking to internal or external structures and water penetration from the exterior of the building.

The Chair of Strata Community Australia (NSW), David Ferguson, says the partnership provides much-needed assurance.

"The directions we take as an industry need to be made with clear information," says Ferguson. "Partnering with UNSW has ensured that the decisions we make today are robustly supported."

"Our role is to provide better information about how our cities are performing. There are multiple problems, such as high-density living, economics of land use, housing affordability, and sustainability."

Professor Bill Randolph
City Futures Research Centre

"Partnering with UNSW has ensured that the decisions we make today are robustly supported."

David Ferguson
Strata Community Australia (NSW)

Eco-friendly living

Environmental pressures are also affecting housing developments.

One of the biggest opportunities for emissions reductions is in buildings, which is where the new Cooperative Research Centre (CRC) for Low-Carbon Living, led by UNSW, comes in.

"The built environment is responsible for 40 per cent of energy use and Australia's homes account for 16.5 per cent of our emissions in electricity use alone, without accounting for energy embodied during the production and disposal of building materials," says CRC head Professor Deo Prasad from the Faculty of Built Environment.

"Unless we have carbon-positive products, it will be difficult to have carbon-positive buildings," he says. The CRC is a national consortium with 50 participants from local, state and federal governments, as well as Australian companies ranging from property developers, materials suppliers, energy specialists, architects and engineers, to industry groups, professional bodies, and local and international universities.

With a total expenditure of $104 million ($28 million from government grants and the remaining $76 million committed by the Centre's partners), the CRC will devise innovative ways to reduce the building industry's carbon impact without risking the $150 billion-a-year construction industry.

"A lot has been done on sustainability in different circles," says Professor Prasad. "The CRC brings together this national and international experience, knowledge and learning in a common platform. We believe this integrated approach will make the next big jump in performance."

Commencing in July 2012, the CRC will seek input from its partners across three core research programs: integrated building systems to make low-carbon building affordable; low-carbon precincts that make such infrastructure desirable; and engaged communities that enjoy the freedom to inform and empower their decision-makers.

Creative downsizing

The reluctance of older Australians to downsize into smaller dwellings, and therefore contribute to the sustainable city, is another concern for researchers.

UNSW's Enabling Built Environments Program, led by Associate Professor Catherine Bridge is conducting ground breaking research in the area of ageing and the built environment. Example projects include an ARC-Linkage with GWA (Caroma/Dorf) Australia's largest supplier of kitchens and bathrooms products; the Home Modification Clearinghouse Service supported by the Department of Health and Ageing Home; and a project led by Professor Bruce Judd investigating the motivations, obstacles and consequences of downsizing funded by the Australian Housing and Urban Research Institute.

Sustainable city living is also being explored through the creative industries. *Curating Cities* is a five-year research project being conducted by the National Institute of Experimental Arts (NIEA) at UNSW's College of Fine Arts (COFA).

Led by NIEA Director and COFA's Associate Dean (Research) Jill Bennett in partnership with the City of Sydney, the project examines how the arts can encourage environmental change and also influence the development of green infrastructure.

"Our research team is developing innovative curatorial projects to demonstrate the role that art and creative thinking can play in enhancing city space and promoting sustainable living," says Bennett.

PROJECT PARTNERS:
City Futures Research Centre:
Strata Community Australia (NSW) // Owners Corporation Network // Lannock Strata Finance // Macquarie Bank // NSW Land and Property Management Authority // NSW Fair Trading
Cooperative Research Centre for Low-Carbon Living has major industry, government and university partnerships.
Associate Professor Catherine Bridge and her team partner with:
Federal Government's Department of Health and Ageing Home and Community Care Program // Caroma // University of Western Sydney // Australian Housing and Urban Research Institute
Professor Jill Bennett and her team partner with:
City of Sydney // Object: Australian Centre for Design // Carbon Arts

Making sense of the numbers ...
why Australia fared better during the GFC

Photo: iStock

Learning the lessons of the GFC

One of the significant insights of the global financial crisis (GFC) was that Australia's regulatory environment had helped create a financial space that was more robust than other nations.

This awareness led to government and academic interest on understanding exactly why our economy was more resilient.

To further mine this issue, the Centre for International Finance and Regulation (CIFR), led by UNSW's Australian School of Business and Faculty of Law, was established.

"There has been interest in understanding what were the trends and developments in international finance that had such an effect on the mainstream economy: what was appropriate legislative or regulatory intervention and what was the consequence of that?" says Alec Cameron, Dean of the Australian School of Business.

"There was a view that we had something to say globally given that our economy seemed to be faring better than others during that period."

Based in Sydney's CBD, the $41 million Centre is sponsored by the Federal and NSW governments and brings together experts and senior executives from universities, government, regulators and the finance industry. Its partnership with international finance research centres, including NYU's Salomon Center and Volatility Institute and UCLA's Fink Center, opens the way to collaborations with Nobel Laureates.

"The strength of the Centre will come from the collection of information from those groups in terms of major challenges and issues," says Cameron, a member of the Centre's governing Board. "It will concentrate on issues that carry risk and impact for the broader economy: how does appropriate regulation manage and mediate risk without stifling economic growth? There is great interest from all of the partners in getting this right."

The calibre of the Board is impressive. Peter Mason, chairman of AMP and Senior Advisor to UBS Investment Bank is Chairman, with other Board members including Secretary to the Treasury Dr Martin Parkinson, UNSW Vice-Chancellor Professor Fred Hilmer, and Steven Harker, CEO of Morgan Stanley Australia. Banking and finance law specialist Ros Grady has taken on the role of chief executive.

"It is well known there is a gap in translating academic research into industry and government practice," Mason says. "We will identify leaders from industry, government and academia who can work together to ensure that cross-fertilisation occurs in a disciplined fashion."

The Centre also creates a great opportunity for Australia to enhance its role as a financial centre in the greater Pacific region, Mason says.

"The Centre can help to build on the lessons learned during the GFC and to grow the capacity of the Australian financial services industry," he says.

> "We will identify leaders from industry, government and academia who can work together to ensure cross-fertilisation occurs in a disciplined fashion."
>
> Peter Mason
> AMP Chairman

The Centre's multidisciplinary research will cover five broad areas: examining financial market developments; managing regulatory responses; fostering prudent decision-making; economic stability and growth; and understanding systemic risk.

CENTRE PARTNERS:

Macquarie University // The University of Sydney // University of Technology Sydney // ANU // The University of Melbourne // Capital Markets CRC Ltd // SIRCA // NYU's Salomon Center and Volatility Institute // UCLA's Fink Center // The Commonwealth Bank of Australia // Macquarie Group // KPMG // The Federal Treasury and NSW Government.

Questioning the science ... Professor Gary Edmond, Director of the Program in Expertise, Evidence and Law

Photo: Paul Henderson-Kelly

Forensic fallacies

When Professor Gary Edmond examined the use of expert witnesses in criminal trials, he was mortified by what he saw.

"I just thought there were really poor quality expert opinions being allowed into court," he says. "These opinions weren't being adequately addressed by counsel for the defendants or the judge. They were being allowed and the jury was hearing them."

Around the same time, question marks were being raised in the US over the scientific validity of the use in criminal trials of various forensic-science techniques, including fingerprint and ballistics analysis.

Following these events, Edmond, an Australian Research Council Future Fellow, turned his attention to improving the quality of forensic techniques in a bid to prevent questionable evidence seeping into trials and to reduce the incidence of mistaken identifications.

Edmond is Director of the Program in Expertise, Evidence and Law in the School of Law at UNSW. With an interdisciplinary team – including experimental psychologists, forensic scientists and lawyers – he is trying to better understand the ways forensic science is used and how it might be improved in both investigations and criminal proceedings

The research has attracted high-level industry partners from Australia and around the world, including the Australian Federal Police (AFP) and Spain's national police force, the Guardia Civil.

> "The work is vital in resolving doubts over the use of forensic science."
>
> Dr Simon Walsh
> Australian Federal Police

Dr Simon Walsh, the AFP's Coordinator of Biometrics, in the Forensic and Data Centre Portfolio, says the work is vital in resolving doubts over the use of forensic science.

"The research is addressing the issue of forensic evidence interpretation, and clearly this is something that is fundamental to the application of forensic science," he says. "This is because it goes to the credibility and reliability of the conclusions that experts draw, which subsequently supports criminal investigations and prosecutions."

The AFP provides support financially and in kind, as well as in providing an "operational relevance" to direct the research towards practical applications and solutions for use in the field.

Edmond is also part of a team trying to improve understanding of the source of identification errors with a focus on fingerprint and other comparison forensic sciences.

Helping the marginalised

Fellow UNSW researcher Eileen Baldry has also tackled issues within the criminal justice system.

She is examining the experiences of Indigenous Australians and people with a disability in the system.

The ongoing research has been undertaken with a long list of industry partners, and has been critical in identifying instances where organisations can work more closely together in sharing information and resources, to help rehabilitate some of Australia's most marginalised people.

"No-one has gathered all this information together in this way, and been able to provide agencies and governments with this level of information and understanding which will hopefully lead to more helpful support and interactions," she says.

PARTNERS:

Professor Gary Edmond and his team partner with: The Australian Federal Police // State-based Australian police forces, including those in Queensland, Western Australia and Victoria // National Institute of Forensic Service Australia // Australia New Zealand Policing Advisory Agency // Australasian Speech Science and Technology Association // Guardia Civil // Universidad Autonoma de Madrid

Professor Eileen Baldry and her team partner with: NSW Police // NSW Department of Corrective Services // Juvenile Justice NSW // Ageing, Disability and Home Care, Department of Families and Community Services, NSW // Housing NSW // Justice Health // Legal Aid NSW

The path less travelled ... Regina Osten, NSW Health with Dr Kristy Muir, Social Policy Research Centre

Photo: Paul Henderson-Kelly

Centre of change

It is an award-winning scheme that has been copied across Australia.

But without researchers from UNSW its impact might never have been so far-reaching.

The NSW Housing and Accommodation Support Initiative (HASI) sounded good in theory: identify people with severe mental illness living in hospitals, boarding houses, refuges, crisis accommodation and prison then set them up in social housing and surround them with social support and health services.

But no-one knew whether it actually worked.

To solve this mystery the NSW Government called on UNSW's Social Policy Research Centre (SPRC).

Primary researcher Dr Kristy Muir, Associate Dean (Research) in the Faculty of Arts and Social Sciences, was shocked by her findings.

"I thought we'd made a mistake with the analysis," she recalls.

That analysis revealed HASI participants were not only enjoying better mental and physical health and spending more time with their families; they were also spending 81 per cent less time in hospital – saving the government money as a result.

> "The results were quite remarkable – an 81 per cent reduction in hospitalisation is huge."
>
> Regina Osten
> NSW Health

"The results were quite remarkable – an 81 per cent reduction in hospitalisation is huge," says Regina Osten from NSW Health's Mental Health and Drug and Alcohol Office.

The SPRC's evaluation "made a substantial contribution to the expansion of the program because we were then able to demonstrate that it worked and that it was a good investment'', Ms Osten says.

Founded more than 30 years ago, the SPRC is one of the leading forces behind social policy development in Australia – and increasingly in countries like China.

Pick any current social issue and it's a fair bet the Centre's researchers either identified it as a problem, are working on its solution or are evaluating the policies that address it.

"The aim of the SPRC is to make a contribution to how we understand complex social issues and to help inform the solutions," Muir says.

Recent solutions to which SPRC research has contributed include a boost to the minimum wage in 2004, changes to child protection in NSW, a review of Australian family law, greater protection for vulnerable children in China and a 2009 increase in the aged pension.

SPRC boasts expertise in, among other fields, disability, inequality, poverty, families and mental health, with several of its researchers serving on policy advisory councils.

Its broad sweep of expertise makes for some interesting lunchroom conversations and for research that examines social problems from different angles rather than in isolation, says Muir.

This, she says, is important, because life does not occur in compartments. "Unless you think holistically you're not going to have the outcomes you want," adds Muir.

CENTRE PARTNERS:

Federal Department of Families, Housing Community Services and Indigenous Affairs // Department of Education, Employment and Workplace Relations // Australian Institute of Family Studies // Ageing, Disability and Home Care, NSW // NSW Health // Victorian Department of Human Services // Queensland Alliance // beyondblue // Campbell Page // UNICEF

A bold direction ... Eileen Pittaway (at left) and Linda Bartolomei, Centre for Refugee Research with Richard Towle, UNHCR

Photo: Paul Henderson-Kelly

Fighting for refugee rights

UNSW's Centre for Refugee Research is internationally recognised for its work. Its latest success was to expose widespread sexual harassment of women in refugee camps, a cause fully endorsed by the UN Refugee Agency (UNHCR).

The UNHCR's Assistant High Commissioner for Protection, Erika Feller, invited the Centre's Eileen Pittaway and Linda Bartolomei to have a dialogue with refugee women in seven countries: Colombia, Zambia, Thailand, Finland, Jordan, India and Uganda.

"We were committed to getting these people heard by the governments concerned through the UNHCR," says Dr Bartolomei.

The issues ranged from harassment to access to sanitary napkins and attitudes towards lesbians and older women in the camps.

"Partnerships are critical in the work that we do. We are not service providers, we are academics and in order to access refugees, we need good partners," says Dr Bartolomei.

"In our operations we have to grapple with the human reality for people who have been forcibly displaced. Academics tend to take a more 'arms length' and theoretical view," says Richard Towle, Regional Representative of UNHCR in Australia. "But the most effective academics are able to test their theories with good field experience. We find this invaluable in helping to shape UNHCR's policies and operations to deal with these global challenges."

Another of these academics is Professor Jane McAdam. As the Director of the International Refugee and Migration Law Project at the Gilbert + Tobin Centre of Public Law at UNSW, in 2009 McAdam was asked to advise the UNHCR on climate change, forced displacement and international law.

"Climate change is certainly impacting on people's ability to remain where they are, but the cause–effect relationship is far more complex than that," she says.

Studies show that most displacement will be within countries rather than across international borders. This is a crucial consideration when it comes to shaping appropriate legal and policy responses.

"At times there can be a disconnect between what is happening on the ground and what policy makers assume are the relevant issues. I try to convey what I have learned from local communities into the international conversation about how to create workable, human-rights-sensitive approaches to climate change and forced migration."

McAdam is also a leader in her research on the feasibility of the relocation of whole communities in the Pacific region, which won her a prestigious Australian Research Council Future Fellowship in 2011. Her reputation in this field led to her appointment in 2012 as a Non-Resident Senior Fellow at the Brookings Institution in Washington DC – the world's leading think-tank.

She has also been at the forefront of the development of Australian legislation on complementary protection, which took effect early in 2012, entrenching in domestic law Australia's international obligations to protect asylum seekers from being returned to torture, inhuman or degrading treatment, and other forms of serious harm.

"I think that's where my work has had a tangible impact and now puts Australia in line with international law on this issue," she says.

CENTRE PARTNERS:

The Centre for Refugee Research partners with:
UNHCR // ANCORW – The Australian National Committee on Refugee Women // DIAC – The Department of Immigration & Citizenship // AMES – Australian Multicultural Education Services // STARTTS – The NSW Service for the Treatment and Rehabilitation of Torture and Trauma Survivors // Relationships Australia // Amnesty International // ACT for Peace – National Council of Churches

Professor Jane McAdam and her team partner with:
UNHCR // International Organization for Migration // The Brookings Institution, Washington DC // Refugee Studies Centre, University of Oxford // Refugee Review Tribunal // Refugee Council of Australia and other NGOs // Refugee Advice and Casework Service // International Association of Refugee Law Judges // Auckland District Law Society // Australian Government // Government of the Maldives // UK Government

Our partners are valuable at all stages of the innovation process, from supporting original research to helping commercialise research outcomes.

Research Outcomes

@UNSW

A brighter future ... Kevin Cullen from NewSouth Innovations wants the University's research in the public domain

Photo: Patrick Cummins

To market, to market

UNSW is ready to sign away its rights to research discoveries in a revolutionary bid to bring economic and social benefits to the public.

In laboratories on campuses worldwide, researchers are often driven by the desire to answer some of life's most challenging questions in the hope of making real differences to people's lives. Yet it is estimated about 80 per cent of the intellectual property they generate never finds its way into productive use.

In a revolutionary bid to put more on-campus research into practical use, UNSW is now offering nearly all of its intellectual property to business for free under an approach known as "Easy Access Intellectual Property".

"Easy Access IP is all about universities reclaiming their purpose to create and disseminate knowledge," the architect of Easy Access IP, and the head of UNSW's commercialisation company, NewSouth Innovations (NSi), Dr Kevin Cullen says.

Under Easy Access IP, universities decide which IP to commercialise in-house, and which developments to offer to the private sector. Academics have the choice on whether to have their IP included under the Easy Access IP model.

In December 2011, NSi inked its first Easy Access IP deal in the area of clean energy with ROAM Consulting, a Brisbane-based firm specialising in energy market modelling.

> "Easy Access IP is all about universities reclaiming their purpose to create and disseminate knowledge."
>
> Dr Kevin Cullen
> NewSouth Innovations

"Easy Access IP has allowed ROAM Consulting to develop Wind Insight™, a wind-power forecasting tool that provides alerts and animations for potential large rapid changes in wind-power generation," says Dr Nicholas Cutler, an engineer at ROAM Consulting. "Power system operators can use Wind Insight™ to help them manage large amounts of wind generation."

The new approach gives industry greater incentive to take a chance on early-stage developments and work with UNSW's researchers to harness the commercial potential of their discoveries.

"In the process, we hope to see a much deeper engagement between UNSW and our industry partners and the end result will be better research and a smoother uptake of great University ideas," UNSW's Vice-President and Deputy Vice-Chancellor (Research) Professor Les Field says.

The adoption of the Easy Access IP approach adds to a long list of efforts by NSi to put increasing amounts of on-campus research into practical use.

NSi has played a key role in the establishment of spin-off companies, such as BT Imaging, a venture-capital-funded start-up that has developed a suite of high-tech inspection tools for the photovoltaic manufacturing industry.

NSi also commercialised Professor David Taubman's Kakadu Software, a program that helps develop applications to compress or manipulate digital images, and it has been purchased by Google, Disney, Pixar and Apple.

Examples of NSi's involvement in UNSW's commercialisation and spin-off activities:

- Kakadu Software
- BT Imaging *(pages 40-41)*
- CIMTECH *(page 41)*
- iCinema Centre's virtual reality mining project *(page 12)*
- Green steel innovation *(page 40)*

Steely resolve ... Professor Veena Sahajwalla with Paul Vielhauer, OneSteel

Photo courtesy of OneSteel

A sturdy partnership

UNSW's researchers have a long and successful history in commercialising discoveries made in the lab.

UNSW Scientia Professor Veena Sahajwalla is one of them. She was confident from the first that the science behind her "green steel" technology was valid. She had done more than enough to know that her process of turning industrial waste, such as tyres and plastics, into resources for metals processing was successful.

But she wanted to take it one step further: "I wanted to know how we were going to make the engineering work and prove the science could work in the real world. Around that time, OneSteel said, 'OK, let's get on with it.'"

The partnership between Professor Sahajwalla and the mining and materials group has now stretched for eight years with three successful Australian Research Council Linkage Grants.

Professor Sahajwalla, who is the Associate Dean for Stategic Industry Relations for the Faculty of Science, has significant experience in working with industry and says it is critical researchers engage with as many levels of the company as possible.

"It's about aligning your plans with the company's perspective," she says.

OneSteel's Strategic Marketing Manager Darren O'Connell says the partnership with Professor Sahajwalla is a "real opportunity" to build on her ideas around using recycled materials and develop innovative solutions to reduce cost and improve productivity in the company's steel-making facility.

But this industry partnership has evolved to become so much more than just science being given a practical application.

"We feel we have built a successful model for academic and industry collaboration that has benefited both UNSW and OneSteel," O'Connell says.

Aside from the technological developments, the financial support provided by OneSteel has sponsored both Masters and PhD students, as well as the OneSteel Chair in Recycling Sciences, which supports Professor Sahajwalla's research into recycling waste.

The company has also provided opportunities for UNSW students and academic staff to gain experience at OneSteel facilities, leading to the employment of a number of UNSW graduates.

Bright sparks

Another excellent example of the University's success in commercialising its research is with solar-cell technologies.

Thorsten Trupke arrived at UNSW around a decade ago, taking a post-doctoral position in the field of photovoltaics after completing a PhD in Germany.

Ten years on, Associate Professor Trupke and fellow inventor Dr Robert Bardos, also from the School of Photovoltaic and Renewable Energy Engineering, have been involved in the creation of start-up company BT Imaging, which has successfully commercialised their work in identifying deficiencies in solar-cell products.

Known as photoluminescence imaging technology, the work can immediately show up flaws in solar cells and problems with the quality of the materials used.

"I wanted to know how we were going to make the engineering work and prove the science could work in the real world. Around that time, OneSteel said, 'OK, let's get on with it.'"

Professor Veena Sahajwalla
Associate Dean for Strategic Industry Relations, Faculty of Science

Deficiencies in a solar cell can be lethal for efficiency. "And solar-cell efficiency is what it all boils down to," says Professor Trupke.

Previous methods to diagnose flaws threw up an unenviable set of trade-offs.

"Before, we had very fast methods that only gave us a single value for a specific sample or we had spatially resolved technology that took several hours to produce results," Professor Trupke explains. "Our technology marries the two things."

He and Dr Bardos worked closely with NewSouth Innovations, UNSW's commercialisation company, to create BT Imaging and take the intellectual property out of the University. NSi was also involved in putting the fledgling company in contact with venture-capital firms.

BT Imaging has experienced commercial success with its current suite of tools, which help engineers to quickly assess the quality of materials being used in the production process, from silicon wafers to solar cells. R&D engineers can remove the materials from production lines, analyse them using BT Imaging's tools and quickly gain a series of measurements to identify any flaws.

Trupke says the next stage for the company is to move towards products that assess the quality of materials as they are moving through production lines.

Traditional healing

CIMTECH is a company that has used the know-how and experience at UNSW to commercialise its unique technology.

Founder Graham Matheson completed his doctoral research at UNSW in assessing the medical benefits of traditional plant-based remedies long used by the Koutu Nui tribal chiefs of the Cook Islands.

Bringing his discovery to UNSW, Dr Matheson worked closely with Professor Bill Walsh from the Surgical and Orthopaedic Research Laboratory at the Prince of Wales Clinical School to develop commercial applications in the fields of skin and bone technology, and the effects of ageing.

Cook Islands Medical Technologies (known as CIMTECH) was established as the commercial venture to capitalise on this technology and counts the Koutu Nui and NewSouth Innovations as its key partners and shareholders.

The first commercial application of the technology will be released in late 2012, when CIMTECH launches a cosmetic line. Other commercial applications, including bone regeneration, are being explored on an ongoing basis.

Surgery without stitches

SurgiLux is a thin-film surgical adhesive, which has the potential to replace sutures in operating rooms. It was developed by UNSW's Bio/Polymer Research Group, headed by Associate Professor John Foster.

Professor Foster's team has been examining applications for SurgiLux in the dura mater (the membrane covering the brain and the spinal cord, and lining the inner surface of the skull), as well as for operations involving the eye.

"We feel we have built a successful model for academic and industry collaboration that has benefited both UNSW and OneSteel."

Darren O'Connell
OneSteel

Partners in the research include the McGowan Institute for Regenerative Medicine at the University of Pittsburgh.

Professor Foster says the ocular applications present the most promising commercialisation potential for SurgiLux. A pilot trial with humans could begin by the end of 2013.

THE PARTNERS:
OneSteel // McGowan Institute for Regenerative Medicine at the University of Pittsburgh // Save Sight Institute at the University of Sydney // CIMTECH // Koutu Nui // NewSouth Innovations

Professor Marie-Paule Austin holds the country's first Chair of Perinatal and Women's Mental Health, a partnership between St John of God Hospital and UNSW. The position allows Austin to focus solely on women's mental health issues, particularly those associated with childbearing.

Photo: Grant Turner, Mediakoo

Nurturing talent

UNSW has sealed long-standing partnerships with business, industry and government through the establishment of Professorships dedicated to furthering research, policy and education.

Professorships sponsored by business and industry in partnership with UNSW:

Anthony Mason Chair in Law, *Gilbert + Tobin Lawyers, Gilbert + Tobin Centre of Law, UNSW*
Ausgrid Chair in Electrical Power Economics, *Faculty of Engineering*
Commonwealth Bank Chair in Finance, *Australian School of Business*
Evans & Peck Chair in Transport Innovation, *Faculty of Engineering*
KPMG Chair in Taxation Law, *Australian School of Business*
Macquarie Group Foundation Chair, *Centre for Social Impact, Australian School of Business*
Macquarie Group Chair in Financial Services, *Australian School of Business*
Macquarie Bank Foundation Chair in Schizophrenia Research, *UNSW Medicine with Neuroscience Research Australia and the Schizophrenia Research Institute*
Mitsubishi Chair in Sustainable Mining Practices, *Faculty of Engineering*
OneSteel Chair in Recycling Sciences, *Faculty of Science*
Rio Tinto/Northparkes Chair in Mine Geotechnical Engineering, *Faculty of Engineering*

Professorships sponsored by government and NGOs in partnership with UNSW:

Australian Ireland Fund Chair in Modern Irish Studies, *Faculty of Arts and Social Sciences*
Brien Holden Vision Institute Chair in Experimental Optometry, *Faculty of Science*
Chair in Intellectual Disability Mental Health, *NSW Government, UNSW Medicine*
Chair in Forensic Mental Health, *Justice Health, UNSW Medicine*
Chair in Ophthalmology, *Royal Australian and New Zealand College of Ophthalmologists, Medicine UNSW*
Chair in Schizophrenia Epidemiology and Population Health, *Schizophrenia Research Institute, UNSW Medicine*
Cure for Life Foundation Chair in Neuro Oncology, *UNSW Medicine*
HammondCare Chair in Positive Ageing and Care, *UNSW Medicine*
RTA Chair in Road Safety, *Faculty of Science*
St John of God Health Care Chair in Perinatal and Women's Mental Health, *UNSW Medicine*

In addition to partners mentioned in the stories, UNSW acknowledges support from the Australian Research Council and the National Health and Medical Research Council for many of the projects featured in this publication.

If you would like to collaborate with UNSW researchers and/or would like to explore the possibility of an industry partnership please contact:

Office of the Deputy Vice-Chancellor (Research)

The Deputy Vice-Chancellor (Research) is responsible for driving the strategic research direction, in particular, maintaining and advancing the University's profile in research and research training, as well as technology transfer.

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Research Partnerships Unit

The Research Partnerships Unit facilitates and enables successful and sustainable partnerships that aim to deliver high-quality outcomes for our partners and UNSW. It is responsible for the identification, establishment and effective management of Australian and international research partnerships with industry, governments and affiliated institutions.

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Web: research.unsw.edu.au/units/research-partnerships

Students interested in pursuing a postgraduate research opportunity should contact:

Graduate Research School

The Graduate Research School is the central administrative and support unit for all students enrolled in PhD, MPhil and Masters by Research higher degrees at UNSW and their supervisors.

Phone: + 61 2 9385 5500
Fax: + 61 2 9385 6238
Email: enquiries.grs@unsw.edu.au
Web: grs.unsw.edu.au

For information on commercialisation and other partnerships with the University please contact:

NewSouth Innovations

NewSouth Innovations works with researchers, business and the community to provide easy access to world-class research and cutting-edge technologies developed at UNSW.

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Email: info@nsinnovations.com.au
Web: nsinnovations.com.au

UNSW Foundation

The UNSW Foundation Limited, a registered charity, is a company limited by guarantee. Registered in 1988, the company is linked to the University by a trust deed and is the principal vehicle for UNSW's fundraising activities. It oversees the raising of philanthropic gifts for scholarships, research and capital projects.

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