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BUILDING THE FOUNDATIONS
FOR A BETTER FUTURE

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UNSW researchers are committed to building a strong foundation for a better future.

contents

climate change + sustainability 02
a perfect storm 04
changing course 06
the vanishing 07
future proofing 08
energy fix 09
risky business 10
rising tide 11

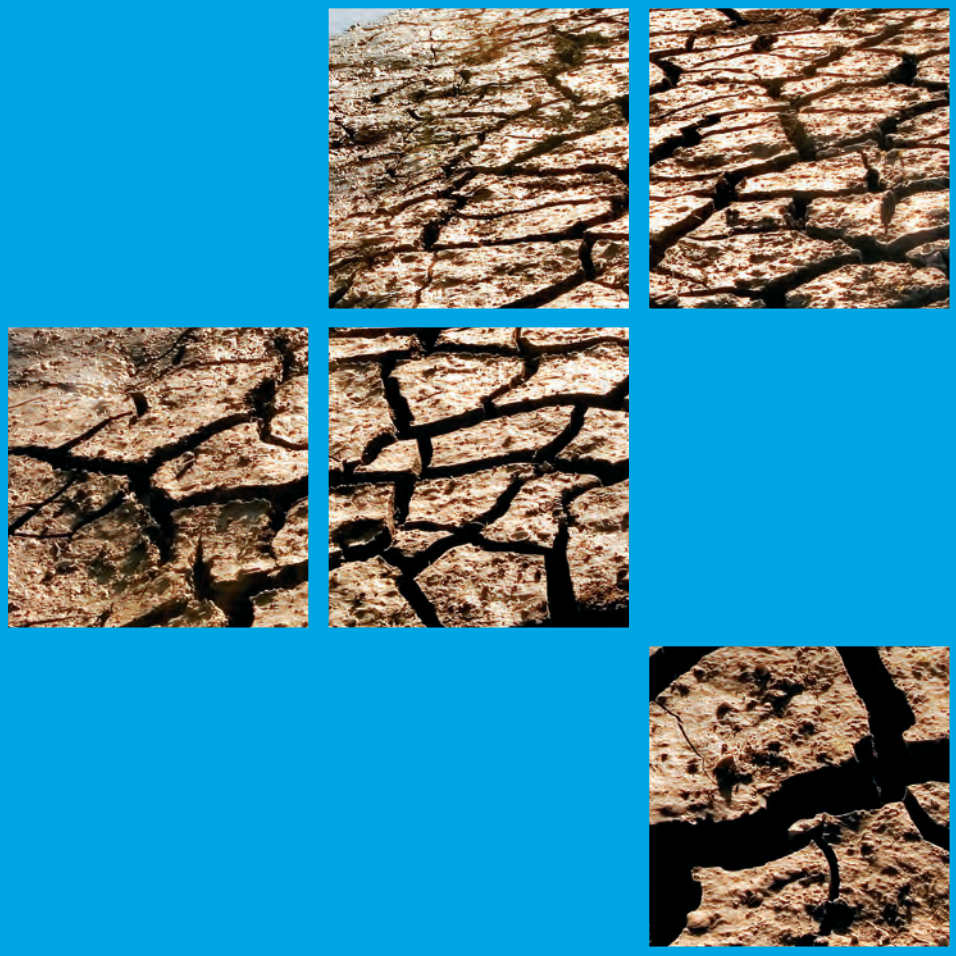
smart technology 12
get SMaRT 14
a vision splendid 16
inner space 17
small wonders 18
surgical strikes 19
flight of the MAV 20
solar's hard sell 21

creative media 22
media blitz 24
game playing 26
i m here. where r u? 27
breaking the news 28
shock waves 29

social inclusion 30
family matters 32
burden of care 34
cannabis culture 35
early warning 36
sorry situations 37

saving lives 38
confronting cancer 40
mind thief 41
the good heart 42
fightback on infection 43
tipping the scales 44
city and country 45

leading the field 46
seizing the opportunity 48



UNSW has more than 60 researchers in climate change, covering all aspects of the water and energy cycles.

climate change + sustainability

- greenhouse gases
- ocean warming
- rising seas
- climate change mitigation
- emissions trading
- sustainable markets
- population pressure
- renewable energy
- drought and salinity
- water security

a perfect storm

As the world scrambles to combat climate change, UNSW researchers are offering practical solutions to some of the biggest threats.

Climate change is here to stay and urgent action is needed to avert and manage its potentially disastrous effects.

For Australia, the market impacts of changes in rainfall and temperature are projected to slash consumption and economic growth by five percent, and cut wages by eight percent by century's end.

If nothing is done soon to reduce carbon emissions, Australia could lose its iconic Great Barrier Reef and see a 20 percent fall in agricultural output from the nation's food bowl, the Murray–Darling Basin.

These are the grim warnings included in the Federal Government's draft Garnaut climate change report, which says Australia needs an emissions trading scheme in place by 2010 as the best option for cutting greenhouse gas emissions.

As the nation grapples to take wise, decisive action, UNSW academics are providing research findings and expert advice to governments, industry and communities who bear the brunt of the impacts – now as well as into the future.

The Climate Change Research Centre (CCRC) is a multidisciplinary group comprising one of the nation's largest and highest impact university teams in climate science, oceanography, terrestrial processes, atmospheric sciences and meteorology.

Led by Matthew England and Andy Pitman, the CCRC researches the physics of climate variability and climate change, and the ways that the oceans and terrestrial systems affect climate and rainfall patterns. Understanding the changes in the oceans and land surface and the way they impact on rainfall and carbon cycling is core to the CCRC's research agenda.

"Nobody fully understands the drought cycles that regularly occur over Australia," says Professor England. "For example, we know that El Niño plays a major role but El Niño events vary markedly. A very severe El Niño may only have a modest impact on rainfall in one year, while in another year a modest El Niño can see severe droughts."

England points to warming sea temperatures as an obvious signature of human-induced climate change. Increasing greenhouse gas emissions mean that a greater fraction of outgoing long wave radiation is trapped in the atmosphere, causing ocean warming, melting icecaps and rising seas.

The CCRC's study of sea temperature variations is yielding significant benefits, according to England. "In the south-west of Western Australia seasonal rain predictions have improved due to our research linking local rainfall variations to changes in temperature patterns over the Indian Ocean. Farmers have taken advantage of the projections, resulting in better cropping outcomes potentially saving millions of dollars."

Ocean warming brings other threats too, says England. "When Hurricane Katrina hit the Gulf of Mexico, ocean surface temperatures were exceptionally warm – well beyond their natural range of variability. These warm temperatures intensified the hurricane. Katrina wasn't created by climate change but the fact that it was so powerful is considered to be a direct result of global warming."

Jane Carthey, Professor Matthew England, Professor Andy Pitman and Dr Donna Green
Photo: NOAA / Science Photo Library, Susan Trent / Gasbag Studios. Graphics: Shaun Dougherty

Katrina had an important lesson for Australia. While average worldwide sea temperatures have risen 0.6 or 0.7 degrees centigrade, the rise in the Tasman Sea has been two degrees. High ocean warming rates have also occurred over Australia's north-west shelf, where tropical cyclones are common.

Rising carbon emissions are also bringing major changes on land. "Australia's plants are reacting to more carbon dioxide by reducing transpiration and improving water use efficiency," says Professor Pitman.

"That appears to be making them hotter. This contributes a small difference to global-scale climate, but it can have an important local impact by making extremely hot days more common, particularly when linked to a drying environment and associated increases in drought. An increasing number of very hot days affects ecosystems' survivability.

"By focusing our interest on the extreme patterns of temperature and rainfall occurring over the continent we're able to improve the reliability of climate projections. As we've added these processes to our modelling, we've found the overall effects of climate change are more concerning, particularly at regional scales," says Pitman.

Extreme weather will impact on human health and the demand for health services. The elderly and other vulnerable groups will be most at risk, and there will be a rising incidence and prevalence of heatstroke, respiratory diseases and vector-borne diseases such as malaria.

Jane Carthey, the Director of UNSW's Centre for Health Assets Australasia, says that health services, transport and communication systems will need to adapt to cope with events on a similar scale to Hurricane Katrina, which had a devastating impact on infrastructure and in particular health services.

"In the short term, we need to educate the community regarding the health risks associated with such events," says Carthey.

"In the medium to long term, the number, location, size and specialisation of health services will need to adapt. This involves a rethink about health service needs as well as architectural design and materials, energy backup systems, workforce planning and urban and regional planning."

Further afield, climate change could generate an unprecedented refugee crisis as up to 250 million people in low-lying regions and island nations flee from rising seas. For many living on Australia's northern frontier, the threat is not abstract.

In 2006, several inhabited Torres Strait Islands were inundated by storm surges more powerful than any seen in the last 50 years.

CCRC scientist Donna Green works with remote Indigenous communities to increase their capacity to adapt.

"While we don't have long historical records of sea levels in the Torres Strait, we do know that climate change is causing sea levels to rise and is increasing the intensity of extreme weather events," she says.

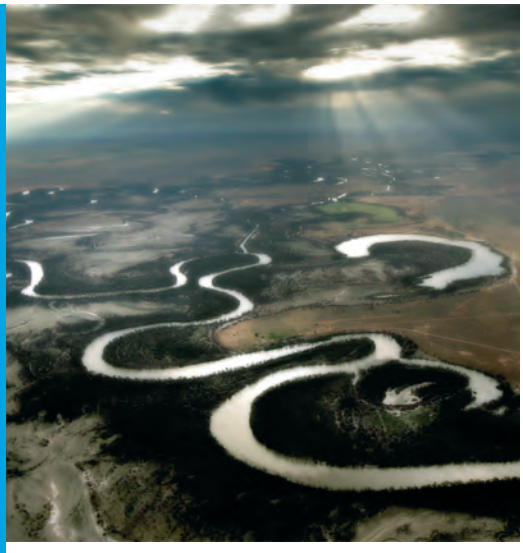
Dr Green is also an expert on the political barriers that have hindered Australia's ability to make deep cuts in greenhouse gas emissions. As a nation now committed to significant emissions cuts, her research is timely and relevant.

The Opportunity

The CCRC undertakes research in climate variability and climate change, from the underpinning physical and biophysical science through to impacts and adaptation. PhD and post-doctoral research opportunities are available in the areas of regional and global climate change, atmospheric dynamics, oceanography and land-surface processes. Industry and government partnerships are available in areas relating to climate extremes, climate risk and climate adaptation.

changing course

One vital element has the ability to alter our environments forever. It's called water.



The Opportunity

PhD scholarships are available in coastal engineering, coastal processes and coastal impacts of climate change. Post-doctoral fellowships are offered for work focusing on fieldwork, laboratory studies and numerical modelling of the coast. International research collaboration is underway with leading coastal research teams in Europe and the USA, while industry collaboration exists with local, state and the federal governments.

Funding is also being sought for new PhD scholarships in water research. Prospective students should inquire directly to the UNSW Water Research Centre.

The Murray River
Photo: Simon O'Dwyer / Fairfaxphotos.com

Forget oil. Water is becoming the world's most precious commodity, with water security and innovation in conservation, management and recycling increasingly driving nations' responses to climate change.

UNSW researchers in the faculties of Science and Engineering are taking an integrated approach to research across the entire water cycle, with projects as varied as recycling, beach erosion, groundwater subsidence and water treatment.

A new crop watering system, developed by Associate Professor Greg Leslie and the UNESCO Centre for Membrane Science and Technology in conjunction with the University of Sydney, has the potential to help water-starved farmers turn previously useless brackish groundwater into high-quality water for irrigation. The subsurface drip irrigation system strips brackish water of salt, using the crop plants' root systems to draw the clean water through a reverse osmosis membrane.

The water system – provisionally patented by UNSW's commercial arm NewSouth Innovations – promises to open up more arable land and assist struggling farmers in areas where decades of poor water management has enabled salt to leach into the water table.

Ian Turner from the Water Research Laboratory is part of an international team working in France to discover the mathematical equilibrium that keeps the world's coastlines intact.

The urgent question is whether even small changes in sea levels due to climate change will wreck this natural balance and trigger devastating coastal erosion.

Measurements recorded on what's believed to be the single largest array of scientific instruments ever deployed in experimental coastal research show that a single wave can shift the sea bed up to two centimetres. Over a three-week period movements of 100 metres have been recorded – mitigated only by the fact that nature is constantly seeking equilibrium no matter how extreme the short-term movements.

"Relatively small changes in the wave climate could cause relatively large impacts on beaches in the same ways small temperature changes can disrupt natural ecosystems," says Dr Turner.

"But it's also possible our research could show that because beaches have this natural equilibrium they may have the ability to adjust to rising sea levels."

As more cities turn to recycled water, Stuart Khan, from UNSW's Centre for Water and Waste Technology, is working to find a more sensitive method for monitoring the quality of the water from recycling plants.

"It's very important to monitor the water, not just by taking samples and taking them back to the laboratory, but online and in real time," he explains. "That's the challenge."

Dr Khan's research will allow a continuous assessment of the water treatment process.

"Knowing that it's working well today is great but will it be working well tomorrow? Are there periods during the day when the water quality fluctuates?

"These are the things to understand in very fine detail."

the vanishing

UNSW scientists are leading the fight to save our waterways and the wildlife and communities they support.

Australia's rivers are in crisis. A worsening drought and over-allocation of water are crippling agriculture across much of the country's south-east and chronic water flow shortages are causing species' reductions and habitat destruction on a catastrophic scale.

In our most important river system – the Murray–Darling Basin – UNSW researchers are fighting to protect what's left of the wetlands and help manage rivers more sustainably.

Led by Richard Kingsford, UNSW's Wetlands and Rivers Research Laboratory has issued a series of seminal reports on the fate of Australia's wetlands, inland rivers, flood plains, vegetation and the knock-on impacts on our resident and migratory shorebirds.

Last spring, Professor Kingsford's team reported on aerial surveys that showed water and waterbirds had all but vanished from the northern reaches of Macquarie Marshes, north of the NSW town of Dubbo. The result, the worst in the 25-year history of aerial waterbird surveys of eastern Australia, stemmed from drought and the long-term effects of over-allocating water for irrigation.

"We didn't find a single bird in the Marshes' northern region," says Kingsford. "In the 1980s we averaged 20,000 waterbirds from more than 20 species in the Marshes. In the 1990s that figure dropped to 5,000 birds from 13 species and since 2000 we have averaged around 500 birds from just nine species."

In autumn 2008, Kingsford revealed more bad news – three-quarters of eastern Australia's millions of resident and migratory shorebirds had disappeared.

"The wetlands and resting places that these birds rely on for food and recuperation are shrinking all the way along their migration path, from Australia through South-East Asia and up into China and Russia," says Kingsford, who co-authored the report with Dr Silke Nebel and Dr John Porter.

The team also found the lower Macquarie River and its flood plain and flood-dependent vegetation were being starved of water by often illegal earthwork structures, such as channels, levees and dams.

Further upstream on the banks of the Namoi River, Ian Acworth and UNSW's Water Research Laboratory have pioneered a new way to monitor water movement in "cracking soils".

Cracking soils offer favourable conditions for agriculture because of their high nutrient content and water-holding capacity. Their fine grain is believed to be a factor assisting water retention.

Professor Acworth and his colleagues, Associate Professor Bryce Kelly and Ms Anna Greve, are using time-lapse photography and electrical borehole tomography to estimate changes in soil moisture content.

The team has successfully applied the technique in laboratory and field experiments based in Boggabri, a wheat, wool and cotton town set on the banks of the Namoi River, with the technique to be further trialled in Narrabri.

The improved monitoring could lead to more sustainable irrigation – crucial to ensuring less water is drained from our most important waterways.

The Opportunity

The Wetlands and Rivers Research Laboratory undertakes research in wetland and river ecology providing PhD and post-doctoral opportunities working with industry partners in conservation and river management and with state and Commonwealth governments. For more information go to www.wetrivers.unsw.edu.au.

PhD and post-doctoral projects are also available in a number of areas associated with the Connected Waters Initiative. For information on research into water movement go to www.connectedwaters.unsw.edu.au.

The Murray River at Mulwala
Photo: Andrew Quilty / Fairfaxphotos.com

future proofing

UNSW sustainable cities researchers are taking their message to the world.

The Opportunity

PhD and post-doctoral studies and industry collaborations are available in sustainable buildings and sustainable cities.

Thermogram – Boston, Massachusetts
Photo: Scientifica / Getty Images

One of the biggest global challenges taking place is urbanisation. The number of people living in cities continues to grow and soon, for the first time, more than 50 percent of us will live in cities.

In the past the building and maintaining of cities has been unsustainable, argue UNSW researchers Deo Prasad, Peter Graham and Allan Giddy, who are working to ensure that the future is a different story.

“With so many people now living in cities we must find a way to make them more sustainable,” says Professor Prasad, a sustainable-living expert from the Faculty of the Built Environment (FBE).

Dr Graham, also from the FBE, agrees. “Buildings are responsible for about one-third of all of humanity’s greenhouse gas emissions. There is a need to mitigate emissions and begin to adapt to climate change,” he says.

Both Prasad and Graham are working with the United Nations to take the message about changing our cities to the world.

Prasad is the chair of the United Nations Environmental Programme’s (UNEP) Asia Pacific committee on urbanisation.

“Our job is to assess, evaluate and guide cities in how to go down sustainable pathways,” he says.

Prasad’s research looks at tools for sustainable development of cities, as well as specific aspects of high-performance buildings. He also looks at how companies can take the sustainability idea as part of their daily work in design, construction and management.

Graham is currently working in Paris as the Coordinator of the UNEP’s Sustainable Buildings and Construction Initiative.

“I work closely with the public, civil and private sectors to assist the global transition to mainstream sustainable buildings and construction,” he says.

“Part of my academic research is assessing the life-cycle sustainability impacts of building. Through the UN this is guiding international think-tanks on benchmarking the environmental performance of buildings, and in understanding how buildings can adapt to climate change.”

Mr Giddy, from the College of Fine Arts, is using art to take the sustainable cities message to the masses.

In collaboration with the FBE and Chemical Engineering, Giddy works on projects that raise awareness by using sustainability as a working methodology rather then just a rhetorical framework.

“The artworks practise what they preach,” he says. “They use solar or wind energy, recycled material, contemporary communication systems and so on.”

Examples of Giddy’s work include huge cranes that measure temperature and humidity at Sydney’s Olympic Park.

“This work is not rhetorical, which is the problem with a lot of environmental art,” he explains. “My work shows that the art community is also able to respond to the environment.”

energy fix

A new energy institute is taking up the challenge of finding clean and sustainable ways to fuel our future.

When leading US environmental economist Michael Hanemann visited UNSW to open the new Centre for Energy Research and Policy Analysis (CERPA), he warned of the enormous complexity involved in combating climate change. Professor Hanemann, of the University of California, Berkeley, said greenhouse gas production was not limited to a small group of usual suspects – rather, dangerous emissions came from throughout the economy. And, for the foreseeable future, there were no easy fixes.

"What is needed is behavioural change and new technologies – and this is a wonderful start you are making with CERPA," he said.

Launched in August 2008, CERPA brings together the diverse capabilities of seven UNSW faculties. Backed by more than $25 million in total annual research funding, CERPA is also believed to be the first Australian institute to cover all aspects of energy research – from renewable technologies and sustainable use of fossil fuel to markets policy. Its purpose is to develop multiple solutions to the complex challenges posed by climate change and rising global energy demand.

CERPA research concentrates on five key areas: renewable energy technologies; fuels for a cleaner environment; distributed energy systems; efficient energy technologies; and economic, social and regulatory policy.

Renewable energy research includes photovoltaic cells, wind power, solar thermal energy, biofuels, geothermal energy and solar hydrogen.

Clean fuels research is focused on carbon capture and storage, and new, alternative fuels from gas, coal and biomass.

Distributed energy systems – demand-side systems such as local solar, cogeneration and biomass – are attracting growing interest worldwide for their ability to avoid the high costs associated with new centralised energy generation, such as power stations.

Similarly, energy-efficient technologies is a vast new field of research focused on optimising energy use, sustainable design, and manufacturing and creating new materials for capturing and storing energy.

In social and regulatory policy, CERPA researchers in law, economics and social sciences are working on bridging the gaps between what scientists create, what industry will pay for and what the community is ready to use.

CERPA Director Rose Amal says the transition of innovations from lab to marketplace will be a key goal of the centre.

"At the upstream of the innovation pipeline, we have fundamental understanding of the science, followed by materials discovery and design," Professor Amal says.

"These activities are housed mainly in Science and Engineering. The discovery phase will lead to novel technology development and further downstream we will have systems to ensure the new technologies can be distributed efficiently to the consumer in the marketplace."

The Opportunity

CERPA is positioned to be a key partner with governments and industry players in developing innovative and practical energy solutions.

Photo: istock

risky business

Learning from others' mistakes will be vital when Australia launches its emissions trading scheme – one of the most significant economic restructures in the past 50 years.

The Opportunity

PhD and post-doctoral research opportunties are available in testing design options for an emissions trading scheme; assessing interaction of schemes with renewable energy markets; and energy-efficiency measures.

Dr Regina Betz
Photo: Susan Trent / Gasbag Studios

Australia's carbon trading scheme, to be launched in 2010, will harness market forces to help us meet our emissions reduction targets. Organisations will have to buy and sell permits that represent how much carbon they are allowed to emit. Hence a pollutant, in this case carbon, becomes a commodity and those who pollute in their line of work must pay for the right to do so.

It can be a good system in theory. But Regina Betz and Roger Simnett argue that there are risks involved in getting the design right and in ensuring the credibility of emissions reporting. The problems can be seen in real-world examples and have been identified by UNSW research, which uses experimental economics and mock trading in which participants act as companies.

"In Australia a lot of the discussion is going to be around whether we give free permits to companies or do we auction them," says Dr Betz, who heads the Centre for Energy and Environmental Markets alongside the Faculty of Engineering's Dr Iain MacGill.

"My view, based on my research, is that we should auction permits. That's not only because of the unfair impacts on consumers but because an unbalanced allocation at the outset might lead to a less efficient market outcome."

In the European Union, where rather than auctioning permits the authorities gave them away, polluters made billions of euros from consumers as they built a cost-of-carbon premium into their pricing structure. Essentially they charged customers for what they had received for free, turning the "polluters-pay principle" upside down.

In Betz's experiments participants came up with their own strategies to trade permits with each other and to invest in carbon reducing technology. It was a facsimile of what would happen in the real world. Betz found that the market wasn't particularly rational and the prices ended up being a lot higher than expected. She believes more experiments are needed to determine the best design.

Another important question: How do we know emissions disclosures are credible? Professor Simnett, from the School of Accounting, believes the only way is to require an independent expert to attest to the disclosures.

"Australia's scheme will be less effective without an assurance system that ensures emission disclosures are accurate and reliable. Emissions Trading Schemes provide economic incentives to misrepresent a company's actual level of emissions, and society is looking for a method that promotes trust and confidence."

As co-chair of an international taskforce setting guidelines for assurance on emission disclosures, Simnett says independent assurance is also essential for trade between jurisdictions.

Betz agrees that there's a lot to consider: "Because the market in emissions trading is a designer market, the government has many options. Our research is giving it the guidance it needs to improve the market and in turn deliver emissions reductions at lowest cost."

rising tide

Rising seas and vanishing nations could generate a refugee crisis unlike any seen since the Second World War.

The potential impacts of climate change are catastrophic: island nations in the Pacific and Indian Oceans and large tracts of land from Bangladesh to Egypt risk submergence, while elsewhere nations face extreme weather events, shoreline erosion and increased salinity.

With a potential 50–250 million people at the risk of displacement, the world faces a "refugee" crisis on a scale not seen since the Second World War.

Jane McAdam, from the Faculty of Law, is investigating what obligations states have, if any, towards people who are displaced by habitat destruction.

"On the one hand, they're entitled to the full range of rights set out in international human rights law," says Dr McAdam, who is Project Director of the Climate Change Refugees and International Law project at the Gilbert + Tobin Centre of Public Law.

"But on the other, they're not yet recognised as an identifiable group whose rights are articulated, or as a formal legal category of people in need of special protection.

"They don't fit the international legal definition of refugee and there's no agency, such as the United Nations High Commissioner for Refugees, with a mandate to assist them."

Whether people who move due to climate change are viewed as "environmental migrants" or "climate refugees" has enormous repercussions for international law responses. McAdam says the challenge is to have a legal regime in place before the crisis unfolds.

She says it's likely an entirely new legal response will be required, drawing on refugee, human rights, humanitarian and environmental law – a task made difficult for lack of political will.

The possibility of disappearing states raises other legal questions. If a state ceases to exist, what will happen to its exclusive economic zone and continental shelf, and the rights to exploit the resources there?

With Pacific islands already facing inundation, Rosemary Rayfuse, Co-Director of the Climate Change Law and Policy Group, has devised a trust system whereby commercial rights are maintained even after states disappear and any income generated is used to pay for the relocation of former inhabitants.

Professor Rayfuse is also working with Associate Professor Shirley Scott from the Faculty of Arts and Social Sciences to examine the normative effects on international law of adaptation and mitigation responses to climate change.

"The threat of ill-conceived mitigation and geo-engineering solutions making the world a worse place is very real – witness the biofuels/food shortage issue," Rayfuse says.

Her research has helped bring about a de facto international moratorium on one mitigation response – "ocean fertilisation" where iron, nitrogen or phosphorus is pumped into the seas to promote massive phytoplankton blooms to absorb atmospheric CO_2.

Environmental consequences aside, Rayfuse found any push to commercialise the practice as carbon offsets would contravene international treaties regulating the use of the sea, and it looks set to be banned for anything other than scientific research.

The Opportunity

PhD and post-doctoral opportunities exist to pursue research on legal and policy issues related to emissions trading and geo-engineering responses, and on the impacts of climate change and mitigation and adaptation measures on international law, human rights, environmental law, trade and investment, peace and security, corporate responsibility, planning law, trade practices and the insurance sector.

Links: www.gtcentre.unsw.edu.au/projects_partners/projects/ccril/index.asp

Photo: Paul Harris / Fairfaxphotos.com

From nanomaterials and sustainable production to artificial intelligence and robotics, UNSW is finding concrete solutions to industry demands.

smart technology

- waste
- efficient production

- energy demand
- quantum computing

- rebuilding the body
- drug delivery

- functional nanomaterials
- photovoltaics

- pilotless flight
- polymer plastics

get SMaRT

A new research centre aims at the heart of producing sustainable materials.

Imagine if we manufactured buildings, clothes, food, energy and transportation systems so they didn't harm the environment and the processes that sustain life. Nobel Laureate Al Gore could pack up his slide show and take up fly-fishing, knowing that humanity had ticked the box called "sustainable development".

The fact is we're a long way from that goal, which is why UNSW has initiated a research and technology hub linked to a string of materials-related industries that want to be part of the solution on sustainable development.

The Centre for Sustainable Materials Research and Technology (SMaRT@UNSW) develops innovative materials, processes and technologies to re-use "waste" as a resource and reduce energy consumption in the process. One of the aims is reduction of greenhouse gas emissions by providing pathways for industries to achieve their sustainability targets.

Established in January 2008, SMaRT@UNSW includes researchers from the faculties of Science, Engineering, Built Environment and ADFA. The Centre has a string of research and development partnerships with companies from the manufacturing, mining, steel and aluminium industries, including AceRack, Anglo Coal Australia, BlueScope Steel, LKAB (Sweden), OneSteel, Posco (Korea), Rio Tinto Alcan, Ruukki Steel (Finland), Shinagawa Refractories Australasia and US Steel (USA).

"The Centre and its industry partners are focused on devising new recycling methods and ways to add value to waste by turning it into high-value products or by using waste as raw materials for manufacturing completely different end products. Now that's innovative recycling," says materials scientist Veena Sahajwalla, who heads SMaRT.

"The guiding principle is to devise ways to reduce the environmental impact and enhance community benefits associated with materials-related industries and related technologies," Professor Sahajwalla says.

The Centre's linkage to industry – leading industry representatives sit on its board – underscores an ambition to facilitate the rapid transfer of innovation by addressing at square one the scientific and engineering barriers that often inhibit technology transfer and adoption.

Sahajwalla's own innovation, a new commercial green steel-making process using waste plastic in the furnace, is an example of this new "industrial ecology". The technology turns plastic rubbish into a material resource and reduces the use of high emissions coke and coal.

The process works by reacting blends of waste plastic and coke/coal at intense temperatures in electric arc furnace (EAF) steel-making. It produces an identical end product, but uses less electricity and recycles waste that would otherwise accumulate in landfills, boosts productivity and reduces greenhouse gas emissions.

The technique has now been commercialised by the Australian steel-maker OneSteel, which has signed a global licensing deal with UNSW's commercialisation arm, NewSouth Innovations (NSi), giving the company rights to sublicense this exciting new green technology.

Professor Veena Sahajwalla and Dr Sami Kara
Photo: Paul A Souders / Corbis, Susan Trent / Gasbag Studios. Graphics: Shaun Dougherty

In another recent UNSW breakthrough, UNSW@ADFA's Dr Obada Kayali has turned polluting fly-ash waste from coal-fired power stations into an environmental building products solution for the world's carbon-hungry construction sector.

The first 100 percent "made from waste" fly-ash bricks, pavers and aggregates are now coming off the production line at a pilot plant in a special Chinese zone for industrial recycling.

Apart from the immediate environmental benefits of utilising fly-ash – hundreds of millions of tonnes of which contaminate the air and clog the world's waterways – the new building products also offer significant cuts to greenhouse gas emissions for the construction sector.

"Our research applies a holistic life-cycle approach to materials development, manufacturing and end products because this is at the heart of sustainable development," says Sahajwalla.

"That necessarily means we carefully select eco-friendly materials and promote or devise low carbon and energy-efficient processing technologies that deliver products with extended life spans, that can themselves be recycled into the next phase of the cycle."

The Faculty of Engineering's Life Cycle Engineering (LCE) program, a key member of SMaRT@UNSW, is a driver of the "life cycle" approach. The program is headed by Sami Kara from the Faculty of Engineering's School of Mechanical and Manufacturing Engineering.

"Life Cycle Engineering is a new research field in engineering that is closely related to sustainable development," Dr Kara says.

"Where sustainable development – a product of the second-wave environmentalism of the '80s – recognises the need for economic growth, LCE defines the life cycle of a product from raw material use to disposal stage in order to reduce environmental impact.

"A major advantage of the LCE methodology is that it comes from multiple points of view – environmental and economics as well as technological."

The approach is exemplified by vehicle manufacturer Mercedes-Benz. Since 1993 all its vehicles have been designed to employ re-usable, natural and renewable raw materials and, where possible, components have been recycled at the end of the vehicle's life. To that end, 85 percent of its current A-Class vehicle can be recycled.

All laudable aims. So how will SMaRT@UNSW be evaluated?

"Over the next three years we aim to generate external research income of at least $1 million per annum, develop two new long-term research and development relationships with industry, attract more high-degree research students and publish annually at least 15 journal papers and 15 refereed papers," says Sahajwalla.

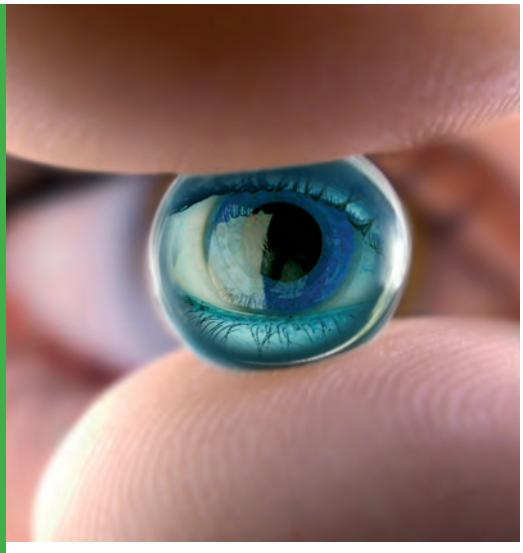
"I'm confident we'll achieve those aims because the Centre draws the best and brightest researchers and innovators."

The Opportunity

SMaRT@UNSW offers research expertise to address the available pathways for industries to achieve their emissions reduction targets and enhance sustainability. Postgraduate research possibilities exist in sustainable materials development alongside Australian and international industry partners.

a vision splendid

The race is on to move a Holy Grail of modern medical research – the bionic eye – from science-fiction dream to genuine modern miracle.



The Opportunity

The Centre for Implantable Bionics undertakes research in various aspects of implantable medical device technologies. A specific focus is on neuroprosthetics, with a large research program devoted to developing a bionic eye. PhD and post-doctoral research opportunities are available across a diverse range of engineering, materials science and clinical applications.

Photo: istock

When Prime Minister Kevin Rudd endorsed the push for an Australian-developed bionic eye at the 2020 Summit, UNSW researchers Nigel Lovell and Gregg Suaning knew the vision could quickly become a reality if the right steps were taken – and taken quickly.

Professor Lovell and Associate Professor Suaning are leading the research at the Australian Vision Prosthesis Group (AVPG), which over the past decade has advanced the science-fiction dream of bionic vision to the stage of a viable "vision prosthesis" which can detect not only light and dark but also patterns.

While the device is now in technical trial stage with human trials still a couple of years away, Lovell says a functional device can be a reality by 2020 – with a concerted national effort.

The AVPG is not alone in the race for bionic vision: around the world, teams are working on various concepts that may prove to be the breakthrough technology that gives sight to the blind. But the UNSW team is confident it can be part of an Australian world first if coordination and the support it needs comes about.

"There are already some overseas trials of rudimentary bionic eye devices but we have certain designs which are more advanced," says Lovell.

"We need to act now if we want to take advantage of our technical edge."

Suaning says the device consists of an external microcamera and microprocessor which is mounted on glasses and transmits a signal to an implanted electronic circuit and electrode, connected to the retina at the back of the eye.

The Australian Bionic Eye project is a collaborative effort between UNSW's AVPG, the Centre for Eye Research Australia, the University of Melbourne based at the Royal Victorian Eye and Ear Hospital, the Bionic Ear Institute and NICTA, Australia's National Information and Communications Technology Research Centre of Excellence.

It's collaborations like this that offer the best hope for the much-needed breakthrough, according to Lovell. Combining the engineering and medical brilliance scattered across the country will be the best chance to achieve a world-first bionic eye advancement to match the bionic ear.

Suaning says the bionic eye project needs a relatively small amount of funding to become reality and has welcomed the support proposed by the Prime Minister at the 2020 Summit.

"This isn't going to cost anything like a space program," he says.

"We can get it done here in Australia with local funding – we are talking millions, not billions."

inner space

Creation of a quantum computer is edging closer with the development of the world's smallest silicon wire.

Scientists at UNSW's Centre for Quantum Computing Technology (CQCT) are paving the way for the next generation of computers by building a wire just three atoms thick.

Using a scanning tunnelling microscope, they have placed rows of single phosphorus atoms in a wafer of silicon, creating the world's smallest conducting silicon wire.

Bent Weber, a 27-year-old doctoral student who has been working in the Atomic Fabrication Facility at the CQCT since 2005, pioneered the breakthrough.

"Using a modified scanning tunnelling microscope provides atomic-scale precision to image and place a row of phosphorus atoms into silicon. The row of atoms represents a 'wire' which, because it is so narrow, exhibits unique quantum properties," says Mr Weber.

The Director of CQCT's Atomic Fabrication Facility and leader of the research program, Federation Fellow Michelle Simmons, says the breakthrough has caught the interest of the Semiconductor Research Corporation – an industry-funded body that sits between US industry and university research. Her group is now collaborating with US industry to model new device architectures for conventional computing based on their technology.

While quantum computation is one of the ultimate goals for the CQCT, Professor Simmons' group is also trying to ensure it captures the benefits of the technology developed in the short term for conventional silicon chip design.

The advance lowers the size limit of the connections possible within integrated circuits, helping to perpetuate the famous "Moore's Law", which predicts that the number of transistors on a computer chip should double every 18 months.

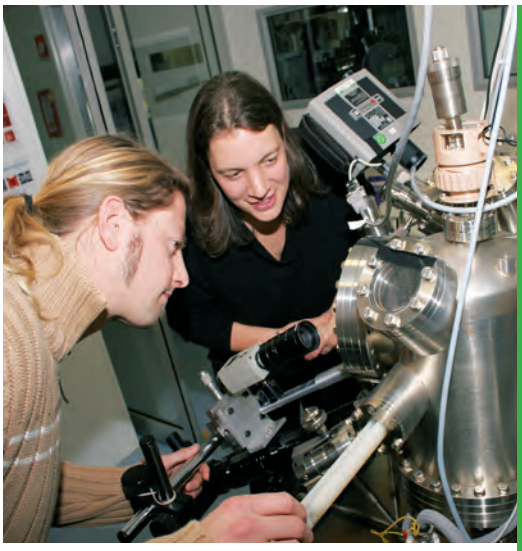
The result also has important implications for the continued development of the silicon-based quantum computer. Conventional transistors – basic building blocks of today's computer chips – know only two logical states, which are either "on" or "off". Together the two states form one classical binary digit, or bit.

Being able to build devices at the atomic scale would allow the fabrication of single-atom quantum bits or qubits with the ability to be in many states at once – "on", "off" and "every possible combination of the two" – something that is possible only in the quantum world. It is this counter-intuitive ability that makes a quantum computer so powerful.

"In a classical computer, calculation power grows linearly with the number of bits," says Simmons. "In the quantum world, every time you add a quantum bit you're doubling power."

Simmons' group is part of CQCT's national efforts to realise a quantum computer in silicon. Her colleagues, including Professor Andrew Dzurak, are working on a program using ion implantation to engineer qubits in silicon.

"It is a very exciting time for the Centre – after years of hard work in developing aggressive new fabrication technologies we are now producing unique devices internationally, allowing us to explore the power of the quantum world," Simmons says.



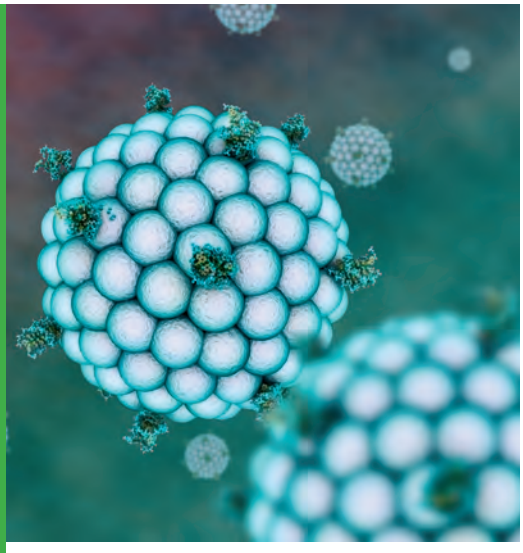
Bent Weber and Professor Michelle Simmons
Photo: Dan Gaffney

The Opportunity

PhD and post-doctoral opportunities exist for research into a wide range of quantum computing technologies. International collaborations are underway with students from around the world and with the Universities of Cambridge, Tohoku, Taiwan, Walter Schottky, Purdue, Sandia National Laboratories and with leading industrial companies IBM and Zyvex.

small wonders

UNSW's nanoscale research is revolutionising everyday materials to make them better, stronger and faster.



The Opportunity

ARC Centre of Excellence for Functional Nanomaterials focuses on the novel synthesis, characterisation and application of functional nanomaterials such as nanoparticles, nanotubes, thin films, and nanoporous and nanocomposite materials. PhD and post-doctoral research opportunities are available in these areas.

Nanoparticles
Photo: Lawrence Lawry / Science Photo Library

Pick up an Apple iPhone, smear on cosmetics or jump in a new model car and you are likely to be dabbling in the world of nanotechnology. At last count, there were more than 600 nanotechnology products on the market, with new ones coming on stream at the rate of four per week.

Researchers in the faculties of Science and Engineering are at the forefront of this emerging field. By manipulating structures at the atomic and molecular levels, they are creating and imbuing materials with new and enhanced properties, such as lightness, flexibility, durability and electrical conductivity.

UNSW's ARC Centre of Excellence for Functional Nanomaterials is an internationally renowned research centre. The Centre's Aibing Yu is a world-leading scientist in particle/powder technology and process engineering.

"A 'nano' device or material is one designed at the nanoscale, which is in the 1–100 nanometre range – a nanometre is a billionth of a metre," he says. "The comparative size of a nanometre to a metre is the same as that of a marble to the size of the earth. It would be very interesting to see how the different forces involved at different time and length scales make these 'particles' behave differently."

Professor Yu, an ARC Federation Fellow, is a recognised authority in the areas of particle packing, particulate and multiphase processing, and simulation and modelling. He has revealed a new way for generating "silver nanoplates". Visible light can interact with free electrons in silver nanoplates, making them promising candidates for applications as optical probes or contrast agents in biomedical imaging.

Light metals is another area with enormous potential. UNSW's Centre of Excellence for Design in Light Metals aims to expand Australia's light metals industry by making alloys of metals such as aluminium, magnesium and titanium more attractive options than steel and plastic.

"We see opportunities to increase the use of light metals in the automotive, aircraft, aerospace, packaging and construction sectors," says Professor Mark Hoffman.

In the late 1970s it was revealed that plastics could be made to conduct electricity by manipulating their chemical structure, a discovery that won the 2000 Nobel Prize in Chemistry. New polymer plastics have since been developed for anti-static substances for photographic film, electromagnetic radiation shields for computer screens and "smart" windows that exclude sunlight.

ARC Post-doctoral Research Fellow Dr Adam Micolich is part of a global effort to improve polymers' conducting properties. "The problem with these plastics is that the conducting molecules are very long and spaghetti-like, which is great for strength and flexibility but isn't so great for electrical properties."

Micolich is working with Dr John Anthony, a synthetic chemist at the University of Kentucky. "We're tweaking the structure of acene molecules to make them more suitable for use in transistors. Changing a molecule's shape gives it promising new electrical and optical properties and makes it far easier to turn into a device."

surgical strikes

The future of medicine is very small and very, very smart.

In an era when we can travel to any part of our planet and beyond, gaining safe, accurate access to all parts of the human body for medical treatment still poses a challenge for human ingenuity.

Teams from UNSW's faculties of Engineering and Science are navigating this final frontier, developing a new generation of smart materials for targeted, controllable drug delivery and monitoring of diseases and trauma inside the human body.

Gold has long been valued for adorning our bodies. Now research led by UNSW chemical engineer Rose Amal promises to make the yellow metal a precious resource under the skin as well.

Professor Amal heads the Particles and Catalysis Research Group, a member of the ARC Centre of Excellence for Functional Nanomaterials. Her team, in conjunction with the Biosensors and Biodevices Group, is developing functionalised magnetic gold nanoparticles for biomedical applications. The nanoparticles are clusters of iron oxide particles, sealed in a shell of gold. The magnetic quality of the iron allows the particles to be manipulated inside the body – for example, to deliver an anti-cancer compound to a tumour. The inert nature of the gold shell stops the iron reacting with the body.

Working on a similar scale but with organic materials is Martina Stenzel of the Centre for Advanced Macromolecular Design. Associate Professor Stenzel leads research into advanced polymers – substances which are custom-synthesised to serve a purpose such as targeted drug delivery inside the human body.

"You can design polymers for anything," Stenzel says.

"You can, for example, heat a tumour and make a polymer which starts decomposing and releasing its drug as soon as it reaches the area which has been heated."

Stenzel and Amal are also investigating the use of nanoparticles for gene delivery.

Justin Gooding heads UNSW's Biosensors and Biodevices Group, which is working on the development of biosensors for a range of analyses using the body's biological recognition molecules, such as enzymes, peptides and DNA.

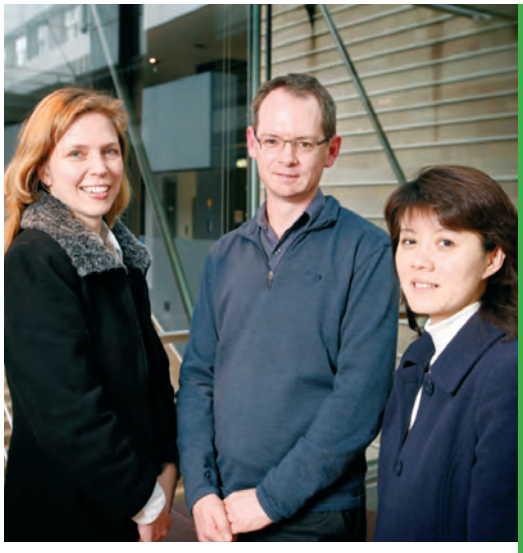
Professor Gooding is developing a mobile test kit that would allow diabetics to self-check the effectiveness of their therapy. Such a test would save the time and costs currently associated with lab testing for diabetes control among diabetics and those at risk of the disease.

"The biosensors we are investigating link the remarkable specificity of some biological molecules with a signal transducer," he says.

"This means that we can detect a single species, such as glycated haemoglobin, within a complex medium like blood, without the sophisticated sample preparation needed in a testing lab."

Glycated haemoglobin, also known as HbA1c, is a blood-based biological marker which is elevated when diabetes mellitus is poorly controlled, increasing the risk of problems such as stroke and eye, kidney, heart and nerve damage.

The Biosensors and Biodevices Group is in discussions with a US company that specialises in patented next-generation biosensor technologies.



The Opportunity

PhD and post-doctoral research opportunities are available.

Associate Professor Martina Stenzel, Professor Justin Gooding and Professor Rose Amal
Photo: Grant Turner / Mediakoo

flight of the MAV

A new generation of pilotless micro aircraft that mimic the navigation of bees is drawing keen interest from the US army.

The Opportunity

Scientific funding and industry linkage possibilities exist for future research in rotary-wing MAV and UGV–MAV cooperation. Major collaborators include the ARC Centre of Excellence for Autonomous Systems, the US Army and Virginia Tech. PhD and post-doctoral positions are available.

Unmanned helicopter on autonomous approach to moving deck
Photo: Andrew Lambert

You are facing a war zone or a dangerous or toxic space. You need to see what's happening, perhaps locate someone or something, but it's the last place you would want to send a person. Instead you deploy a small pilotless aircraft which has the ability to know exactly where it is, control its own hovering, even direct its own movements forward and sideways – and does it all undetected.

It's every army commander or rescue coordinator's dream. And now, thanks to collaboration between UNSW@ADFA researcher Matthew Garratt and the world of insects, such an aircraft is close to reality.

Dr Garratt has flight tested a new generation of "optic flow" sensors that mimic bees' ability to use the motion of the ground beneath them to calculate their height. Stealthy, light and simple, the sensors replace heavier radars and lasers. They can be mounted on any unmanned aerial vehicle (UAV) but are particularly suited to micro air vehicles (MAVs) – aircraft with a wingspan of 15 centimetres or less.

And best of all the sensors produce no electromagnetic emissions making them undetectable in a battlefield or law-enforcement situation.

Now Garratt and his team have secured funding from the US Army to develop even lighter sensors (five grams) and ones that will allow MAVs to navigate cluttered environments without using GPS.

As someone now "plagiarising nature", Garratt has long been fascinated by insects' capabilities.

"They can do so many things that we can't, like sensing chemicals at incredibly low concentrations, flying backwards, flying sideways. It would be great to just copy these mechanisms using nanotechnology – but unfortunately we can't do that yet."

Another flock of MAVs is also in flight at UNSW's Kensington campus as PhD student Lin-Chi Mak works on novel techniques for indoor navigation. Already proven outdoors at the MAV 08 competition in India (the first US-Asian demonstration and assessment of micro and unmanned technology), the MAVs were developed by the Computational Mechanics and Robotics (CMR) group led by Tomonari Furukawa within the Faculty of Engineering.

In competition, the MAVSTAR team – led by Mr Mak at the invitation of his supervisor Dr Furukawa – directed both its aerial and unmanned ground vehicles (UGVs) on a search-and-rescue mission to locate a hostage in a building while detecting and avoiding landmines and guards, winning the Best UGV Performance award and the right to bid for its own US Army funding.

"MAVs have the advantage of being sacrificial and stealthy," says Dr Jay Katupitiya from the Centre of Excellence for Autonomous Systems who contributes to plans for MAVSTAR.

Like Garratt, he sees MAVSTAR as a pilotless envoy entering unfriendly environments to deliver essential information. "We can use them as sacrificial single agents or as multiple agents that might form sensor clouds or even battle destructive swarms of pests," he says.

solar's hard sell

UNSW's world record-holding photovoltaics researchers are paving the way for solar power technology that is simple, low cost and efficient.

PhD student Nicole Kuepper is using nail polish, pizza ovens and inkjet printers in an innovation that could bring affordable solar power to two billion of the world's poorest people.

It may seem like an unorthodox approach to an energy revolution, but the 23-year-old photovoltaic engineer is using the household items to manufacture solar cells without the prohibitive costs of current techniques.

The iJet solar cell uses low-purity silicon, an inkjet printer to etch the surface of solar cells using nail polish and nail polish remover and a low-temperature pizza oven to "bake in" the metal contacts. The potential of the process captured the Australian public's imagination when Kuepper won the People's Choice Award at the 2008 Eureka Prizes. She also won the British Council Eureka Prize for Young Leaders in Environmental Issues and Climate Change.

The UNSW School of Photovoltaic and Renewable Energy Engineering's impressive record in advancing solar cell technology was also recognised when the entire School won the IAG Eureka Prize for Innovative Solutions to Climate Change.

The ARC Photovoltaics Centre of Excellence – which is attached to the School – is a leader in solar cell research. The Centre holds the world record for efficiency in first-generation solar cells achieved under the directorship of Scientia Professors Stuart Wenham and Martin Green.

The School is breaking new ground in the second-and third-generation solar cell technologies that are setting new benchmarks in efficiency and design. But with commercial solar cell production still focused on first-generation cells – the silicon wafer arrays seen on rooftops – UNSW researchers are also focused on making these cells work better and cost less.

PhD student Budi Tjahjono is another young researcher working to get solar into the mainstream. He is developing a high-efficiency solar cell using laser doping. Doping is the process by which elements such as boron or phosphorus are diffused into pure silicon wafers to give them the electrical properties required of solar cells. The research, supervised by Wenham, has proven the viability of using lasers to etch grooves for a cell's metal contacts in the surface of a silicon wafer and diffuse a dopant into the silicon at the same time. The development eliminates several steps from production and cuts costs.

"The aim is to develop a new solar cell design that has significantly better performance over the existing, screen-printed technology, yet is simple, low-cost and applicable to existing solar cell production lines," the 27-year-old Indonesian-born engineer says.

The process is a development of the breakthrough "buried contact" technology invented by Wenham and Green two decades ago. The ARC Centre continues to break new ground in photovoltaic cell research. In 2007 the Centre had continuing ARC funding of $7.2 million approved for the 2008–2010 period.

The Opportunity

The Centre is looking for industry partners to work with collaboratively to develop and demonstrate latest technologies in an industrial setting.

Nicole Kuepper
Photo: Kate Geraghty / Fairfaxphotos.com

UNSW's collaborations in the arts and sciences are meeting the demand for creative media content and smarter mobile applications.

creative media

- digital content
- intelligent systems
- mobility
- citizen journalism
- privacy and censorship
- media ethics
- future of tv
- virtual reality
- youth trends
- internet communities

media blitz

An innovative research partnership is propelling UNSW on creative media's next great leap forward.

These are the industries of the future: sectors with high median incomes and international prestige, harnessing new digital technology and the creative arts to satisfy a burgeoning global demand for cultural content and digitally based forms of communication and training.

According to the latest estimates more than 430,000 Australians – or 5.4 percent of the workforce – are engaged in the creative sectors. Our digital content industry alone is estimated to be worth around $21 billion.

To recognise the crucial contribution of the arts to our identity and creative media's enormous economic potential UNSW has formed the Creative Media Institute (CMI). The CMI is a platform for world-class multidisciplinary research and application of new forms of technology-enabled creative media. It will focus on incubating and supporting collaborative research with industry in new media, contemporary art, media studies and intelligent systems.

A partnership of three host faculties – Arts and Social Sciences, the College of Fine Arts (COFA) and Engineering – the CMI brings together four creative media research centres – the iCinema Centre for Interactive Cinema Research, the Centre for Contemporary Art & Politics, the Journalism and Media Research Centre, and the Centre of Excellence for Autonomous Systems.

CMI Convenor and one of the CMI's four co-chairs, iCinema Centre Co-Director Dennis Del Favero, says the CMI represents a consolidation of one of UNSW's emerging research strengths, namely digital technology and content creation and analysis.

"It brings together world-leading research capable of generating new ventures in artistic and cultural fields that engage with contemporary social and economic issues in a way that will enable UNSW to lead Australian creative media research. We will be able to seize new opportunities for funding, and for developing and implementing innovativion," Associate Professor Del Favero says.

An example is the iCinema Centre's development, in collaboration with the International Mining Virtual Reality Group, of a virtual-reality training tool that teaches miners emergency response and safety procedures.

"The project has generated multi-million dollar sales and attracted intense interest across the mining sector," says iCinema Director Jeffrey Shaw. "And it is a clear example of how artistic research at iCinema generates innovation with immense commercial potential."

Similar to a giant sophisticated 3D computer game, the interactive system recreates extremely realistic mining environments displayed in multiple theatre modes including AVIE (Advanced Visualisation and Interaction Environment), the world's first 360-degree stereoscopic cinema. AVIE is being deployed at mines around the state and is also being used in museums and in artistic applications for clients such as the Sydney Festival, the Biennial of Seville and the Shanghai eArts Festival.

"AVIE allows the integration of the physical and the digital worlds, making the digital more user-friendly, compelling and useful for the way we live and work in the world today," Professor Shaw says.

Clockwise from top left: Associate Professor Dennis Del Favero; Associate Professor Kate Crawford; Professor Paul Compton; and Associate Professor Jill Bennett.
Photo: istock. Graphics: Shaun Dougherty

One of iCinema's latest projects is a collaboration with UNSW Literary Fellow and multi-award-winning playwright Stephen Sewell, who will contribute to an innovative cinematic work using AVIE's capability to allow audiences to interact with intelligent 3D digital humanoid characters.

This technological capacity is supported by the Faculty of Engineering's Centre of Excellence for Autonomous Systems.

"Autonomous systems represent the next great step in the fusion of machines, computing, sensing and software to create intelligent systems capable of interacting with the complexities of the real world," says CMI co-chair, Professor Paul Compton.

The aim of the Autonomous Systems Centre is to research and explore the nature of intelligence in problems of perception, learning and control, and thus to lay the scientific groundwork for the development and application of intelligent autonomous systems.

Turning creative inspiration to practical application within the CMI is the Centre for Contemporary Arts & Politics (CCAP), based at COFA.

Led by Jill Bennett who is also a CMI co-chair, the CCAP is investigating the social and political dimensions of digital media, internet communities and the new media, particularly the study of affect, or emotion. Other work is being done in visual anthropology, focusing on Indigenous communities' use of media. The CCAP, in collaboration with the University of Utrecht, is constructing experiments in which political speeches are re-enacted. It's hoped the experiments will shed light on the emotional elements of political speech that simple language-based analysis cannot.

"Everyone understands on one level the way that politicians manipulate media and play to the camera, but there is a whole deeper level of analysis that hasn't been studied in any great degree," Associate Professor Bennett says.

"We have captured an agenda in creative media that combines academic media analysis, digital media production and high-end art production."

The Journalism and Media Research Centre (JMRC) in the Faculty of Arts and Social Sciences is another central player in the CMI. The JMRC's Kate Crawford will also act as one of the CMI's co-chairs. The JMRC investigates an array of issues facing the creative media sector, with particular focus on the uses of mobile media, citizen journalism, the future of television, social networks, digital copyright, privacy and censorship as well as the growing need to encourage creative collaboration between the technology and arts sectors.

"The Centre is currently undertaking the first major national study of mobile media, which will help us understand how people are engaging with these technologies to communicate, and also how users create and share their own images, text, videos and sound," Associate Professor Crawford says.

"We are also studying the impact of Web 2.0 technologies for new forms of journalism and creative practice, and how this is changing concepts of creative media beyond the digital realm."

The Opportunity

The CMI undertakes research and business development in creative media, ranging from the creation of frontier digital technology and experimental artistic and cultural projects, through to media analysis and evaluation. Industry and government partnerships are being undertaken and are available in virtual-reality training systems, cultural heritage and museum environments, new media and visual anthropology applications, mobile media, listening technologies and television. The CMI facilitates interdisciplinary PhDs in creative media.

game playing

Whether it's on the battlefields of Iraq or in the suburban lounge room, gaming technology is saving lives.

The Opportunity

Postgraduate research opportunties exist in virtual-reality and gaming technologies.

Gaming scenario
Photo: Courtesy of Michael Barlow

Rightly or wrongly, computer games are blamed for a litany of woes from wasted time to overweight kids and violence in society. However, UNSW researchers Michael Barlow and Russell Lowe believe gaming technology can also be a force for good.

Dr Barlow, an expert in virtual-reality and simulation technologies, is using computer gaming to recreate virtual war zones for the training of Australian soldiers at UNSW's Australian Defence Force Academy.

"All scenarios can be rehearsed, trained and experimented with in simulations like this," he explains.

The gaming scenarios are instrumental in helping to prepare soldiers for as wide a range of contingencies as possible before they arrive in the war zone.

"One of the things we added to existing gaming technology was further fidelity and higher representation of factors that affect the individual. You can see the gun moving up and down with the breathing of the soldier: If the soldier exerts himself further he breathes faster and that makes a simple thing like firing a weapon considerably harder."

Now Barlow is applying the technology to saving lives even further afield.

He is evaluating the impact of interactive games on the heart fitness of 10 to 14-year-old children. He believes that new-generation interactive games like Dance Mat, Wii Fit and SingStar might be part of the solution to the problem of bulging teen waistlines.

"These newer gaming technologies are incredibly popular with kids and demand a high level of physical activity for sustained periods of time," he says. "Games like Dance Mat and SingStar are finding their way into homes around the world because they appeal to children's sense of fun and competitiveness."

Anecdotal evidence aside, there is little scientific proof that the games promote a physical benefit. Barlow's research will compare the impact on heart rate of traditional games involving no physical activity with new games that involve physical exertion.

"If the research tells us that there's a physical benefit then these types of games could be part of the solution, rather than the bogeyman when it comes to childhood obesity," he says.

Faculty of the Built Environment Architectural Studies lecturer Mr Lowe has also discovered a new role for computer gaming technology, this time in the classroom. His students are now able to test their designs, in a virtual world, and in real-time.

"The technology adds a new level of interactivity, enabling students to move around and understand the environment they have designed," Lowe says.

"Whether it is a new train station, airport or playground, students can use this technology to jump into their designs and see exactly what they are like, and what may need changing."

The technology enables a class to take virtual tours of students' projects, providing a valuable avenue for peer feedback.

i m here. where r u?

Tech-savvy teens are rewriting the rules on staying connected.

Teenagers and those in their 20s have a reputation for living in a technology bubble, isolated from the so-called "real world".

However, the reverse might be the case, according to the Journalism and Media Research Centre's (JMRC) Gerard Goggin and Kate Crawford, who're taking a deeper look at youth culture and mobile media.

Eighteen to 30-year-olds – the fastest adopters of new technology – are the focus of the ARC-funded study by the JMRC.

"We need to look at what people are doing with the technologies, rather than what the technologies are doing to them," says Professor Goggin. "There's this idea of technological determinism, but people have an active role in deciding what they like. The products don't come into a void."

The pair is hoping to answer questions such as how many mobile phones and portable music devices young people own and how they use them.

"Young people are seen to be guilty of two incompatible sins," observes Goggin. "They're seen as using technology too much, yet on the other hand they're seen as being socially disconnected.

"Intuitively that seems a little strange. If they're on technology all the time, then who're they talking to?

"The most common thing people say on the mobile phone is 'I'm here, where are you?' So the conversation's all about place. Mobile phones give us a cue – they are about connecting us into place and societies, rather than disconnecting."

The different ways we are listening to music are the focus of research by Associate Professor Crawford.

"There is very little research into the cultural practices of listening, particularly the different modes and reasons for listening to music alone versus listening to music in shared public spaces," she says.

It's a logical interest for this music lover, who's also an internationally released electronic musician known for her work in duos such as B(if)tek and Clone.

"There's a popular view that personal technologies such as MP3 players isolate us. The criticism is they draw us away from communal publics, and that these spheres are suffering," she says.

"The way we listen does change with technological formats but people are still drawn to hearing music together in public space."

While Crawford believes live performance is a "critical experience" for performer and audience interaction, she's also interested in whether music communities can exist without being in the same physical space.

She argues that a jazz fan listening to Miles Davis on a personal music device or on the internet has new ways to connect with the broader jazz community, without ever stepping into a darkened basement.

"Online communities such as Facebook, MySpace and Twitter are having a considerable impact and I'm interested in how live music culture's been changed and how it continues to thrive."

The Opportunity

PhD and post-doctoral opportunities exist in research in the areas of youth culture and mobile media.

Photo: Wade Laub / Fairfaxphotos.com

breaking the news

UNSW researchers are mapping the complex trends underway in the new media world.

The Opportunity

Postgraduate research possibilities exist in journalism and media research, and industry and government partnerships are encouraged. The Centre will offer a Masters of Journalism in 2009.

The team at the JMRC. Back row L-R Professor Gerard Goggin, Associate Professor David McKnight, Dr Kath Albury. Front row L-R Associate Professor Kate Crawford, Professor Catharine Lumby, Dr Clifton Evers
Photo: Susan Trent / Gasbag Studios

Within ten years, Australians could be paying by the minute for commercial television programs using their credit card, and what we know of as journalism could be facing a radical transformation, according to researchers from the Journalism and Media Research Centre (JMRC).

Headed by Catharine Lumby, the JMRC is looking at "hot button" issues like the Australian media's impact on children, the burgeoning use of online and mobile technology and the changing role of journalism.

Professor Lumby says there is an ongoing need for critical research into the media and in particular its impacts on young people.

When police swooped on a Paddington, Sydney art gallery, seizing photographs of naked teenagers, Lumby and colleague Dr Kath Albury were deluged by phone calls from journalists, reflecting the growing public concern about the popular media portrayal of children.

The pair's earlier research formed the basis of a submission to a Senate inquiry into the sexualisation of children.

"The first thing we said was that serious empirical evidence needs to be gathered in an Australian context," Lumby says. "It's dangerous to make public policy in an evidence-free zone, or on the basis of what people 'feel' is happening.

"There are a lot of people talking on behalf of young people, but it's also possible to do excellent and empirical research with young people which focuses on their experiences and how they think the media affects them."

The pair also called for a standardised, age-appropriate sex education in schools that includes a discussion of media material, and for the creation of a one-stop shop for making complaints about the media.

"Many people find it difficult to navigate a complaints system that is so diverse," Lumby says.

The practice of journalism itself is under the spotlight through the work of Associate Professor David McKnight, who has written a book about the political commentary of the international outlets of News Corporation, and Philip Bell, who believes commercial TV as we know it is under threat.

Emeritus Professor Bell is part of a project called Outside the Box, which is examining where television might be in 2018. More households, each with fewer members, will be using what we now call TV very differently, he predicts.

"Time-shifting, podcasting, interacting, archiving content and building one's own audio-visual resources, will become second nature and broadcasting will continue to converge with computing.

"Advertising will change and be more focused, and 'free-to-air' services will decline," he says.

But Professor Bell believes this could be good news for the ABC, which is growing in importance as a public forum.

"The ABC is cleverly keeping ahead of the digital game," he says. "It's the ABC's journalism that makes it distinctive and it's hard to imagine the nation without a national broadcaster."

shock waves

Research in science and technology is pushing the boundaries of art.

Kaleidoscopic patterns, technicolour renderings, symmetry and contrast. It's the language of art and aesthetics not usually associated with science and technology. But two UNSW researchers, Harald Kleine and Paula Dawson, are transforming their scientific research into spectacular art.

Dr Kleine, from the School of Aerospace, Civil and Mechanical Engineering, ADFA, is one of the world's leading experts in the field of high-speed flow visualisation. Density-sensitive visualisation techniques have helped advance the field of fluid mechanics research, but Kleine has revealed a dual purpose to these visualisation records.

Using cameras that shoot one million frames per second, Kleine captures shock wave phenomena – anything from explosive blasts and bursting balloons to the supersonic flows around jet aircraft models – and the visualisation techniques he uses yield images in technicolour.

"Research records can also be works of art," says Kleine. "The symmetry, contrast and kaleidoscopic patterns visible in these recordings can give these images an artistic character. But it is important to note that it is nature creating the patterns and essentially choosing the displayed colours – with my techniques I merely provide the palettes. By exploring the artistic potential inherent in these techniques Kleine believes both scientists and artists can discover new and innovative ways of displaying their work.

"A scientist who recognises the artistic potential of their research can deliberately exploit it to emphasise aspects of the phenomena being studied."

Where fluid dynamicists reveal the complexities of pre-existing objects, artists communicate ideas and emotions through the creation of an object or image. College of Fine Arts (COFA) lecturer and internationally acclaimed hologram artist, Associate Professor Dawson reveals the aesthetic potential of holograms while incorporating the traditional techniques of painting, drawing and mosaics.

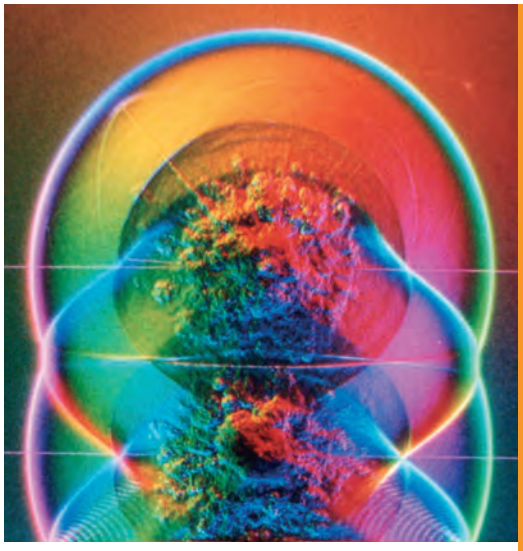
Her latest research project, Modelling Light, proposes a revolutionary approach to 3D digital content creation using virtual tools that enable the detailed handcrafting of subjects.

"I want to be able to convey the essence or presence of a person in holographic form. Michelangelo was one of the great artists who achieved this through drawing a line or excavating a piece of stone," says Dawson.

Direct access to Michelangelo's artworks in the Louvre will allow Dawson to closely study his practice and reconsider the way immaterial surfaces of holographic subjects are rendered. The PHANTOM, a touch-sensitive haptic arm, will allow each mark and its 3D spatial location, shape and colour to be registered. The resulting software will allow both expressive potential and computational simplicity while generating a 360-degree 3D image.

"Leading international designers and artists will begin to utilise Australian expertise and technology for the composition of major hologram projects," predicts Dawson.

Dawson has also received funding for another major project, Destination, which aims to develop the world's largest hologram in Melbourne's Federation Square, a world first in technology.



The Opportunity

The School of Aerospace, Civil and Mechanical Engineering undertakes research in compressible fluid mechanics, from the investigation of supersonic airflows around aircrafts and their components to the study of unsteady shock wave interactions. Flow visualisation and the development of cutting-edge diagnostic tools are crucial components of these activities. PhD and post-doctoral research opportunities are available in studies related to shock wave reflection and focusing processes, the analysis of instabilities in supersonic flows as well as the measurement of 3D compressible flow fields.

For research opportunities in the field of holograms, contact COFA.

Shock waves from an explosion
Photo: Harald Kleine

Contemporary global issues such as disadvantage, marginalisation and family pressures are being tackled by UNSW's cross-disciplinary researchers.

social inclusion

- work / life balance
- maternity leave
- gender divisions of labour
- provision of care
- ageing population
- child poverty
- drugs and alcohol
- stigmas
- human rights
- family payments

family matters

The family, child care and a viable work/life balance are fertile grounds for UNSW's social policy researchers.

Few topics whip up a more fiery debate than those on the family and how to create an acceptable work/life balance. Whether it's ageing and retirement, gender divisions of labour or paid parental leave, everyone is affected and everyone, it seems, has an opinion.

One of the most pressing issues is the provision of care. Some 22,500 older Australians are now primary carers of children, with the actual number probably much greater, according to UNSW's Social Policy Research Centre (SPRC).

"The vast majority of grandparents who are primary carers are simply raising the children in an informal way," says the SPRC's Deborah Brennan. "Aside from the social implications, this is having dramatic financial and administrative consequences."

The increase in the number of grandparents who are carers is largely attributed to the Family Court and welfare authorities who have reacted to the increasing emphasis on child protection and on "kinship care" by assigning more formal care to grandparents, according to Professor Brennan, who is coordinating the research with colleague Bettina Cass.

Around two-thirds of the grandparents are on some sort of income support. While those who have formal custody may get the same payments as foster carers, those who look after their grandchildren informally often get nothing.

"In some circumstances they can apply to Centrelink for family income support payments, but often they don't, because they don't know they have an entitlement, or because they're very concerned about exacerbating conflict within the family. So this is a critical issue for policy development," says Professor Cass.

The research also looks at grandparent care in Indigenous communities, with the assistance of Associate Professor Sue Green from UNSW's Indigenous programs unit, Nura Gili.

The work is funded by an ARC Linkage Grant, with partners Mission Australia, FaHCSIA, the NSW Department of Families and Community Services, the South Australian Department for Families and Communities and the Northern Territory Department of Health and Community Services.

International comparative social policy will be the focus of the SPRC's latest appointment, Peter Whiteford. Previously the principal administrator on social policy at the OECD, Professor Whiteford enhances the SPRC's capacity to conduct comparative research on a wide range of topics including sole parent policy, child poverty, parental leave and family payments. The Australian Government is increasingly interested in the lessons to be learnt from other countries, and Whiteford's appointment will be a major boost to the SPRC's already high capacity to contribute to government decision-making in key policy areas.

The increased pressure on families has also re-energised the debate about paid parental leave. As one of only two OECD countries without fully funded maternity leave, Australia lags far behind countries such as Sweden where new parents are entitled to up to 18 months leave at full pay.

Professor Bettina Cass, Dr Lyn Craig and Professor Deb Brennan
Photo: Susan Trent / Gasbag Studios

Brennan says a wealth of national and international research shows Australian parents and employers need leave arrangements that are flexible, affordable and fair. While Australia is well behind most of the rest of the developed world, the Federal Government has referred the issue to the Productivity Commission to examine ways to improve support for parents with newborn children. The Commission is due to report in February 2009.

"The Rudd Government's response to the Productivity Commission inquiry will be a major indicator of its willingness to base public policy upon soundly based evidence," says Brennan.

"Australia needs a taxpayer-funded scheme that will enable parents to care for their infants for the first year of life without major financial penalty. The rest of the developed world can manage this, and so should we."

The pressures on families also raise serious questions about the quality of the unparalleled corporatisation of early-childhood care in Australia.

"No other country in the world allows a single corporation to dominate the provision of early-childhood education and care to the extent of Australia. "There is an inherent incompatibility between the functioning of markets and the needs of children."

Child care is also the focus of Senior Research Fellow Lyn Craig, who's looking at how Australia compares with other countries in the division of care responsibilities.

The study has found that fathers in Denmark devote more hours to the physical care of their children than those in Australia, France and the United States. It also found that Australian men do a quarter of what women do in time spent in child rearing.

"On the birth of a child, the gender division of labour is most extreme in Australia," says Dr Craig. "The difference between men earning and women caring was most pronounced here: women's work hours decreased dramatically, while men's stayed high."

Craig says leave provisions by the Danish government have affected division of labour in the family.

"In Denmark the time men spend with their children is somewhat more equal to the women," she says. "It does imply that a policy environment which encourages equity has an effect in the home."

The research has implications for policy development, from paternal leave and paid maternity leave, to formal child-care arrangements.

The Opportunity

The SPRC has an unrivalled program of Australian and comparative social policy research and is keen to hear from PhD and post-doctoral candidates interested in social inclusion/exclusion, family policy, child care and ageing, time use research, disability, housing, homelessness and gender. The SPRC has ARC Linkage Grants with industry partners including government agencies, community groups and non-government organisations.

burden of care

The world's population is top-heavy with the aged, heralding profound economic and social challenges.

The Opportunity

Postgraduate research opportunities are available in many areas of AIPAR's work.

Photo: Circlestock / Corbis

John Piggott points to contemporary Japan as an example of the ageing problems soon to be faced by much of the developed world.

"The Japanese economy has been stagnating for some time," he says. "Their labour force has been declining for a decade and they have projections of enormous numbers of very old people who are very expensive to look after."

Longer life expectancies and lower birth rates mean much of the world's population is ageing rapidly, creating enormous challenges in economics, health, technology and lifestyle. By 2050 more than a quarter of Australians will be over the age of 65 – up from 14 percent now. Currently there are five Australians of working age to support each person over 65, but by 2050 there will be less than 2.4. The issue is even more serious in Asia where, by 2050, people over 65 will number 500 million.

The Director of the Australian Institute for Population Ageing Research (AIPAR), Professor Piggott, says research into the best policies now is vital to head off future problems.

"The Japanese are only now introducing policies such as a kind of public insurance program, but that involves considerable sums of money that have not been put aside in the past. Because these reserves are not there, Japan now confronts a declining workforce which means a declining tax base, plus projections of expanding fiscal outlays."

Bringing together researchers from five UNSW faculties, AIPAR also works in collaboration with researchers overseas. It's an innovative approach that intends to offer holistic solutions.

"Other research groups work specifically in health or finance or demography, but the idea behind AIPAR is to keep people in touch across different areas," Piggott says. "The individuals involved will have a more rounded perspective that will lead to questions being asked that don't immediately confront people working in narrower fields."

Disciplines covered within AIPAR include economics, finance, actuarial studies, medicine, community health, engineering, computer science, behavioural science, the built environment and the social sciences. This cross-disciplinary research will provide a unique perspective.

Australia-specific research projects include works on the simplification of the superannuation system, the true value of residential real estate and ways to make this illiquid asset more financially useful, adequate retirement income, new sources of this income, and implications of delaying retirement age. Health and aged-care systems are being analysed, as is innovative technology in delivery of aged care.

Piggott says AIPAR's collaborative approach will offer solutions for policy makers and opportunities for the private sector – all of which will lead to a smoother transition into an uncertain future.

cannabis culture

UNSW's new cannabis prevention centre takes aim at one of our most popular illicit pastimes.

Cannabis is Australia's illicit drug of choice. Figures show that just over one-third (33.5 per cent) of adult Australians have tried it and at least 200,000 adults are believed to be cannabis-dependent. Around one in ten who ever use the drug becomes dependent on it at some time in their life.

Opened in April 2008, the National Cannabis Prevention and Information Centre (NCPIC) is a world-first initiative that brings together a range of drug and alcohol, mental health and criminal justice researchers, and service providers.

According to its Director, Jan Copeland, the Centre will provide a bridge between research and practice resulting in "greater momentum in preventing and reducing use and harms associated with cannabis".

"We will provide the community with high-quality, evidence-based information on cannabis use. This is an exciting innovation in the way we conduct research, community information provision, and workforce training on cannabis," Professor Copeland says.

The Centre was officially opened by the Minister for Health and Ageing, Nicola Roxon and is funded by the federal Department of Health and Ageing.

Copeland says scientists are now turning their attention to this previously neglected drug. "Evidence about cannabis-related health problems is now unfolding in the same way evidence of tobacco smoking did in the 1970s," she says.

The team at NCPIC is using that research to develop resources and guidelines for more effective cannabis treatment in addition to developing and testing interventions arising from their own internationally recognised expertise.

Along with its consortium partners, the Centre is currently developing a cannabis and mental health early intervention program to be offered through schools and primary care. This "first aid" approach should make early-stage assistance to those developing cannabis addiction and mental health concerns more widely available across the community.

Statistics show a growing demand for cannabis treatment. However, there are no guidelines to assist clinicians in the delivery of evidence-based interventions. In 2009 NCPIC will publish a "how to" manual that will detail evidence-based options for screening, assessment and treatment.

The Centre is also utilising its website as a tool for reaching dependent cannabis users who are not accessing formal treatment, particularly those in rural and regional areas. A "self-test" will allow online self-assessment, feedback and will suggest skills that can be used to manage change in cannabis use.

The Centre runs a free national information and helpline,1800 304 050, as well as their website, www.ncpic.org.au.

The Centre's efforts complement the wider drug and alcohol research efforts underway at UNSW. The National Drug and Alcohol Research Centre (NDARC), UNSW's internationally recognised Research Centre of Excellence, is a NCPIC consortium partner.

The Opportunity

A comprehensive range of postgraduate research opportunities exist in alcohol and other drug related issues at both NCPIC and NDARC.

Photo: Lawrence Lawry / Science Photo Library

early warning

The stigma of mental illness puts it in a class of its own when it comes to genetic testing.

The Opportunity

UNSW research into identifying susceptibility genes for bipolar disorder and depression has the potential to identify targets for novel pharmaceutical agents and to enhance diagnosis. PhD scholarships and post-doctoral fellowships are available, with funding inputs from a range of industry partners and philanthropic supporters.

Photo: Tamara Voninski / Fairfaxphotos.com

Genetic testing for mental illness is close to clinical reality. With susceptibility genes responsible for up to 90 percent of the cause of bipolar disorder and up to 50 percent of depression, many people are eager to know their vulnerability.

But unlike genetic testing for other hereditary diseases, research shows that knowing about a propensity to mental illness conjures up a raft of prejudices.

UNSW medical researchers discovered an important risk gene for bipolar disorder (manic depression) two years ago. When they surveyed people with a strong family history of the illness, they found one in three was reluctant to have children largely due to the condition's perceived social stigma.

That number rose to 50 percent among those actually diagnosed with the illness.

The findings suggested the negative attitude to childbearing was significantly more pronounced compared to other hereditary diseases such as Huntington disease or hereditary cancer – even when the genetic risks were lower.

"The proportion of people less willing or unwilling to have children was not in line with other genetic disorders," says lead author of the study, Associate Professor Bettina Meiser, from the School of Psychiatry.

"We know from studies into childbearing among people at high risk of cancer, for example, where the lifetime risk for a gene mutation carrier can be 80 percent or more, that attitudes to childbearing are not affected in any significant way. Even having a very serious disorder, such as Huntington disease, doesn't deter that many people from having children."

Team leader Philip Mitchell says patients and their families view genetic testing as an early warning system.

A separate landmark longitudinal study of depression in teachers showed two-thirds wanted access to gene testing, and after undergoing it most considered it a positive thing.

"People feel gene testing is positive in that it could allow earlier therapeutic intervention and may also help people avoid stressful situations that could worsen their condition," Professor Mitchell says.

"On the downside, they are particularly anxious about the stigma if employers or insurance companies discover they have a mental illness gene."

The fears highlight the ethical and educational issues still surrounding such testing.

"When it comes to mental illness we're not just contending with the accuracy of the science in terms of the testing," Mitchell says, "we also have major issues to deal with at an individual, family and societal level before we introduce testing for mental illness in the community."

"The old Victorian 'stain' of mental illness still applies," Mitchell says. "The stigma doesn't just affect the person involved. Relatives see themselves as possible carriers of defective genes and feel diminished in the eyes of others.

"Clearly we still have a big job to educate the community about mental illness before we roll out this technological advance."

sorry situations

Two researchers are drawing on the experience of Indigenous people internationally to determine reparation for past wrongs.

With the ageing of Australia's Stolen Generation, time is running out for meaningful reparations – a fact acknowledged in a recent Senate Inquiry report.

The report, which considered a Bill for monetary compensation for the Stolen Generation, acknowledged that an "overwhelming majority" of evidence supported compensation. However, it steered away from endorsing monetary compensation and instead recommended the establishment of a National Indigenous Healing Fund.

It's an approach that concerns Andrea Durbach, Director of UNSW's Australian Human Rights Centre (AHRC). A similar model introduced in Canada in 1998 did some good work, she argues, but failed to fully address the problems facing Indigenous Canadians.

As a result the Canadian Government last year agreed to a much broader reparations package including a Truth and Reconciliation Commission and individual compensation payments.

In their joint submission to the Senate Inquiry, Associate Professor Durbach and the Public Interest Advocacy Centre proposed an alternative Stolen Generations Reparation Bill to establish a National Reparations Tribunal with the power to initiate a wide program of commemorative projects, educational scholarships and healing centres.

Many of the submission's points were endorsed by the Senate Committee, but were left out of its final recommendations.

"Our research, which draws on interviews with members of the Stolen Generations and histories in Canada and South Africa led me to advocate a broad strategy of reparations," Durbach says.

"Compensation alone offers some redress for past harm but it fails to address the ongoing manifestation of that harm in Indigenous communities."

Durbach began her research following the Human Rights and Equal Opportunity Commission's Bringing Them Home report. She found a collective approach was vital.

"Given the removal experience was so pervasive," says Durbach, "it seemed critical to develop a strategy which embraced the many consequences of harm – individual trauma, and loss of identity, culture and language.

While disappointing in its recommendations, the Senate Report offers some prospects to revisit the development of a broad reparations strategy, inclusive of but not limited to compensation, she says.

Improving the lives of Aboriginal women, is the focus of research by Megan Davis, Director of UNSW's Indigenous Law Centre (ILC). Aboriginal herself, Ms Davis is working on a book titled *Aboriginal Women in Liberal Democracies*, which looks at the discrimination faced by Indigenous women across law and politics.

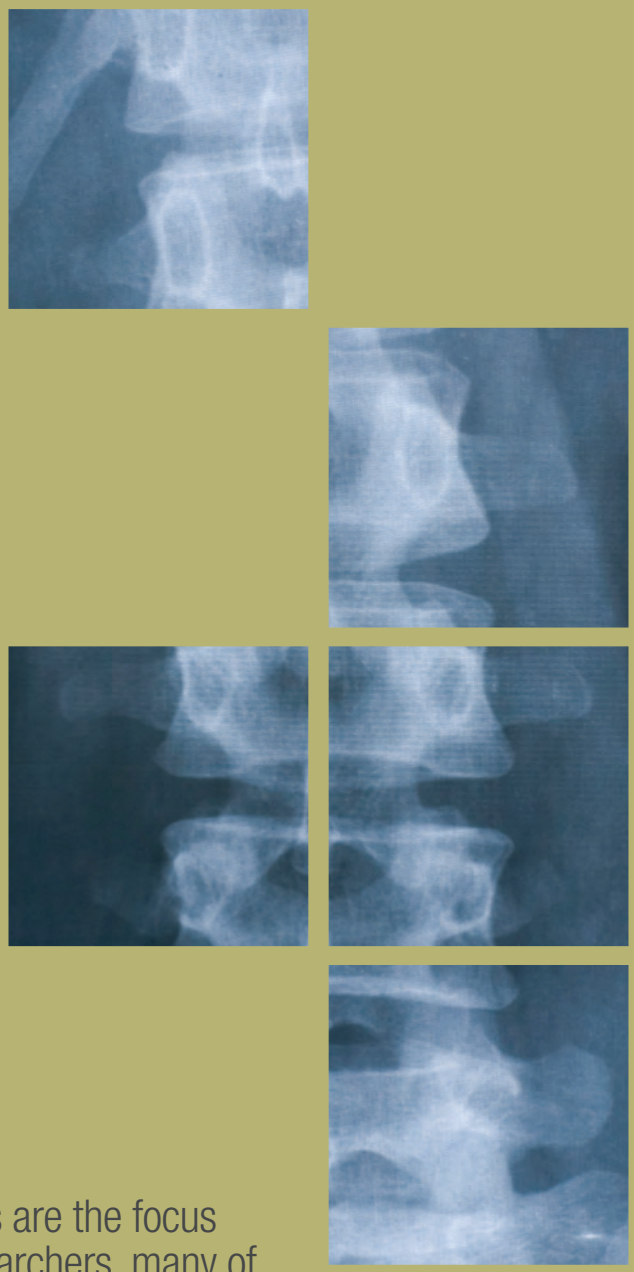
Davis recently received an ARC grant to travel to Canada to study its constitutional reforms of the 1980s. "Aboriginal women do better in Canada compared to Australia," says Davis. "My research shows it's because they've got stronger constitutional rights."

The Opportunity

An interdisciplinary research centre, the AHRC undertakes research across health and human rights, the impact of climate change and environmental degradation, corporate accountability, business and human rights and international humanitarian law.

The ILC conducts research into Indigenous peoples and the law including constitutional reform in Australia, Aboriginal women's legal issues and reparation for the Stolen Generations. Both Centres welcome Visiting Research Fellows, PhD candidates and post-doctoral students and collaboration with partner organisations in applying for funding to support current and planned research projects.

Associate Professor Andrea Durbach
Photo: Britta Campion



Our key health problems are the focus of UNSW's medical researchers, many of whom are leading the world in developing groundbreaking treatments and cures.

saving lives

- heart disease
- Indigenous health
- HIV / AIDS
- cancer
- dementia
- mental illness
- obesity
- lifestyle
- hepatitis C
- drug development

confronting cancer

The new Lowy Cancer Research Centre will boost the fight against cancer on multiple fronts.

The Opportunity

Postgraduate research opportunities and collaborations exist across a range of cancer initiatives.

Professor Philip Hogg
Photo: Britta Campion

Construction is well underway on the $100 million-plus Lowy Cancer Research Centre and, in preparation for its 2009 opening, medical scientists Philip Hogg, Robyn Ward and Minoti Apte are continuing to build their own multidisciplinary approach to the killer disease.

The Lowy Centre will be home to over 400 scientists and bring under the one roof adult and childhood cancer research for the first time.

"There's a lot of commonality between the ways different cancers can be approached," says Professor Apte of the Lowy Centre's collaborative potential.

Brain cancer is a focus for UNSW and its partner the Cure for Life Foundation. Two million dollars will be spent over the next five years to establish a chair in neuro-oncology and strengthen research in the field at the Lowy Centre.

Another focus is pancreatic cancer. Having identified the role of stellate cells in cancer's multiplication, Apte and her team are now trying to "interrupt that interaction in any way", thanks to funding from the NSW Cancer Council.

In the process, they've created the first model to incorporate all the major components of human pancreatic cancer.

A multidisciplinary approach is important also to Professor Ward, whose primary research interests include identifying factors that put people at risk of developing colon and other cancers.

"It's important to think about cancer from as many different angles as possible, otherwise connections get lost," she says.

In 2007 a team led by Ward identified a new pattern of disease inheritance, with implications for people with a family history of bowel, ovarian and uterine cancers. It has particular relevance where the cause of cancer is undetermined or cannot be explained by current genetic tests.

The team found that the presence of a chemical marker, or tag, on a critical gene could also be passed from the parent who is predisposed to cancer to their children.

Ward will step in another direction in 2009, overseeing second-generation trials of a drug developed by Professor Hogg. As inaugural Lowy Director, Hogg is investigating a new class of anti-mitochondrial drugs – "they target the power supply of cancer-supporting cells" – and an imaging agent that detects dying cells and alerts doctors to the efficacy or failure of treatments: "that pretty much keeps us busy," he says.

While his first-generation trials could find funding only in the UK, he credits the Lowy Centre with bringing the next phase home – and attracting Ward to the project.

All three professors hope to advance their work from these initial frameworks to more general applications. "If you're working on cancer," says Hogg, "you want to make sure what you're doing is both novel and important."

To open up unique research angles – as all three continue to do – is to allow our knowledge of and approaches to cancer to keep building as well.

mind thief

Professor John Hodges has dedicated his career to finding solutions to one of the human body's most cruel disorders – dementia.

It's a cognitive impairment that will ruin the lives of five percent of those who are over 65. By the time we reach 80 – which is increasingly likely as medicine advances and the population ages further – one in three of us will suffer the terrible effects of dementia.

The cruel affliction not only causes progressive mental deterioration in the sufferer but also sends out shock waves among family members and loved ones.

The outlook for the future, however, is not all negative. John Hodges, Professor of Cognitive Neurology has utilised his extensive experience in the fields of medicine, psychiatry and neuroscience, coupled with a prestigious ARC Federation Fellowship, to set up FRONTIER, the Frontotemporal Dementia Research Group.

Previously Professor of Behavioural Neurology at Cambridge University, Professor Hodges' aim within FRONTIER is simple – to alleviate the suffering of patients with younger-onset dementia and to translate scientific advances into clinical practice.

"My special interest is in younger people with dementia, those under 65," Hodges says. "In the elderly the biggest causes of dementia are Alzheimer's disease and vascular disease. In younger sufferers the most common cause is still Alzheimer's but the second most common cause is frontotemporal dementia, which has a high genetic component. That's where I focus my research."

"I'm interested in a broad range of approaches and am particularly trying to translate what goes on in laboratories into clinical practice. The things I focus on are early and accurate diagnosis, telling apart the different kinds of dementia, developing tests that we can use to pick up cases of these different kinds of dementia, the use of brain imaging in diagnosis and monitoring. We also do research on the everyday impact of dementia, how it's affecting people's relationships."

The typical and tragic effects of dementia, Hodges says, are a deterioration of language abilities and of social functioning, causing people to undergo marked changes in personality and behaviour. This, of course, leads to devastation within family groups.

But as we live longer, Hodges says, the problem will only become worse if we don't discover more about the disease. "Because people are living longer they're facing more wear and tear," he explains. "Infectious diseases are becoming a thing of the past, so now a lot of medicine is looking into degeneration caused by longer life spans."

UNSW is at the forefront of the battle against dementia, having won more grants than any other institution in Australia in a 2008 round of funding from the National Health and Medical Research Council, totalling more than $1.6 million.

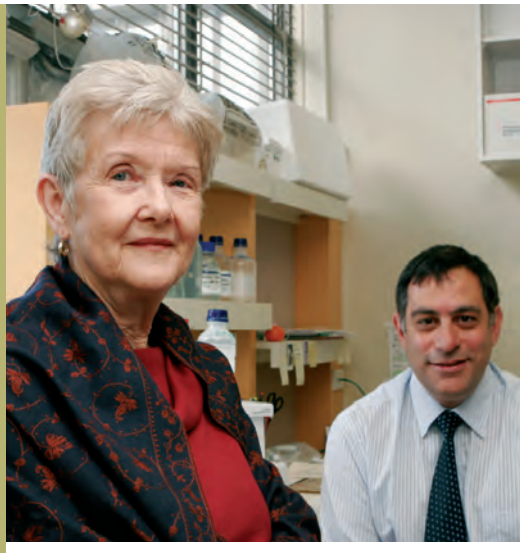
The Opportunity

The Frontotemporal Dementia Research Group (FRONTIER) directed by Professor John Hodges undertakes a broad range of work on frontotemporal and related dementias including neuropsychology, brain imaging, in vivo markers of underlying pathology, impact on carers and treatment approaches. PhD and post-doctoral research opportunities are available in these areas. Industry and government partnerships are also available.

Photo: Virginia Star / Fairfaxphotos.com

the good heart

UNSW medical researchers are targeting our number one killer.



The Opportunity

PhD and other postgraduate research opportunities are available in vascular research.

Professor Carolyn Geczy and Professor Levon Khachigian
Photo: Susan Trent / Gasbag Studios

Claiming one Australian life every ten minutes, cardiovascular disease is our biggest killer. And with 3.5 million of us suffering from the disease, finding solutions from prevention to cure is a national priority.

Research is showing promise in one area of the fight, atherosclerosis – a condition affecting arterial blood vessels and commonly referred to as a "hardening" of the arteries. It's hoped that the insights could lead to development of a new drug that prevents the development of clots and eventual thrombosis.

"We showed an unexpected way that blood clots form," says Carolyn Geczy from the School of Medical Sciences.

"We found that a particular protein serum, amyloid A, induces molecules that promote blood clotting on white blood cells," says Professor Geczy. "Other researchers backed up our work showing that this protein also affected the endothelial cells – the lining of the blood vessels – in the same way."

If a drug were developed to target the protein, better management of the condition would result.

"The drug would target the protein to stop any further reaction. This is important because the inflammatory process involved in atherosclerosis is ongoing," says Geczy. "We would prevent a chain reaction leading to thrombosis."

Any ongoing treatment of this nature would also reduce the likelihood of patients having to undergo surgery, which involves tremendous health risks.

Another class of drug being developed at UNSW is about to go into human clinical trials. The experimental drug will be trialled first in those with the most common type of skin cancer, basal cell carcinoma, but it also has the potential to treat a range of health problems including joint inflammation and heart disease.

"This may be a 'one-size fits all' therapy, because it targets a master regulator gene which appears to be involved in all of these diseases," says Levon Khachigian, from UNSW's Centre for Vascular Research.

"c-Jun is an important disease-causing gene," says Professor Khachigian. "It stands out because we don't see much of it in normal tissue but it is highly expressed in diseased blood vessels, eyes, lungs, joints, and in the gut – in any number of areas involving inflammation and aggressive vascular growth.

"Our experimental drug, Dz13, is like a secret agent that finds its target, c-Jun, within the cell and destroys it," he says. "It is a specific, pre-programmed 'molecular assassin'."

The next phase in the therapy's development will be a trial with non-melanoma skin cancers. The tumours would be injected with the drug over an eight-week period.

"While we are further ahead with cancer, the drug also shows exciting potential in the area of cardiovascular disease," says Khachigian. "We have shown that it is possible to slash by half heart muscle damage after a heart attack, in experimental models."

fightback on infection

As global efforts to find a vaccine and cure for HIV/AIDS ramp up, researchers are thinking harder and smarter about prevention.

With no vaccine and no cure, the number of people living with HIV/AIDS is rising, and so too is funding pressure for the cocktails of antiretroviral drugs that can keep HIV patients alive. Last year, an estimated 2.5 million people were newly infected, with 2.1 million deaths, expanding the HIV/AIDS case load to about 33.2 million people worldwide.

From social research to developing vaccines and drug therapies, UNSW is approaching HIV/AIDS holistically. On the social front, the National Centre in HIV Social Research (NCHSR) is investigating ways to change behaviours and attitudes to reduce risk and improve health outcomes. On the clinical front, medical researchers have received a boost with the NSW Government's announcement of $20 million to establish the National Institute for Virology, led by UNSW's National Centre in HIV Epidemiology and Clinical Research (NCHECR).

As part of its work in Timor Leste, NCHSR is researching the sexual behaviours of sex workers. "The thing that has worked best around the world is condoms," says NCHSR's Associate Professor Heather Worth. Yet, in Catholic East Timor complex social and religious barriers discourage condom use, and the criminal status of commercial sex work complicates prevention efforts. The social taboos surrounding homosexuality also makes men who have sex with men hard to reach. The NCHSR study will give Timor Leste an evidence-based guide to HIV prevention.

In Papua New Guinea, NCHSR and its partner research centre, the PNG Institute of Medical Research are studying the roll-out of lifesaving antiretroviral drugs. Preliminary results suggest the strong belief that HIV/AIDS is a punishment from God heightens stigma and discourages people from seeking treatment, even when they are critically ill.

Last year the search for a vaccine suffered a set-back with the suspension of an international trial after the vaccine was found to be ineffective. However, under Director David Cooper, NCHECR will take a different approach in a $17.7 million vaccine development program for HIV and Hepatitis C, beginning in 2009.

"There has been some pessimism about a vaccine since the failed trial, which has led to a rethink," says Dr Damien Cordery.

"But relying on waiting for a vaccine is wishful thinking. We need a concerted effort – a vaccine is just one part."

NCHECR is also studying a new antiretroviral drug, raltegravir, which stops the DNA of the HIV virus integrating with a patient's DNA. The study will determine whether the drug can blunt the progress of HIV in its earliest stages.

NCHECR Deputy Director John Kaldor and James Ward, who is heading a new program in Aboriginal and Torres Strait Islander health, are also examining prevention models for Australia's remote communities, where bacterial sexually transmitted infections (STIs) can affect 15–20 percent of adolescents and young adults. The study promises to lift the burden of STIs, and at the same time reduce the potential for HIV transmission.

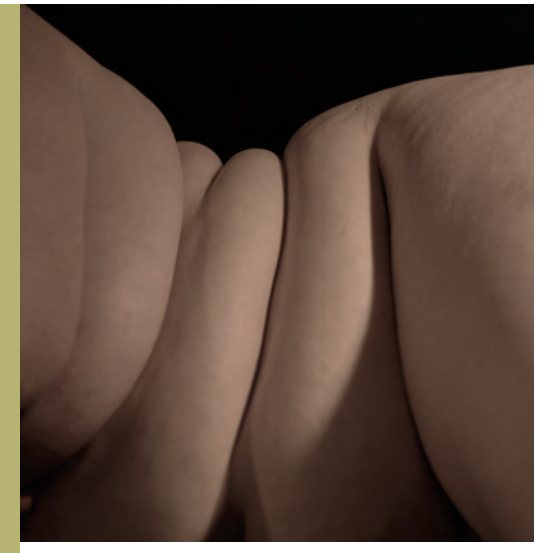
The Opportunity

NCHSR offers three degrees: a Graduate Diploma, Master of Arts by Research and PhD in Health, Sexuality and Culture. It offers specialised core courses in the social theories of sex and drug practices as well as research methods. Students enrolled in the program undertake their own research project, supervised by NCHSR staff. NCHECR offers a range of postgraduate research opportunities.

Photo: Torsten Blackwood / AFP / Getty images

tipping the scales

Research suggests the obesity time bomb has maternal origins.



The Opportunity

For information on postgraduate opportunities in obesity research, contact Professor Morris.

Photo: Karen Kasmauski / Corbis

When Australia elbowed out the United States to take the global lead in obesity it was bad news for the growing ranks of Australians who are literally eating themselves sick.

With four million adults now obese – 26 percent of the adult population – and another five million adults overweight, Australia is facing sharply rising health costs and the increasing risk of premature death and hospitalisation. At UNSW, scientists are examining why obesity is on the rise, and the answer appears more complex than just blaming fast food.

Research suggests you are not just what you eat, but what your mother ate. Professor of Pharmacology, Margaret Morris, says the increase in obesity may be partly related to effects across generations. International population studies show that about 30 percent of mothers now enter pregnancy overweight or obese, which could affect appetite in their offspring; so the next generation may be effectively pre-programmed to overeat.

The studies look at the impact of maternal obesity on the next generation of rats, but the results have important implications for the human population. At birth, the offspring of obese mothers have higher body fat ratios than the offspring of lean mothers.

“It’s likely that maternal obesity can exert a programming effect on adult obesity and cardiovascular disease in offspring, and more work is needed to dissect the underlying mechanisms,” Professor Morris says.

The research followed earlier studies by Morris and colleagues on links between early life circumstances and obesity rates in adults. One of these studies suggested that “comfort eating” is not a socially contrived phenomenon – but rather one based in biology. The result could explain why some people overeat when under stress.

Morris says she was surprised by the clear link between a high-fat diet and the feeling of pleasure in animals that had experienced stress early in life.

“What this might be telling us is that there is something going on in the brain circuits that regulate feeding if you are stressed while very young – if you are given nice things to eat, you are more able to experience pleasure,” she says.

In other words: “You choose that eating behaviour because it makes you feel good”.

Morris says this and other work shows that brain chemicals that regulate feeding can be changed early on in life.

“We know there are strong genetic and environmental components in obesity. This shows there is a strong nexus between hormones produced in your fat and what happens to your brain appetite circuits, your hunger and your drive for food,” she says.

“Current research is addressing a number of critical questions like what happens when diet is reversed early in life – can we reduce the impact?”

city and country

With most Indigenous Australians living in cities, success on closing the gap in Aboriginal health will be a mostly urban affair.

"If you get it right for Indigenous people," says Lisa Jackson Pulver, "you'll get it right for everybody."

An expert in Indigenous healthcare systems, Associate Professor Jackson Pulver says basing health and education services on the needs of the Aboriginal and Torres Strait Islander population is a good way to ensure those services can cope across the board.

Herself an Indigenous woman, Jackson Pulver's past research revealed that Indigenous people's health is almost 100 years behind that of other Australians.

Poor health indicators include shorter average life expectancies (59.4 years for Aboriginal men compared to 76.6 for all males and 64.8 years for Aboriginal women compared to 82 for all females); greater levels of ill health resulting in higher levels of disability and reduced quality of life; and high rates of established behavioural health risk factors such as smoking and substance abuse.

Jackson Pulver, in cooperation with Professor Tony Broe at the Prince of Wales Medical Research Institute, is now looking at Indigenous health in urban environments, particularly in regard to dementia.

"Very little work has been done on Indigenous health in an urbanised environment," she explains. "People don't realise that most Aboriginal people in this country live in an urban environment. In fact the majority of Aboriginal people live here in NSW, in a big town called Sydney.

"Just because someone lives next door to a hospital doesn't mean that their health is going to be better than those people who live a long way away."

Jackson Pulver, who is the Director of the Muru Marri Indigenous Health Unit at UNSW, has found that Indigenous Australians living in urban areas could be just as vulnerable to high rates of dementia as those living in remote areas.

Findings from existing studies show that remote Indigenous people are more likely to develop dementia at a very young age (between 45 and 59 years) than the rest of the Australian population. Dementia figures for older Indigenous people in remote areas (those who are 65 and above) were four times higher than the non-Indigenous rate.

"If this rate applies to the general Indigenous population – and we think it might – there is likely to be a disproportionate number of Indigenous people with dementia in coming years," Jackson Pulver explains.

The risk factors for cognitive impairment and dementia include educational disadvantage; unemployment, under-employment and low status jobs; high rates of drug and alcohol use; social trauma; brain trauma; and increased rates of diabetes, hypertension, renovascular and metabolic disease.

"We need a three-tier process," Jackson Pulver says. "We need to prevent cognitive decline by investing in early-childhood education and family support; we need to improve literacy; and we need to provide tertiary education programs and employment opportunities."

The Opportunity

Postgraduate research opportunities exist in the area of Indigenous health.

Associate Professor Lisa Jackson Pulver
Photo: Susi Hamilton

leading the field Major Awards

ARC Federation Fellowships 2008

Professor Brett Neilan
School of Biotechnology and Biomedical Sciences
Faculty of Science

Professor Neilan is a world expert in the study of toxic cyanobacteria which forms harmful blue-green algal blooms in rivers and reservoirs. Under the Fellowship, Professor Neilan plans to fully characterise the genetic and biochemical basis of toxin biosynthesis and its regulation in cyanobacteria. This research will provide new understanding of the factors that affect drinking water quality and the future of novel pharmaceuticals, including antibiotics, anaesthetics and immunosuppressants.

Professor Michelle Simmons
Program Manager of the Atomic Fabrication Facility
ARC Centre of Excellence for Quantum Computer Technology
Faculty of Science

This is the second Federation Fellowship for Professor Simmons, a leading international researcher in the field of quantum computing. Under her first Fellowship, Professor Simmons demonstrated a radical new fabrication strategy of commercially based silicon transistors at the atomic scale. She now plans to address fundamental impediments to transistor scaling, which are of vital strategic importance for the global semiconductor industry.

Professor Aibing Yu
UNSW Scientia Professor and Director of the Laboratory
for Simulation and Modelling of Particulate Systems
Faculty of Science

Professor Yu is a world-leading scientist in the fields of particle/powder technology and process engineering. His work aims to overcome problems in the design and control of particulate and multiphase processes in industries that are important to Australia, such as minerals, metallurgical, chemical, energy, pharmaceuticals and materials. Being Deputy Director of the ARC Centre of Excellence for Functional Nanomaterials, he is also working in nanotechnology with a particular interest in the synthesis and application of nanoparticles.

Eureka Prizes 2008

The Land & Water Australia Eureka Prize for Water Research and Innovation

Professor Matthew England and his team from the Climate Change Research Centre, Dr Alex Sen Gupta, Dr Caroline Ummenhofer and Dr Agus Santoso, with Dr Mike Pook from CSIRO.

For their research to identify variations in ocean temperatures enabling predictions of dramatic rainfall variations in Western Australia.

The British Council Eureka Prize for Young Leaders in Environmental Issues and Climate Change and the People's Choice Award

Nicole Kuepper
Lecturer in the School of Photovoltaic & Renewable Energy Engineering

For her groundbreaking work on developing an innovative, cheap and simple photovoltaic device that promises to bring affordable electricity to over two billion of the world's poorest people.

The IAG Eureka Prize for Innovative Solutions to Climate Change

The entire UNSW School of Photovoltaic and Renewable Energy Engineering headed by Dr Richard Corkish, for its groundbreaking record in solar cell research.

The CSIRO Eureka Prize for Leadership in Science

Professor Robert Clark

For his pioneering research in the field of quantum computing.

The Australian Government Eureka Prize for Promoting Understanding of Science

Professor Richard Kingsford
School of Biological, Earth and Environmental Sciences

For his major role in lifting awareness of the health of and threats to Australia's major rivers and wetlands systems.

Other Achievements

ATSE Clunies Ross Award 2008

Professor Stuart Wenham of the School of Photovoltaic & Renewable Energy Engineering

For his enormous contributions to solar cell development and commercialisation. Since beginning his work on solar cells in the 1980s Scientia Professor Wenham has invented or co-invented numerous breakthrough technologies that have delivered major advances in energy conversion efficiency. The ARC Photovoltaics Centre of Excellence at UNSW, of which Professor Wenham is director, holds the world record for solar cell efficiency and has licensed its technology worldwide, with global sales exceeding $1 billion.

The Banksia Environmental Foundation Mercedes-Benz Australian Environmental Research Award 2008

Professor Matthew England
Co-Director of the UNSW Climate Change Research Centre

For research revealing the link between variations in sea surface temperature and drought cycles for Australia and other Indian and Pacific Ocean rim nations. The $30,000 prize is considered the most prestigious environmental award in Australia.

Australian Council on Healthcare Standards Medal 2008

Professor William Rawlinson of the School of Medical Sciences (Faculty of Medicine) and the School of Biotechnology & Biomolecular Sciences (Faculty of Science)

For his leadership in quality practices, particularly relating to infectious diseases. Professor Rawlinson is the current Head, Virology Division, SEALS Microbiology at Prince of Wales Hospital. Professor Rawlinson's list of achievements is considerable. He is renowned for his focus on the needs of patients.

Australian Institute of Physics Bragg Gold Medal for Excellence in Physics 2007

Dr Frank Ruess of the School of Physics

For his pioneering work on a new way to make atomic-scale electronic devices using the atomic resolution capability of the scanning tunnelling microscope. The award honours the best physics PhD thesis nationally each year. Based at UNSW's Centre for Quantum Computer Technology, Dr Ruess is working with colleagues in the Atomic Fabrication Facility under the supervision of Federation Fellow, Michelle Simmons.

seizing the opportunity

Following successful trials in China, UNSW's commerical arm NewSouth Innovations (NSi) is working to license technology that turns polluting fly-ash waste from coal-fired power stations into an environmental solution for the world's construction sector.
The technology, developed by UNSW@ADFA Civil Engineer Dr Obada Kayali, has generated interest in Australia, Indonesia, India the United States and the Middle East.

Making rubbish useful … Obada Kayali and his fly-ash bricks
Photo: Courtesy of ADFA

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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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.

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For information on commercialisation possibilities please contact:

NewSouth Innovations

NewSouth Innovations Pty Limited (NSi) is UNSW's commercialisation arm and specialises in transforming research and technology developed at UNSW into a successful venture or product.

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It oversees the raising of philanthropic gifts for scholarships, research and capital projects.

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