



# SCIENCE IN *ACTION* 04

Achievements, action and outcomes in Australia's  
Cooperative Research Centres

2004

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# Introduction

Australia's Cooperative Research Centres program is admired internationally for its ability to focus the talents of leading scientists, industry and scientific resources from across Australia on challenges of national priority.

The following 47 stories illustrate many of the exceptional outcomes and achievements of the CRCs in 2004.

They also illustrate the growing contribution of the CRCs to the Knowledge Society, and their pervasive impact across the economy, society and the environment.

The stories were compiled as part of the CRC Association's 2004 National Media Initiative. Julian Cribb & Associates were engaged to carry out the project. Details of the release schedule are provided in Appendix A. The media releases themselves are available on [www.crca.asn.au](http://www.crca.asn.au).

The CRC Program covers six industry sectors:

- Manufacturing Technology
- Information & Communication Technology
- Mining & Energy
- Agriculture & Rural-Based Manufacturing
- Environment
- Medical Science & Technology

Contacts for individual CRCs are in Appendix B.

# **SCIENCE IN *ACTION* 04**

## **SUMMARIES**

# Manufacturing Technology

## Engine shaper

**An Australian-invented alloy has been chosen to build the heart of the engine of the car of the future.**

A high performance magnesium alloy developed by Australia's Cooperative Research Centre for Cast Metals Manufacturing (CAST) has been selected for the cylinder block alloy of a new magnesium-intensive engine research project by the United States Automotive Materials Partnership.

Use of magnesium instead of iron in a car's engine block saves 2.75 tonnes of CO<sub>2</sub> equivalent over the life of the car.

## Building revolution

**A "green calculator" is helping to transform the building and construction industry.**

The world-first LCADesign, developed in the Cooperative Research Centre for Construction Innovation, provides property professionals with an instant cost and environmental assessment of any commercial building.

Working from the 3D computer design, the calculator provides an instant display of the volume and cost of all the materials involved in its construction and the environmental impact of those materials.

## Hot wood

**Australian microwave technology can slash the time it takes to convert a green log to finished planks from months to days.**

The new treatment technology developed by the CRC for Wood Innovations is being commercialised through Australian Solar Timbers, in Kempsey, NSW.

The technology, which could revolutionise world timber production, cuts drying time to a tenth of normal, or less, giving Australian timber a vital productivity edge.

## **Timely trains**

**Australian engineers have cracked a problem that has baffled rail managers for 150 years – how to make trains run to time.**

The CRC Railway Engineering and Technologies has developed a suite of smart tools to help rail operators integrate train timetables with crew availability and track maintenance, reduce congestion on busy lines and re-schedule long-haul networks in real time to avoid delays.

Rail CRC researchers led by Assoc. Prof. David Panton of the University of SA are honing a 'best of all worlds' maths-based system that treats all sets of schedules as part of an integrated process and selects the best solutions.

## **Cast performer**

**An Australian technology is set to revolutionise the world car parts industry by dramatically improving component casting.**

The new coating technology, CASTcoat™, developed by researchers in the Cooperative Research Centre for Cast Metals Manufacturing (CAST), protects metal casting equipment up to ten times longer than present coatings.

Drawing on technology developed to protect jet engines CAST researchers invented a new kind of ceramic coating which lasts ten times longer and has a novel application method.

## **Green construction**

**Australia's \$90 billion construction industry could be an international leader in sustainable building methods by 2020.**

That's the finding of the Construction 2020 report by the Cooperative Research Centre for Construction Innovation.

The report identifies eight ways technology can help lift the Australian building and construction sector to a new level of success. Environmentally sustainable construction- which minimises the impact of building on the environment - is the area of greatest potential.

## **Welding success**

**An Australian welding technology that promises to reshape the metal fabrication industry is taking off worldwide.**

Licences have been granted for the Australian-invented Keyhole TIG welding to two of the largest stainless steel pipe producers in the United States and Europe.

Developed by scientists in the CRC for Welded Structures Keyhole TIG welding is proving significantly faster, cheaper and simpler than current welding methods for corrosion-resistant metals like stainless steel, nickel alloys and titanium.

### **Smarter vineyards**

**Australia's \$3 billion wine industry has a fresh competitive edge thanks to a new low-cost system to predict the water needs and disease risk in vines.**

The system uses a tiny 4mm micro-climate sensor developed by the CRC for microTechnology and Motorola Australia.

The information collected by the sensor helps predict disease outbreaks with unprecedented accuracy. It is also equipped with a soil moisture meter which allows growers to plan irrigations according to the needs of the crop, leading to savings in water and reduced risk of salinity.



# Information and Communication Technology

## Healthcare advance

**Australia will soon have the world's most advanced system for sharing health records, thanks to a research breakthrough in data management.**

The advance by the Co-operative Research Centre for Enterprise Distributed Systems Technology (DSTC Pty Ltd) will become the backbone of Australia's planned national electronic network, *HealthConnect*, saving lives and up to \$1 billion in waste and duplication.

The answer to massive fragmentation in health records is DSTC's electronic health record (EHR) architecture, *openEHR*, which will give health centres and specialists across the sector rapid access to all kinds of clinical records.

## Keeping in touch

**Internet researchers are developing technology to simplify the use of computers and sharing of information by older people.**

Working with seniors from the Port Hacking Probus Club, researchers from the Smart Internet Cooperative Research Centre and National ICT Australia (NICTA) have field-tested groundbreaking technologies designed for easy use by people 65 and above.

Its first two prototypes, an electronic scrapbook and an electronic table, have none of the peripheral equipment of computers - no keyboards, mice, or tricky software to master. Instead they are operated entirely by touch, speech and pen.

## Blow to fraudsters

**CRC researchers have struck a major blow against economic terrorism, global stockmarket fraud and potential superannuation losses.**

Researchers at the Capital Markets Cooperative Research Centre (CMCRC) have developed and tested fraud detection systems which give brokers instant warning of attempts to manipulate securities and other markets.

Surveillance systems developed by CMCRC research partner, SMARTS Pty Ltd are now protecting nine national stock exchanges and assisting four market regulators around the globe.

## **Imaging breakthrough**

**A world-first in optical fibre technology has opened the way for a major advance in medical imaging inside the human body.**

The development of hollow optic fibres made from perspex only a few times thicker than a human hair was achieved by a team from the Australian Photonics CRC.

A tenth the thickness of a normal endoscope it can penetrate tiny blood vessels and other corners of the body with greater ease, safety and less inconvenience to the patient. The fibre also promises massive increases in computer speed and capacity, moving the PC closer to becoming a machine that runs on light.

## **Neater networking**

**A major advance in the control of complex networks has been achieved by Australia's CRC for Sensor Signal and Information Processing (CSSIP).**

Known as data fusion, the new technology from the uses sophisticated mathematics to analyse the vast flow of data collected by a networks of sensor devices, check its accuracy, correct possible errors in the network and then present the information so human operators can make good decisions.

Its applications include bushfire management, radar networks and battlefield control, management of water and power networks and healthcare prioritisation.

## **Radar revolution**

**Researchers at Australia's Photonics CRC have successfully developed a powerful new mobile radar system that runs on light.**

Designed for use in aircraft, ships or land-vehicles the lightweight antenna system is intended to supplant the familiar, cumbersome rotating dish that has scanned our skies and seas for intruders for half a century.

Working with Singapore's DSO National Laboratories, CRC researchers have developed and tested a low-cost wideband photonic phased array antenna system which uses photonics - light signals in optic fibres – instead of electronics to form and direct the radar beam, monitor a wide microwave spectrum for signals, and process the large volume of data gathered in an instant.

## **Space engine**

**Australian scientists have successfully developed a radical new space engine for powering satellites – or for interplanetary travel.**

Researchers from the Cooperative Research Centre for Satellite Systems and Australian National University developed the Helicon Double Layer Thruster (HDLT) to dramatically increase the service life of satellites.

The research may also pave the way for the ultimate use of plasma thrusters, rather than rocket engines, in interplanetary travel by humans - with potential to cut the trip to Mars to three months.

## **Internet calling**

**A boom in internet phone calls has led to a \$6 million investment in Australian technology which ensures service quality and reliability for both voice and video.**

A spinoff of the Australian Telecommunications CRC and technology commercialisation company QPSX, Cortec Systems Pty Ltd, secured backing from three leading Australian venture capital firms to take its technology to the world market.

ATcrc and Cortec Systems are developing a series of products that can be added to existing networks to manage the quality and performance of essential voice and video connections.

## **Spinoff jackpot**

**A CRC spinoff company has signed an historic export deal potentially worth hundreds of millions of dollars.**

RBN Inc, a spinoff firm incubated by the Australian Photonics CRC, signed a 5-year agreement with the Marconi Corporation, one of the world's largest communications technology suppliers, to resell the Australian-developed technology for expanding the capacity of existing communications networks.

**Real sound**

Technology that dramatically improves the reality of voice communication in cyberspace – from networked games to teleconferencing – has been invented in Australia.

Researchers from the Smart Internet Technology Cooperative Research Centre (Smart Internet) have developed an audio communication system that enables players in crowded virtual spaces such as multiplayer games to experience group conversation as close to reality as possible.

The Dense Immersive Communications Environment (DICE) enables players to hear a spatially-accurate rendering of other's voices in their virtual vicinity as they happen. The voices are adjusted according to orientation and distance from the listener, as well as loudness.

# Mining and Energy

## Sludge success

**A world breakthrough in thickening has helped save Australia's minerals sector \$295 million along with billions of litres of water.**

The fundamental advance in separating fine particles from water is being captured by the minerals industry through a unique partnership between government, science and 27 companies, led by the AJ Parker Cooperative Research Centre for Hydrometallurgy.

The research is revolutionizing one of the mineral industry's most unpredictable and erratic operations – the use of gravity thickeners, huge tanks used to concentrate mineral slurries for extraction or disposal in the alumina, gold, base metals and mineral sands industries.

## Gold finder

**Australian scientists have developed a powerful new technique for uncovering hidden gold deposits.**

The world-first technology developed by the Co-operative Research Centre for Predictive Mineral Discovery (*pmd\*CR*C) enables mineral explorers to predict where buried gold deposits are most likely to occur even when there isn't a trace detectable at the surface.

The advance uses 3D computer visualisation and modelling tools that relate deformation in the rock to the flow of mineralised fluids to predict where buried gold lodes are most likely to occur. It has already been responsible for the first major gold find in 100 years in Victoria.

## Greener coal

**Australian scientists have developed a new way to slash greenhouse emissions from brown coal.**

The Cooperative Research Centre for Clean Power from Lignite (CRC CPL) has successfully tested a process for drying brown coal which can reduce greenhouse emissions from power generation by a third or more.

The Mechanical Thermal Expression (MTE) technology removes over 70 per cent of the water from the brown coals found Victoria and South Australia, resulting in huge greenhouse savings when the dry coal is burnt to generate electricity.

### **Growing nuggets**

**Gold nuggets may grow underground 'like potatoes', according to a dramatic scientific discovery by the CRC LEME researchers.**

The prized pieces of bullion have long puzzled prospectors and geologists because they are found in places where there is no obvious local gold concentration.

Studies by PhD researcher Frank Reith have yielded evidence that gold nuggets may be the product of generations of soil microbes hard at work. This could lead to significant enhancements in gold discovery and exploitation in Australia.

### **Robot mines**

**Australian scientists have taken a vital new step towards the automation of underground coal mining for efficiency and safety.**

As part of the CSIRO/CRCMining Landmark Project on Longwall Automation, researchers at the CRCMining have developed a tool detect, log and identify production stoppages.

With up to 10,000 variables to be constantly monitored at the coalface the task is a huge one, requiring broadband communication and the latest in complex systems analysis.

### **Mercury debunk**

**An international report depicting Australia as the world's worst emitter of the toxic heavy metal mercury got it wrong.**

A recent global anthropogenic (man-made) mercury emission inventory claimed that Australia emitted more than 105.5 tonnes of mercury per year from power generation, transport, domestic and bushfires - making it the world's largest mercury emitter per capita.

The Cooperative Research Centre for Coal in Sustainable Development (CCSD) found the estimates of mercury (Hg) emissions were exaggerated by up to ten-

fold, because Australian coals are much cleaner than the overseas coals used as the basis for the study.

## **Salinity search**

**Scientists have developed new ways to stalk the deadly salt that spreads unseen beneath the surface over vast expanses of Australia.**

The thudding rotors of helicopters are ushering in a new phase in the war on salt, deploying the sophisticated detection techniques used in oil and mineral exploration to combat the nation's gravest environmental menace.

Researchers in the CRC for Landscape Environments and Mineral Exploration (LEME), the SA Department of Land, Water and Biodiversity, CSIRO and the Bureau of Rural Sciences, are using airborne sensors to envisage what occurs beneath the surface and predict whether surface leakage is likely to release salt.

## **Carbon Capture**

**Australian geoscience skills are being sought worldwide for major carbon dioxide (CO<sub>2</sub>) capture and geological storage (geosequestration) projects.**

The CRC for Greenhouse Gas Technologies (CO<sub>2</sub>CRC) is working on a number of international projects in addition to conducting research into CO<sub>2</sub> geosequestration in Australia.

These include the joint Australia-US Frio Project in Texas, which aims to explore the storage of CO<sub>2</sub> in an underground saline aquifer, a study of the carbon storage potential of certain Asian countries and a major report for the Intergovernmental Panel on Climate Change (IPCC) on carbon capture and storage.

## **Energy drill**

**A revolutionary Australian drilling technology for tapping new energy resources, saving lives and slashing CO<sub>2</sub> emissions is entering the world market.**

The Mining CRC has signed a licence agreement with the world's largest resources producer, BHP Billiton, to develop and commercialise its novel water-based tight-radius drilling (TRD) technology, initially in Australia and New Zealand.

TRD makes it possible to safely tap centuries' supply of natural gas locked away in unmineable coal beds. It may also combat global warming by enabling CO<sub>2</sub> to be injected into deep coal seams.



# **Agriculture & Rural-based Manufacturing**

## **Beef breakthrough**

**Australia has taken a lead in the world race to turn grass – or feed – into succulent, mouthwatering steak.**

Three scientific breakthroughs in the CRC for Cattle & Beef Quality have combined to give the nation's \$10 billion beef cattle industry a world lead in breeding animals that convert feed to meat with superior efficiency.

The result will be a cattle herd that is gentler to the environment, more competitive on world markets, more profitable - and which produces more lean beef for consumers. The latest development is a simple, low-cost blood test which enables cattle producers to identify the bulls which sire the most efficient converters of feed-to-beef.

## **Self-managing sheep**

**Sheep that muster, weigh, draft, medicate and manage themselves without human intervention will soon be a reality in Australia.**

Researchers in the Australian Sheep CRC are developing RIAM (remote individual animal management), in which sheep are automatically logged, weighed and checked for certain health conditions as they come to water or move from one paddock to another.

Offering a huge boost to sheep industry productivity RIAM opens the way for sheep to be individually monitored and managed by remote control.

## **More rice, less water**

**A new Australian method for selecting low water-use soils for rice production is increasingly being adopted by rice farmers.**

Australia is already one of the world's most water-efficient rice producers in the world, says. The new technique developed in the CRC for Sustainable Rice Production (CRC SRP) uses electromagnetic induction to create a picture of the soil to a depth of five metres or more, allowing targeted soil sampling that is combined with evaluation of soil chemical properties, particularly soil sodicity.

Soil sodicity levels have been related to decreased soil permeability especially in clay soils. Electromagnetic induction surveys combined with soil sodicity assessment will minimise deep drainage to the groundwater system.

### **Tenderer meat**

**A tender lamb chop or a juicy steak comes from an animal with a calm temperament.**

Australian scientists are applying “behavioural tests” to individual sheep and cattle to select those that are the easiest to manage and, ultimately, produce the best meat.

The CRC for Cattle and Beef Quality, has found that while different breeds of domestic and farm animals have markedly different temperaments, there are also significant differences within a breed. This has major significance in selecting animals that are better able to cope with their production environments and so produce better meat.

### **Beating root rot**

**Researchers have come up with tactics for dealing with black root rot – a fungal pest that can slash up to 30% of the yield of cotton crops.**

The Cotton CRC has devised a Best Management Practice manual to help farmers develop an integrated control program which will prevent the pathogen being spread from farm to farm on farm vehicles, implements, and even farmers' boots.

At the same time they are advocating ‘biofumigation’ – the use of special legume crops, such as hairy vetch, which help cleanse the soil of the fungus while at the same time improving fertility.

### **Model catchment**

**Australia’s Murrumbidgee is showing the world how a river catchment can be managed for the best results for the community and the environment.**

The Lower Murrumbidgee is the world’s first and only ‘global reference basin’, selected in a competitive process from twenty-five other river basins around the world as part of a UNESCO program. The project is co-ordinated by the CRC for Sustainable Rice Production.

Policy makers, hydrologists and scientists from around the world are learning from Australian experience. The modelling tools and participatory hydrologic research methods being used in the Murrumbidgee are now also being applied on the Yangtse and Yellow Rivers in China and the Indus Basin in Pakistan.

## **Sugar plastics**

**A brighter future is on the cards for Australia's sugar industry as it becomes a producer of bio-plastics.**

Bio-plastics are just one of a number of diversification opportunities for the sugar industry, say researchers from the CRC for Sugar Industry Innovation through Biotechnology (CRC SIIB).

"Every household will be using bio-degradable plastic bags, bottles and containers, every car will have bio-degradable plastic dashboards and fittings, fine clothing will be crafted from these biopolymers to replace petrochemical plastic and nylon with bio-nylons and bio-fabrics all made from renewable resources including sugar," says the CRC's Dr Steve Brumbley.

## **Flavour saver**

**A revolutionary water-saving Australian vineyard technology also delivers a better glass of Shiraz or Cabernet Sauvignon.**

In a four-way win for the environment, grapegrowers, winemakers and wine drinkers, new research by the CRC for Viticulture also shows that the enhanced colour and flavour in grapes grown using partial rootzone drying (PRD) do not come at the expense of high yield.

Partial Rootzone Drying applies water to just half a vine's root system at a time. New research shows it also causes a higher concentration of certain natural compounds responsible for colour and aroma in red wine.

# Environment

## Climate impact

**A CRC report commissioned by the Queensland Government predicts potentially catastrophic consequences of climate change along Australia's eastern seaboard.**

The report, by the Rainforest CRC, says a rise of 3.5 degrees Celsius over the next 50-100 years will severely threaten most of our icon species of rainforest birds, reptiles, frogs and mammals, possibly sending many of them extinct. There is also a severely increased risk of the spread of pest and weed species.

The report details how ecosystem functions such as nutrient cycling, soil development and the provision of clean water will be damaged, with reduced runoff, loss of habitat, and deterioration of water quality leading to increased blooms of toxic algae. Increased droughts, high winds, dust storms and bushfires are also predicted.

## Hairy canary

**Hairy canary clover is a possible answer in the fight to save nearly 20 million hectares of Australia from a slow death from rising salt.**

Scientists from the CRC for Plant-based Management of Dryland Salinity say this introduced deep-rooted forage plant can keep water table well below the soil surface, reducing the risk of salinisation.

The plant mimics the behaviour of Australian native plants which have long been cleared from pasture and cropping land, while providing a drought-tolerant pasture for livestock.

## Water bugs

**Water is teeming with thousands more microscopic creatures than previously thought – many still unknown.**

The discovery was made by researchers at the Australian Water Quality CRC who had the idea of using a piece of hospital equipment – a flow cytometer – to assess water quality. This enables them to count up to a thousand bacterial cells per second, giving a reliable answer on what is in the water in hours rather than days.

The benefit of the new technique is that it is easier to use and more accurate for monitoring the status of water supplies and treatment facilities.

## **Reef watch**

**Every Australian can now keep an eye on the health of the Great Barrier Reef via a new Reef Futures website.**

The website is a joint venture by CRC Reef Research and the Australian Institute of Marine Science.

Maps on the site show sea surface temperatures, allowing users to explore current and past coral bleaching events either across the whole Great Barrier Reef or on individual reefs. The site also has interactive graphs that predict the potential impacts of bleaching on corals out to 2050 on the Reef. It includes rapid access to reef publications and links to coral websites around the world.

## **Bat threat**

**The tropical fruit bat, the spectacled flying fox, is in serious trouble from a range of threats.**

Researchers at the Rainforest CRC say the bat plays a key role in maintaining rainforest plant diversity, and its decline could have serious implications for Australia's World Heritage rainforest ecosystems.

Land clearing, reduced fertility and exposure to tick paralysis are among the possible causes of the mammal's decline.

## **Ocean warning**

**Australian researchers have issued a global warning over the dangers of uncontrolled 'bioprospecting' in the deep oceans.**

The Law of the Sea fails to adequately protect the biodiversity of the open oceans and the ocean floor, say scientists at the CRC for Antarctic Climate and Ecosystems (CRC ACE).

Shipping and seabed minerals are the subject of a network of international laws, - but biological resources are effectively there for the taking, they warn.

## **Roo retreat**

**New evidence suggests that northern Australia is experiencing a widespread decline of native mammals including the antilopine wallaroo.**

Scientists say that this could be the first significant decline of a large kangaroo species since European settlement.

According to Euan Ritchie of James Cook University and the Tropical Savannas CRC, the decline is almost certainly happening in parts of antilopine wallaroo's range. The reasons at present are unknown but may include changes in pasture composition, predators and fire regimes.

## **Coral chart**

**A simple colour chart has become a key weapon in the fight to save Australia's coral reefs.**

Tourists, schoolkids, anglers, divers and other reef users may soon take a role as front-line scouts, on the lookout for threats to the nation's marine icons.

The Coral Watch colour chart has been developed by visual neuroscientist Associate Professor Justin Marshall in a joint project between the CRC for Sustainable Tourism, the University of Queensland, and Heron Island Resort.

# Medical Science & Technology

## **Bioterror watch**

An Australian research team is developing early-warning tests for the lethal diseases and toxins that could possibly be used in an attack by bio-terrorists.

A CRC for Diagnostics team has developed the capability to rapidly identify a number of possible bio-terrorism agents, such as smallpox, anthrax, botulinum and salmonella.

Biosensors with great sensitivity are now being built which require just a few molecules of an infectious disease or a toxic agent in a sample taken from a patient to warn of a possible threat, allowing early and rapid preventative measures to be taken.

## **Skin danger**

**Skin infections in Australia's indigenous communities may be linked to world-record rates of rheumatic heart disease and kidney failure.**

Researchers at the CRC Aboriginal Health (CRC AH) have found that kidney failure due to glomerulonephritis and cumulative heart damage caused by repeated bouts of rheumatic fever have a direct link to skin infections caused by the streptococcus bacterium, usually induced by the scabies mite.

"The evidence is building that scabies is a critical factor in the continuing high incidence of rheumatic fever in indigenous communities," says Associate Professor Jonathan Carapetis. "This is a recurrent scourge and leads to serious and permanent heart damage."

## **Protective bugs**

A revolution in understanding of typhoid fever and other killer diseases is being led by Australia's CRC for Vaccine Technology (CRC-VT).

The average person carries some 90 trillion bacteria around with them, on and in their bodies. Many of these are still unknown to science, but some are proving extremely valuable in the fight against deadly diseases like typhoid.

A CRC-VT team is investigating whether the protection given to people by oral vaccines can be significantly enhanced by altering the composition of microbe populations in their gut.

### **Asthma emergencies**

**Asthma sufferers in Australia have a high probability of ending up in a hospital emergency ward.**

Yet the prevention and treatment of asthma in this country is amongst the world's best.

Research by the CRC for Asthma Ltd. shows that this paradoxical situation is due to a combination of social and medical factors. These include the high cost of medication, and the perceived danger of unwanted side-effects.

### **Deafness diary**

**A simple diary has become an important tool in managing hearing loss in very young children around the world.**

The Diary of Early Language (Di-EL) developed by Australia's Cooperative Research Centre for Cochlear Implant and Hearing Aid Innovation (CRC HEAR) enables systematic recording of how deaf infants acquire language.

The Di-EL system provides clinicians and parents with a measurable daily on-line measure of language progress, especially for children fitted with a cochlear implant.



# **SCIENCE IN *ACTION* 04**

## **FULL STORIES**

# Manufacturing Technology

## Engine shaper

In a global technology coup, an Australian-invented alloy has been chosen to build the heart of the engine of the car of the future.

A high performance magnesium alloy developed by **Australia's Cooperative Research Centre for Cast Metals Manufacturing** (CAST) has been selected for the cylinder block alloy of a new magnesium intensive engine research project by USAMP, the United States Automotive Materials Partnership.

USAMP is sponsored by the US Council for Automotive Research, which includes three of the world's leading car makers, DaimlerChrysler, Ford and General Motors.

The alloy has been cast into a specially designed V6 engine block, based on the aluminium 2.5/3.0 litre Ford Duratec engine, in Texas.

Using magnesium instead of iron in a car's engine block results in greenhouse gas savings of 2.75 tonnes CO<sub>2</sub> equivalent over the life of the car.

"Developing a magnesium alloy that can be used in the high temperature conditions found in modern car engines has been the goal of researchers round the world for many years", says Professor David StJohn, CEO of CAST.

"That Australia was first to achieve this goal is testimony to our ability to assemble a team of the best researchers from across the nation in the field of magnesium alloy development, through the CRC.

"The result is AM-SC1, a robust, lightweight alloy specially developed to withstand high temperatures."

AM-SC1 is an alloy of magnesium metal and the rare earth elements neodymium, lanthanum and cerium. The secret of its strength and performance across a range of temperatures lies in the microstructure: the magnesium grains are bound by a very fine intermetallic layer (magnesium-rare earth) which gives the alloy superior stability, strength and 'creep resistance' across a range of engine operating temperatures.

Creep resistance is the ability of a metal to withstand long-term deformation under sustained elevated temperature, pressure and load.

The AM-SC1 alloy receives a similar heat-treatment to aluminium alloys, making it easy and economic to manufacture.

"This alloy can reduce the weight of vehicle engine components by as much as 70 per cent, resulting in greater fuel efficiency, less pollution and lower greenhouse emissions," Prof. St John says.

"Magnesium is a logical lightweight alternative to traditional automotive materials, especially in power train components such as the engine block.

"The heaviest part of a car is its engine and the engine block accounts for 20-25 per cent of the total engine weight," Prof. StJohn says.

The AM-SC1 alloy has been successfully road-tested in Austria in a European AVL Genios LE 3-cylinder engine installed in a Volkswagon Lupo car that has travelled more than 56 000 km since 2003.

Magnesium is 33 per cent lighter than aluminium and 75 per cent lighter than cast iron, has an excellent strength-to-weight ratio, high shock- and dent-resistance and dampens noise and vibrations more than either aluminium or steel.

"The choice of Australia's AM-SC1 alloy by USAMP is a major step towards making lightweight magnesium-based cars a reality," Prof. StJohn says.

The special alloy was developed in the CRC by Australia's leading alloy development team, which includes researchers from CSIRO, The University of Queensland, Monash University and Australian Magnesium. It will be released to the market later this year by Australian Magnesium.

CAST is a Cooperative Research Centre established under the Australian Government's Cooperative Research Centres Program with the support of the Queensland and Victorian State governments.

Prof. St John says the research addresses two of Australia's National Research Priorities – a sustainable Australia and frontier technologies for transforming industry.

More information: 07 3365 3675

## **Building revolution**

An Australian "green calculator" is helping to transform the building and construction industry.

The world-first LCADesign, developed in the **Cooperative Research Centre for Construction Innovation**, provides property professionals with an instant cost and environmental assessment of any commercial building - straight from its 3D computer graphics.

With future development, the calculator will do the same for the family home, for roads, sewage networks or any major construction project, says the leader of the development team, Dr Peter Newton.

"Working from the 3-dimensional CAD design for a building, the calculator provides an instant display of the volume and cost of all the materials involved in its construction - at the push of a button," Dr Newton says.

"At the same time, it can calculate the environmental impact of all those materials - how many tonnes of clay were used to make them, how much water, how much energy, and how much greenhouse gas and other polluting emissions they made to air, land or water."

This will offer builders, for the first time, the opportunity to instantly redesign or respecify materials for a building based on both the economic and environmental cost of the materials involved in its construction.

It will also let them see how well the building complies with government, industry, company or project standards.

Dr Newton says that the calculator is linked in real-time to a constantly-updated index of the prices of more than 800 key building materials - concrete, brick, steel, aluminium, glass, timber, and tiles - to obtain an instant read-out of the cost of alternatives.

At the same time it helps the builder to select those materials which have the least environmental impact over their lifetime.

"You can see the "environmental footprint" for the whole building over the lifetime of the materials it embodies. This allows the builder to choose materials which are most effective over their service life, both economically and environmentally.

"It's a genuine world-first - and we're seeing real interest in it from the North American construction industry where there is currently nothing equivalent," Dr Newton says.

"It is also likely to revolutionise the profession of quantity surveying," he adds.

Behind the LCADesign tool is an extremely powerful Australian-designed software engine, which searches a constantly-updated register of materials prices and a database of their environmental impact.

The calculator will be trialled by leading construction industry and building design firms, including Bovis Lend Lease, engineers Arup PL and Rider Hunt and architects Woods Bagot. From the government side, Building Commission

Victoria, Australian Building Codes Board, and Queensland Department of Public Works are key partners in the project.

Dr Newton says the green calculator illustrates a growing competitive advantage in Australian R&D - the ability to combine the best research from contrasting fields coupled with industry focussed partners to drive real outcomes.

"In this case we're seeing the convergence of the best of Australian expertise in IT and software, with our skills in environmental science and assessment as well as design science. The result is a tool that is likely to put us at world leading edge for sustainable construction."

Construction Innovation envisages commercially releasing the first version of LCADesign following completion of the prototype development in mid-2004.

Chief Executive Officer of Construction Innovation, Dr Keith Hampson, says the calculator will meet an urgent need in the commercial building industry.

"Our industry is likely to remain a major source of environmental degradation if major steps aren't taken now," Dr Hampson explains.

"Commercial buildings have a substantial and multi-level impact on the environment that is predicted to increase in the next few years. On a global scale, they employ ozone-depleting chemicals, contribute to global warming from fossil fuel combustion, and use massive amounts of non-renewable resources.

"At a local level, new commercial buildings all too often create urban congestion and lead to the degradation of air, water and soil. Even indoors, some of the materials used in the construction of commercial buildings are hazardous.

"This research will provide a practical tool for designers, material producers, government regulators, building owners and managers so they can see the environmental impact of commercial buildings," Dr Hampson says.

More information: 07 3864 9295

## Hot wood

Australian scientists have developed a microwave technology that has potential to revolutionise the world timber industry, slashing the time it takes to convert a green log to dried finished boards from months to days.

The new treatment technology under development by **Cooperative Research Centre for Wood Innovations** is entering commercial production through Australian Solar Timbers, in Kempsey, NSW.

“Currently sawn hardwood timber requires a long, slow drying process. However, after microwave treatment, green sawn boards can be dried in one tenth of the usual time,” said Professor Peter Vinden, Chief Executive of the CRC for Wood Innovations.

“This will give the Australian sawn timber industry a vital productivity edge over its rivals, and lead to better quality and higher-value uses for our precious hardwoods.

“It is also a green technology: because it yields better quality wood it will increase utilization of plantation timbers, so helping the growth of that sector.”

A market assessment by timber technology firm MTech estimates a medium sized sawmill can boost its annual drying throughput by almost 40 per cent, to 9000 cubic metres, just by using the microwave processing technology.

Hardwood sawmillers dry sawn boards under controlled temperature conditions for several months, depending on the type of tree they come from. There are two stages – pre-drying and final drying. Using the Australian microwave treatment, a conventional drying process of 2 to 4 months can be shortened to 6 to 10 days, Prof. Vinden says.

The reduced processing time offered by the microwave technology greatly increases throughput capacity, allows sawmillers to respond more rapidly to market demands, and reduces holding and handling costs due to shorter processing times for timber stocks.

The process offers enormous economic benefits to the Australian timber industry, says Dr Douglas Head, whose company Australian Solar Timbers (AST) has committed to investing in the first commercial microwave plant at his established hardwood sawmill in Kempsey, which exclusively produces solid hardwood flooring products. The potential increase in yield and product quality offered by the microwave technology is particularly attractive, he said.

The capital costs of a microwave plant are estimated to be no more than the capital cost of the large capacity kiln that would be required for conventional processing.

Prof. Vinden says microwave processing can also increase the timber yield from each log processed, by reducing defects that occur during the drying process.

“The quality of backsawn timber from ash-type eucalypts dried conventionally is frequently reduced by the formation of small cracks throughout the timber which affect the appearance, final quality and price of the product.”

“Microwave processing helps reduce crack formation and end-splitting, and so generates more timber suited to high value uses such as furniture.”

“When widely adopted, this technology can improve the value of the whole Australian hardwood sawn timber harvest, making better use of our native resources and plantation timbers.”

Microwave treatment causes microscopic changes in wood structure. Inside the wood, microwave energy is converted to heat, creating steam pressure in the wood cells. This causes some thin-walled wood cells to break open, creating microscopic voids in the wood which allow the moisture to escape more easily, and the wood to dry more quickly.

Microwave treatment can increase wood permeability several thousand times. Research at CRC Wood Innovations shows that, by adjusting the amount of microwave energy, the formation of microvoids – and hence permeability – can be controlled.

As well as the microwave drying work, CRC Wood Innovations researchers are exploring the use of microwaves for rapid and complete preservation of timber, and to rapidly bend wood for furniture components. These all address National Research Priorities to create frontier technologies which transform industry and lead to a sustainable Australia, Prof. Vinden says.

More information: 03 8344 5237

### **Timely trains**

The era of the cursing commuter and the frustrated freight forwarder may be nearing its end: Australian engineers have developed a new approach to cracking a problem that has baffled rail managers for 150 years - making trains run to time.

The **Co-operative Research Centre for Railway Engineering and Technologies** has developed a suite of smart tools which will help rail operators to integrate train timetables with crew availability and track maintenance, reduce congestion on busy lines and re-schedule long-haul networks in real time to avoid delays.

"Passengers don't always appreciate that running a rail network is an unbelievably complex task - because one little thing that goes wrong can have a knock-on effect all down the line," says Rail CRC CEO Professor Dudley Roach.

One of the hardest jobs is to co-ordinate train timetables with crew rosters, locomotive fleet assignment and track and train maintenance. Poor performance with any of these elements can have adverse effects on the others. Even when

one element is scheduled to work perfectly, this in itself may cause adverse outcomes with some other elements. The interaction of so many complex parameters requires compromises to produce the best overall result.

CRC researchers led by Assoc. Prof. David Panton of the University of SA are honing a 'best of all worlds' maths-based system that treats all three sets of schedules as part of an integrated process and picks out the best solutions.

Their final package is designed to yield the following advantages for the rail industry:

- new software for train timetabling, crew rostering and maintenance scheduling.
- a decision support tool for scenario evaluation.
- lower overall operating costs.
- better timetable reliability through a more 'robust' schedule.
- reduced staffing costs as a consequence of crew schedules that better address industrial and Occupational Health & Safety issues.
- maintenance of tracks and trains which is more timely, cost effective and better planned.

In a second project a CRC team is developing a tool to help improve rail network performance, to ease congestion hotspots such as access to Sydney when freight and passenger trains are competing for rail space. This involves understanding the patterns in the buildup of congestion so timely action can be taken to ease it.

The project is delivering:

- decision support tools for assessing network performance and for scenario planning
- high level expertise in performance assessment for networks in fully operational or degraded states
- tools to analyse the impacts of congestion in rail networks

A third CRC team is developing a sophisticated system for feeding train drivers with advice that will lead to better timekeeping and greater fuel economy through less speeding up and slowing down. The hand-held advice system is linked to a GPS locator that tells both driver and rail manager precisely where on the track the train is in a long-haul network, and gives advice on driving strategies to minimise energy consumption while keeping to schedule.



The fourth CRC project includes finding a more efficient way for trains to pass one another at the right station when they run on a single line railway. This apparently simple task is the result of weeks of painstaking planning, which is constantly being adjusted up to the moment the trains actually pass. Trains invariably stray from the plan, causing disturbance to ripple through the whole network. Operators are often so busy they have little time to try out alternative plans to see if they work better.

The CRC has developed a real-time dynamic rescheduling system that helps train controllers keep the network running smoothly by monitoring the movements of trains and, when necessary, revising the network operating plan so it recovers quickly from disruptions.

Benefits of the rescheduling system are:

- improved adherence to timetables,
- optimal response to operational disturbances,
- reduced congestion,
- reduced network operating costs,
- reduced train lateness,
- increased network reliability and capacity,
- more efficient operation of individual trains.

"Together these four technologies can make a real difference to the timeliness and efficiency of Australia's national rail network and set new standards for train scheduling," Professor Roach says. "One day, we hope, Aussies will be famous for managing trains in the most efficient way possible."

"This research addresses National Research Priority Three - frontier technologies for building and transforming Australian industries."

More information: 07 4930 9597

### **Cast performer**

An Australian technology is set to revolutionise the world car parts industry, by dramatically improving the performance of component casting.

The new coating technology, CASTcoat™, developed by researchers in the **Cooperative Research Centre for Cast Metals Manufacturing (CAST)**, protects metal casting equipment up to ten times longer than present coatings.

Coatings are applied to protect the equipment used to cast metal components and control the quality of the castings themselves.

“Until CASTcoat™ was invented, manufacturing companies the world over relied on coatings that needed constant repair and replacement,” says Professor David StJohn, CEO of CAST. “This was expensive, time-consuming and not very reliable.”

Traditional die coats are ‘sacrificial’, meaning they are made from brittle ceramics that are gradually destroyed in order to protect the equipment.

Drawing on technology developed to protect jet engines CAST researchers invented a new kind of ceramic coating which lasted ten times longer and had a novel application method.

This is CASTcoat™, a strong, porous ceramic layer with insulating properties that is resistant to wear and tear and is applied using a thermal spraying process.

The technology is for aluminium low-pressure and gravity die-casting operations and the main users will be companies manufacturing lightweight alloy parts for the car industry.

Extensive trials are being carried out in international industry to prove the value of the CASTcoat™ technology. Several of Europe’s leading die casters who supply quality engine castings to companies such as BMW, Jaguar, Porsche and PSA have evaluated CASTcoat™ on challenging components and shown that it significantly outperforms their existing coatings. Following the success of these trials CAST signed an exclusive license agreement with global company Acheson Industries to market the technology to casting companies worldwide.

Prof. StJohn says the commercialisation of CASTcoat™ is proof of the impact of Australia’s Cooperative Research Centres (CRC) Programme.

“This is what CRCs are all about – working in partnership on excellent science, then turning it into commercial reality.”

“This development addresses the third of Australia’s National Research Priorities – frontier technologies for transforming industry,” Prof. StJohn says.

The CASTcoat™ technology was commercialised through a partnership between CAST and FTS, a commercialisation services company, who took a lead role in facilitating the process. Dr Brian Oldland, director FTS, said: “The road to commercialisation was long and difficult but the obvious benefits of the technology and the support of a dedicated team with both technical and commercial expertise made it all possible.”

Support has also been provided through an AusIndustry COMET grant and assistance from the Victorian State Government's Technology Commercialisation Program.

CASTcoat™ was discovered by CAST researchers from CSIRO (Manufacturing and Infrastructure Technology) and a University of Queensland student during a CAST PhD project. The CASTcoat™ technology was then developed for commercialisation by CAST researchers at CSIRO.

CAST is a Cooperative Research Centre established under the Australian Government's Cooperative Research Centres Program with the support of the Queensland and Victorian State governments.

More information: 07 3365 3675

### **Green construction**

Australia's \$90 billion construction industry could be an international leader in sustainable building methods by 2020, according to the Construction 2020 report, prepared by the **Cooperative Research Centre for Construction Innovation**.

The report predicts that Australian building companies will have a significant impact on the global construction industry provided they can overcome the current fragmented state of the industry.

"There are more than 230,000 firms and 730,000 individuals in the industry - but what is clear is that many are now prepared to work hard together, and with researchers, to solve that problem," says Construction Innovation Chief Executive Officer Professor Keith Hampson.

The report says the industry is the backbone of the national economy, with construction, supply and project firms accounting for 14 per cent of gross domestic product. It is growing at 2.6% a year and has huge untapped export potential.

The report identifies eight ways that technology can help lift the Australian building and construction sector to a new level of success.

"The first and clearest, agreed across the industry, is that environmentally sustainable construction - the creation of buildings and infrastructure that minimise their impact on the natural environment - is an area of great potential," says Prof. Hampson.

"Here technologies like Construction Innovation's LCADesign can make a big difference. This is a calculator that works out automatically from 3D computer aided design the environmental and economic costs of materials in a building - at the push of a button.

"By 2020, working with industry, we'd expect to have a comprehensive set of eco-design tools for all stages of the construction life cycle, to minimise energy use, greenhouse and other forms of waste or pollution."

Other technology and management goals developed in consultation with the industry include:

- greater flexibility in meeting client demands
- a better business environment, with greater sharing of ideas and skills and a lower regulatory burden
- greater health and safety for the construction workforce, and upskilling for a fast-changing business environment
- leading-edge communication and IT technologies embedded in industry products and processes
- virtual prototyping for key products and major steps in the construction process, to ensure greater efficiency
- Off-site manufacture and on-site assembly for the majority of construction products for enhanced quality control and lower environmental and financial costs
- a re-engineered industry supply-chain using leading edge manufacturing processes and quality control throughout.

Construction 2020 was compiled after extensive consultation with building firms small and large in all States and is the first major report on the long-term outlook for the industry since the late 1990s, Prof. Hampson says.

"There is clearly consensus that by working more closely together and using the latest in technology, the industry can achieve even greater feats than in the past, especially in the field of sustainable construction. It's a very exciting prospect.

"This also gives small and medium companies a chance to get on board with the larger players, to capture the latest technologies and to share in the global expansion of our industry."

Particular areas of focus include the development of nationally uniform codes of practice, new tools to evaluate design and product performance, comparisons with overseas industries, and a worldwide research network to ensure that Australian technology stays at the cutting edge.

More information: 07 3864 1393

## **Welding success**

An Australian welding technology that promises to reshape the metal fabrication industry, saving millions of dollars, is taking off worldwide.

Licences for the Australian-invented Keyhole TIG welding technique were granted to two of the largest stainless steel pipe producers in the United States and Europe in 2004, with strong interest from other European, North American and Asian companies.

Keyhole TIG welding, developed by scientists in the **CRC for Welded Structures** and CSIRO in Adelaide, is proving significantly faster, cheaper and simpler than current welding methods for corrosion-resistant metals like stainless steel, nickel alloys and titanium.

The technique forms a "keyhole" right through the metals to be joined, liquefying the material evenly so that the join is stronger and more uniform. The keyhole closes behind the torch like a zipper as it moves along, explains CSIRO's Dr Ted Summerville.

"Its uses include tube making, welding of rotatable products such as pipes, and the joining of large sheets. It is particularly suitable for welding titanium alloys, because it reduces the opportunity for contamination," he says.

"Until now, the advantages of keyhole welding, with its deep penetration through the thickness of the material, were only available using plasma arc, laser or electron beam facilities - which are high-energy processes, very expensive and rather finicky," says Dr Summerville.

"But now that some of these major companies have taken a close look at the Australian keyhole technique, they've realised the job can be done much more cheaply and simply, and with better results. They are really thrilled with it."

The secret of the Australian keyhole welding method lies in an understanding of the fundamental physics of the welding arc, which allows a balancing of the surface tension of the molten metal against gravity, and the gas and arc pressure of the torch.

The new keyhole system is being made available to metal fabrication firms, large or small. While it draws more current than conventional gas tungsten arc welding, the process requires no special power supply, just a new torch and the know-how to use it correctly.

"This new process can be used for welding all types of stainless steel, mild steel, nickel and titanium alloys, and other exotic metals", Dr Summerville says.

"This can be carried out in a single pass, instead of the six or seven passes previously required - which represents a dramatic gain in productivity. Welding stainless steel and titanium previously took hours. It can now be automated and completed in minutes."

Another advantage is that the process welds joints with square edge preparation which reduces both machining costs and the amount of filler material required to complete a joint. Keyhole TIG of 12 mm stainless steel plate typically requires only about 50 grammes of costly material per metre of weld, in contrast to a kilo or so of filler with conventional processes.

Between them these advantages offer huge savings to the metals fabrication industry.

Licenses for the Australian keyhole welding technology are being granted in Australia, Europe, the USA and Asia for use in the manufacture of products ranging from spiral-welded pipe and titanium sheet to railway rolling stock, says CRC WS Chief Executive Dr Colin Chipperfield.

"Several licensees in these markets have reported significant productivity improvements. The Americans in particular are highly impressed and talking about converting their whole system to using the Australian technology."

The research addresses the third of the Federal Government's National Research Priorities - frontier technologies for building and transforming industries.

More information: 02 4252 8889

### **Smarter vineyards**

Australia's \$3 billion wine industry is poised to gain a technical edge over its international rivals with the development of a low-cost system to predict the water needs and disease risk in growing vines.

The system is based on a unique micro-climate and moisture sensor developed by the **CRC for microTechnology** and Motorola Australia.

The information collected by the sensor helps predict disease outbreaks with unprecedented accuracy, enabling grape growers to spray only those vines that most need it, says CRC microTechnology Chief Executive Mr Clive Davenport.

The sensor is also equipped with a soil moisture meter which allows the grower to plan irrigations according to the needs of the crop, leading to potentially large savings in water and reduced risk of salinity.

Known as MEMS – micro electrical mechanical systems - the tiny sensor chips measure only 4mm square. They are capable of measuring wind speed and direction, temperature, light, humidity, as well as soil moisture and leaf wetness. The whole system is under international patent.

"The sensor nodes are distributed across a vineyard and send their information by wireless link to a gateway unit which downloads it to a computer, which analyses it and provides reports to the grower," Mr Davenport explains.

"A unique feature is that the sensors can be laid out in any pattern so long as each sensor is within radio range of at least one other. This means the network can be designed to suit individual farm layout and topography. New sensors can be added or removed as needed."

Mr Davenport says a primary target of the sensors is the fungal rot *Botrytis*, the scourge of the southern Australian grape growing industry. By warning of conditions favourable to the growth of *Botrytis*, the sensor enables the grower to take preventative action, targetting the areas most at risk – so avoiding heavy losses and also reducing the use of chemicals.

The soil moisture array consists of three sensor modules buried at different depths in the soil. Being low-cost and easy to install, the soil moisture sensors will bring precision irrigation scheduling within the reach of many grape growers, leading to potentially massive water savings across the industry, Mr Davenport predicts.

In the next stage, it is envisaged the soil sensors will be connected directly to watering valves, making irrigation automatic whenever the soil dries out.

"While other climate sensors are available, they cost in the thousands of dollars, which puts them beyond the reach of the typical grower," he says. "Our sensors will cost only a fraction of that, making irrigation scheduling a reality for the wider farming community."

"The successful trials of the microsensor network have helped identify a clear path to a new, relevant and useful commercial product to keep Australian agriculture world competitive," Mr Davenport says.

"The research addresses National Research Priority 3, frontier technologies for building and transforming Australian industries."

Dr Andrew Hamilton, a senior researcher with the Victorian Department of Primary Industries says the data gathered by the microsensors has enabled scientists to develop a method to accurately predict the likelihood of fungal diseases breaking out on the grape bunches under certain climate conditions.

The soil sensors have also provided invaluable information about soil moisture changes over time, enabling a better match between water and fertiliser applied and the needs of the growing vine.

Mr Pat Eardley, global software group site director for Motorola Australia, says his company has been working with CRC microTechnology on the project since 2000, and considers the system has great potential for monitoring environmental conditions at the micro scale.

"Most of the currently commercially-available sensors are prohibitively expensive, while their large size makes them unsuitable for microclimate monitoring," he says.

More information: 03 9214 8557



# Information & Communication Technology

## Healthcare advance

Australia will soon have the world's most advanced system for sharing health records, thanks to a research breakthrough in data management.

The advance by the **Co-operative Research Centre for Enterprise Distributed Systems Technology** (DSTC Pty Ltd) will become the backbone of Australia's planned national electronic network, *HealthConnect*, saving lives and up to \$1 billion in waste and duplication.

"At present there is massive fragmentation of patient health data," explains DSTC CEO Mr Mark Gibson. "It exists in unconnected 'islands' of usually incompatible information, making it extremely difficult for doctors, specialists and healthcare workers to easily find what they need."

"This increases the risk of adverse events, wastes precious time, leads to duplicate tests and patient interviews, and makes it harder to take the best possible decisions for their care."

The cost runs high. Health authorities estimate that inadequate records play a part in up to 10,000 Australian deaths a year. At least \$1 billion could also be saved by reducing hospitalizations and duplication of tests.

The answer lies in the Australian technology developed by DSTC based on a publicly available electronic health record (EHR) architecture, *openEHR*, which will give health centres and specialists across the sector rapid access to all kinds of clinical records.

"Healthcare is the largest information industry in the world. In the US 30% and in Europe 40% of health budgets are spent on the management of information," Mr Gibson explains. "However the industry has been traditionally slow in the uptake of IT, spending substantially less than other industries."

"DSTC specializes in developing IT systems that allow different enterprises to communicate and share information with one another, even when it has been collected and stored in incompatible ways," he says.

"Since 2000 we have been developing a new way to share disparate health records that is efficient, accessible, medically sound, confidential and adapts to the changing needs of the healthcare system."

The new web-based technology enables the sharing of clinical records across the health system without changing the way they have been collected or kept.

In January 2004, DSTC signed a \$2.9M contract with the Commonwealth Department of Health and Ageing to develop and trial an initial reference implementation of the *openEHR* solution in the Brisbane Southside area in partnership with the General Practice Computing Group and Queensland Health.

It is testing the value, technical feasibility and sustainability of electronic health records shared between the public and private sectors, as part of trials leading to implementation of the national electronic system, *HealthConnect*.

*HealthConnect* trials have been conducted in Tasmania, the Northern Territory and North Queensland, and the Australian Government has announced that in coordination with state governments, state-wide implementations of *HealthConnect* would take place in Tasmania and South Australia. *HealthConnect* is a joint Australian, State and Territory Government initiative.

The *openEHR* technology has excited keen interest around the world, notably in Europe and the United States, whose medical record-keeping systems are more of a jungle even than Australia's.

"The global market for electronic health records is currently around US\$6-8 billion," says Mr Gibson "Australia is a world leader in the emerging market of shared EHRs which support multi-disciplinary integrated patient care across all health care institutions.

"The Brisbane trial is an opportunity to demonstrate clear market application of the intellectual property behind *openEHR*, making it a prime candidate to influence emerging international standards and use of electronic health records."

The DSTC research addresses two of Australia's national research priorities – promoting and maintaining good health, and frontier technologies to transform industry.

More information: 07 3365 4310

## **Keeping in touch**

Australian internet researchers are developing revolutionary technology to simplify usage of computers and sharing of information between people. At the same time it offers all Australians a priceless gift – access to the recollections, wisdom and experiences of their elders.

Working with seniors from the Port Hacking Probus Club, researchers from the **Smart Internet Cooperative Research Centre** and National ICT Australia (NICTA) have begun field-testing the first of a series of groundbreaking technologies designed for easy use by people 65 and above

“When we first talked, many older people told us they regarded computers as horrifically complex, unreliable and designed for experts – not for people,” explains Senior Researcher Fellow, University of Sydney, Dr Aaron Quigley. “We decided to see what we could do about that.”

The result was Project Nightingale – named after the Nightingale nurses who, historically, cared for the elderly. Its first two prototypes, an electronic scrapbook and an electronic table, have none of the peripheral impediments of computers, no keyboards, mice, or complex software to master. Instead they can be operated entirely by touch, speech and pen, as you would with photos, notes and scrapbooks.

Behavioural research has shown the importance of reminiscing, as an aid to keeping the elderly mentally fit and socially active – so Dr Quigley’s team are working on easy-to-use technology that helps people to share memories.

“We’re designing for those people who are approaching the decision of whether to stay in their own homes, or go into care. The aim is to give people technologies that help them remain connected, socially and intellectually, and so able to live independently for longer,” he explains. “In addition, sharing memories and experiences with your peers and family can be a lot of fun.”

Research with the Port Hacking retirees showed that many people kept scrapbooks as a way of reminiscing, so the CRC team has designed an electronic scrapbook which can contain pictures, clippings, hand-written notes written with an infra-red pen, and voice notes.

“We’ve also designed it so, by ticking a box, you can put it on the internet and share it with your family and friends,” he adds.

“Potentially, this offers a wonderful way to access the memories and experiences of older generations. I imagine a time when there are thousands of these kinds of recollections on the internet and you can order your computer to create a special program containing people’s memories of a certain period or event – a sort of do-it-yourself documentary.”

The Smart Internet/NICTA team has also developed applications for an electronic table at which users can sit and pass around photographs, only the ‘photos’ are images on the table which can be manipulated – rotated, enlarged or copied – using your hands.

“We’ve tried to make it as intuitive as possible, so that you handle the virtual images in much the same way as you would ordinary photographs,” Dr Quigley says.

Initial responses of users to the technology have ranged from excitement and delight to comments that it is “off the planet” and concern about the old problem of computers – having to learn a new skill every time there is an update. Dr Quigley promises to keep it as simple to use as possible.

Port Hacking Probus Club president Jan Barber says that being part of the research has been a very exciting experience for her members. “One person can accumulate so much knowledge and experience and gain so many insights during their lifetime that digging out and using all the information is really a problem.”

The Nightingale technology offers a simpler way to do just that, says Smart Internet CEO Professor Darrell Williamson. “One of our goals is to help integrate technological innovation and social and behavioural science. Current technologies do little to bridge the gap between the memories of an earlier generation and a computing medium that enables them to be stored and accessed. In this, Nightingale is leading the field.”

These new technologies will also bring radical changes to the Internet as a whole and the group is also working to understand and meet these changes. Dr. Bjorn Landfeldt at the University of Sydney, a researcher in the group says, “We are now working with technologies that use a large number of small devices that are very different from PCs, and the sheer scale of the Internet will change drastically with these technologies.”

Project Nightingale is a joint project between the Smart Internet CRC and National ICT Australia, a publicly-funded company with a charter to build national capacity and excellence in IT research, training and commercialisation. Project Nightingale addresses National Research Priorities 2 and 3 – promoting and maintaining health and frontier technologies.

More information: 02 8374 5086

### **Blow to fraudsters**

Australian researchers have struck a major blow against economic terrorism, global stockmarket fraud and potential superannuation losses.

Researchers at the **Capital Markets Cooperative Research Centre (CMCRC)** have developed and tested fraud detection systems to provide brokers with instant warning of attempts to manipulate securities and other markets.

Surveillance systems developed by CMCRC research partner, SMARTS Pty Ltd are now protecting nine national stock exchanges and assisting four market regulators around the globe, making Australian anti-fraud technology the undisputed world leader, says CMCRC Chief Executive Officer Professor Mike Aitken.

Prof. Aitken said that the CMCRC in partnership with SMARTS Pty Ltd has now developed a range of real-time fraud detection systems to help prevent national and overseas fraudsters from undermining the wealth of the nation.

"Because we have access to unprecedented volumes of trading data from exchanges worldwide plus some of the best data analysts in the business, we've been able to profile the behaviour of fraudsters and market manipulators and to develop systems which identify and stop them," he says.

"In recent years Australia has placed great emphasis on protecting its physical borders. We need to adopt the same vigilance in securing our economic borders - in particular, our retirement savings."

First deployed in June 2003, CMCRC's new anti-fraud product, "Compliance Explorer", already monitors over 80 per cent of Australian equity transactions on behalf of brokers. Options and futures are being added this month.

Its huge power means it can monitor up to 15,000 transactions a second using hardware costing just \$20k - enough power to process even the largest markets operating today.

With similar plans for the New Zealand, Singapore and other markets, the team expects to be able to provide international brokers with worldwide coverage of the main markets in which they trade by the end of 2005.

"We've designed it in anticipation of the fact that, within the decade the world's 240 markets will have consolidated into just 5-10 major global markets."

"Participating firms will be in a far better position to protect their own interests by securing themselves from rogue trading and simultaneously they will contribute to improved overall market integrity."

Prof. Aitken says that , in a typical month, around A\$350 billion (over 60%) of Australian super funds under management were invested in listed securities on the Australian and overseas markets.

"If a fraudster is able to artificially depress the price of a basket of stocks at the end of a trading day, it is possible that superannuants cashing in their investment on that day will be severely financially disadvantaged.

"Alternatively, by pushing up a basket of stocks on a particular day, super policies could be cashed out at unrealistically inflated values, the cost of which is ultimately met by lower returns to other investors in the fund," he says.

This type of fraud is well documented and known variously as Marking the Close, Painting the Tape or Window Dressing.

"CMCRC has developed systems to identify this, along with 38 other possible abuses (including suspected insider trading and front-running) and is now implementing these systems in nations around the world to help protect their national wealth," says Prof. Aitken.

Nine national stock exchanges, four national regulators and a dozen international brokers have adopted these systems to help protect the integrity of their operations and ultimately the markets in which they participate.

The Capital Markets Cooperative Research Centre was formed in 2001 under the auspices of the Federal Department of Education Science and Technology (DEST) Cooperative Research Centre (CRC) program to bring together the best in innovative research and technology to the capital markets domain in a \$62m research and development program.

"The CMCRC attracts the best of Australia's researchers to work together with industry partners to develop new and innovative technologies for the capital markets domain - like these fraud prevention systems," Prof. Aitken says.

"Not only do we aim to protect Australia's wealth and interests in domestic and global markets, but also to make a real difference to the security, efficiency and trustworthiness of global capital markets."

This research address two of Australia's four national research priorities - frontier technologies for industry and safeguarding Australia.

More information: 02 9233 7999

### **Imaging breakthrough**

An Australian world-first in optical fibre technology has opened the way for a major advance in medical imaging inside the human body, as well as personal computers that run on light.

The development of hollow optic fibres made from perspex only a few times thicker than a human hair was achieved by a team from the **Australian Photonics CRC** and University of Sydney's Optical Fibre Technology Centre.

The fibre promises a new era in medical imaging. Being only a tenth the thickness of a normal endoscope it can penetrate tiny blood vessels and other awkward corners of the body with greater ease, safety and less inconvenience to the patient.

In their first potential medical application they will be used in conjunction with an established Australian medical procedure to cure deafness.

For computers, the fibre promises potentially massive increases in speed and capacity currently unattainable with copper connections, moving the PC closer to becoming a machine that runs on light.

APCRC team leader Dr Martijn van Eijkelenborg says the new fibre was produced by precision-drilling 100 or more holes in an 8cm thick rod of special perspex, then heating and stretching it until it was up to 400 metres long, and a fraction of a millimetre thick.

"This creates a plastic fibre with an array of scores of tiny air channels all along its length. You can send a light signal down each of these channels, or through the perspex islands in between them, which greatly increases the capacity of the fibre - like a coaxial cable with the wires made from air."

In this way, he explains, a fibre with 112 holes drilled in it can create an image with 224 pixels in an area of less than a quarter of a square millimetre. The team has created fibres with up to 300 channels and considers they have not yet reached the limits of the new technology.

The fibres are ideal for coupling with the latest optical-laser micro-arrays and, using these, could become the cables for the future computer.

"As computer speeds build up to around 10 Gigahertz, you start to lose the signal in the copper track which connects the chips. Basically, the faster the computer, the more trouble the chips have communicating with one another. So we thought: why not try an optical solution - use photons [the particles of light] in a plastic cable instead of electrons in a copper wire."

Apart from opening up the scope for ultra-high-speed computing, the plastic cable could improve the interface between computers and video, enhancing both the speed and quality of images.

Dr van Eijkelenborg says that the channels in the fibre can be filled with air, liquid or gas to alter their transmission properties for different applications, and the

team is also developing ways of creating 'inverted' structures with the holes filled with a solid, making the fibre completely solid, more rigid and easier to handle.

"Big, thick optic fibres, which are easy to handle, have a lot of dispersion – which causes a smearing out of the optical signals. By having a whole array of channels we can dramatically reduce this effect, which means we can transmit a very high bandwidth – approaching, in fact, that of a single mode fibre, but far cheaper and easier to handle."

"Polymer materials are ideal for these fibers. They are thicker than glass fibres but more flexible, and the fabrication methods that we use to prepare them allow full control over the positioning and sizing of the cores, he says.

"Any pixel arrangement is possible, both in terms of symmetry (hexagonal, rectangular etc) and in terms of core dimensions. We have even demonstrated multiple core sizes in one fibre. This makes it straightforward to tailor the fibre to match an array of light emitters with the particular symmetry and dimensions required for a specific application, such as chip-to-chip connectors."

The CEO of the Australian Photonics CRC, Professor Mark Sceats, says "The mini-endoscope is a great example that neatly illustrates how skills and technologies developed for telecommunications are now finding applications in industries like medicine.

"Photonics is becoming a pervasive technology, like electronics 40 years ago. Australia largely lost the plot in developing its microelectronics industry, and our CRC is working hard to ensure that the same fate doesn't befall our fledgling photonics industry."

More information: 02 9209 4790

## **Neater networking**

An Australian research team has achieved an international breakthrough in the control of complex networks, in applications ranging from defence radar networks to water supply management.

Known as data fusion, the new technology uses sophisticated mathematics to analyse the vast flow of data collected by a networks of sensor devices, check its accuracy, correct possible errors in the network and then present the information so that human operators can make good decisions.



Team leader Professor Iven Mareels from the **CRC for Sensor Signal and Information Processing** (CSSIP) says the technology can equally be developed to:

- focus scarce resources on the most critical tasks in a bushfire situation
- help nurses and doctors to prioritise and manage the most urgent tasks in a casualty or intensive care ward
- dramatically improve battlefield awareness and control for military commanders and individual soldiers, or
- improve the management of a gas network delivering energy to homes and industry.

"Until recently, if you were operating a network of sensors all reporting different things you were at risk of drowning in data - and you often had no way of checking how reliable it was. This made it very difficult to take the right management decisions," Professor Mareels explains.

"We have developed a system that can not only compute a result from a network of different sensors - but also indicate its reliability. From this you can create a network that is "self aware" and automatically repairs itself. This will then present recommendations or options for action to the operator."

Seven years of research with the Australian defence forces has led to a self-aware radar network which is smarter, and able to get more out of its excellent detection capabilities.

"Basically, we help the radar operator allocate the various technical resources to get the best result. Without this, present radar technology is underexploited because of the sheer complexity of the choices faced by a human operator."

Besides helping to safeguard Australia, CSSIP's data fusion technology is now entering its third year of trials in running a major irrigation network in northern Victoria. It keeps watch over 300 kilometres of gates and channels to ensure farmers receive water when their crops need it - and helps save some of the 30 per cent of water that was previously being lost.

Traditional sensors reported only on flow rates and water levels, but real time measurements are now available on several aspects of water quality - things like salinity, turbidity and pollution - as well as farm demand. Again this presents the manager with a huge computational task to make the right decision. Data fusion technology balances out the information, corrects errors and presents the options in a flash.

The Chief Executive of CSSIP, Professor Matthew Cuthbertson says the technology is delivering against the nation's major research priorities - safeguarding Australia, sustainability and transforming industry.

"It's a truly remarkable advance by Iven, based on a very pure form of mathematics which estimates probabilities. It's not artificial intelligence, it isn't based on huge sets of rules and doesn't have to search through volumes of historical data. It doesn't even need much computer power - you can run it on a PC.

"This makes it truly unique. It distils a flood of complex information into something a human under pressure can use to make a good decision."

"Because of that it has a very wide range of possible uses - from applications in defence to the environment and industry to maybe even the home."

More information: 08 8302 3477

## **Radar revolution**

Australia will gain a fresh edge in national security threat detection with the successful development by researchers at the **Photonics CRC** of a powerful new mobile radar system that runs on light.

Designed for use in aircraft, ships or land-vehicles the lightweight antenna system is set to supplant the familiar, cumbersome rotating dish that has scanned our skies and seas for intruders for half a century.

CRC researchers, working with Singapore's DSO National Laboratories, have developed and tested a low-cost wideband photonic phased array antenna system which can detect microwave signals like a radar dish, but without the need for a heavy rotating mechanism.

"This means that the radar warning system can be lightweight, can be placed on the wingtip of an aircraft, or on the mast of a ship, and can be designed to have a low profile," explains team leader Dr Arnan Mitchell from RMIT University.

"We've been considering various stealth geometries that would enable an aircraft to see without being seen."

The radar system uses photonics - light signals in optic fibres – instead of electronics to form and direct the radar beam, monitor a very wide microwave spectrum for signals, and process the large volume of data gathered in an instant.

Because it uses light, the antenna can be placed as much as 1 km away from the computer that processes the signal – in contrast to current systems which must

have all the signal processing built into the same unit. This makes it more compact for fitting into aircraft and other vehicles.

It is also more reliable in combat, because light-based transmissions are more immune to jamming from electronic warfare countermeasures.

“All this flexibility means that the same low-cost phased array antennas can be used for multiple applications - on ships, tanks, planes or even for ground deployment,” Dr Mitchell says

“Photonics also allows very broadband operation and thus these antennas can ‘watch’ the whole usable microwave spectrum to make sure that, if there is an incoming threat, we’ll see it,” he says.

“We also envisage this technology being used in radio astronomy, where the power of many antennas is harnessed simultaneously to capture very faint signals from extremely distant parts of the universe.”

Professor Mark Sceats, CEO of the Australian Photonics CRC, said that the success of the radar project demonstrates that photonics is now emerging as an enabling technology for a host of new products in many industry sectors, in the same way as microelectronics developed some 40 years ago.

“We are continually amazed at the wide range of emerging uses for our technologies. Its not just about broadband communications. Now it’s about health, security, smart display screens, networks and digital image processing using powerful information processors driven by light.”

This project is a collaboration between the Photonics CRC and the DSO National Laboratories of Singapore.

The phased array radar project addresses two of the four national research priorities: frontier technologies for new industries and safeguarding Australia.

More information: 02 9209 4790

## **Space engine**

The lifespan of telecommunications and other satellites may be dramatically extended if trials of a radical new Australian space engine are successful.

Researchers from the **Cooperative Research Centre for Satellite Systems** and Australian National University have teamed up to develop and test the satellite motors of the future, based on a revolutionary plasma thruster.

The research may also pave the way for the ultimate use of plasma thrusters, rather than rocket engines, in interplanetary travel by humans - with potential to cut the trip to Mars to three months.

"If we can develop a cost-effective thruster that will keep working for decades, it will provide a dramatic boost to satellite life," explains CRCSS chief executive officer Dr Andrew Parfitt.

"Today one of the biggest problems is that geostationary satellites run out of fuel and can't be kept in position. We believe the ANU's plasma thruster may be the solution."

The answer is already working on the ANU's test-bench - the Helicon Double Layer Thruster (HDLT) invented by Dr Christine Charles using the helicon technology patented by Professor Rod Boswell.

The thruster uses radio energy to create a plasma - a cloud of ions (atoms with an electron missing), atoms and electrons - out of a gas such as argon. These ions then pass through a sharp drop in electrical potential that, in the space of a few millimetres, kicks them to speeds of around 10 kilometres/second. This provides the thrust.

Dr Charles made this remarkable Australian scientific discovery on April 8, 1999, while testing various combinations of magnetic field and pressure levels on an experimental thruster, in an experiment run in her spare time. She observed the dramatic increase in speed of the particles as they passed through the drop in electrical potential.

"Often in science you think you've found something, then you come back the next day and you can't recreate the same effect. This time it was there every time - it's a really important Australian discovery," she says.

For the next four years Dr Charles continued to work on the device without funding until 2004 when the CRC/ANU partnership received a grant from the *Innovation Access Programme- International Science and Technology (IAP-IST)* established under the Australian Government's innovation statement, *Backing Australia's Ability*, to design and test a plasma motor for steering satellites to keep them in orbit.

Prof Boswell explains that plasma thrusters have advantages over rocket engines in that they use an electrical power source (such as a fuel cell, solar or thermal-nuclear) which gives them a long life, and do not have to carry the rocket's heavy chemical fuel load.

"An ion rocket is always accelerating, which gives the added advantage that it has a 'down' - a kind of gravity, compared with other craft where you just float around."

Prof. Boswell's colleague, NASA space engineer Dr Franklin Chang-Diaz, has calculated the trip to Mars can be reduced by two thirds to around three months if plasma thrusters were used instead of conventional rocket motors.

The CRCSS/ANU team's brief is to prove up the technology for an immediate practical outcome - keeping costly communication, navigation and earth observation satellites in service much longer, by steering them gently back into orbit.

Two US and European spacecraft have been powered by experimental plasma thrusters, but the Australian team is confident their technology is superior in several ways - including emitting a plasma beam that does not need to be artificially neutralised, as is the case in other thrusters.

To measure the thrust the HDTL is actually capable of developing, it has been run in a European vacuum chamber which mimics conditions in outer space.

"The Satellite CRC, with the backing of IAP-IST, has grasped the challenge of building a new satellite thruster that exploits all the benefits of this unique Australian technology - and the Europeans were impressed enough to want to test it in their vacuum chamber," says Professor Boswell.

The research addresses National Research Priority three - frontier technologies for transforming industry.

More information: 02 6281 8528

## **Internet calling**

The global boom in using the internet to make phone calls is behind a new \$6 million investment in smart Australian technology to ensure service quality and reliability for both voice and video.

A spinoff of the **Australian Telecommunications CRC** and technology commercialisation company QPSX, Cortec Systems Pty Ltd, secured backing from three leading Australian venture capital firms – Foundation Capital, Technology Venture Partners and Starfish Ventures – to take its technology to the world market.

"Demand for Voice over Internet Protocol (VoIP) for telephony and video-conferencing is exploding all round the world, as more and more companies and

government departments seek to put all their communications on the one network," explains ATcrc chief executive Dr Leith Campbell.

"Almost every organisation that wants to replace its PABX phone system is looking at VoIP to save money and improve communications."

But the popularity of VoIP is offset by the difficulty of ensuring voice (or vision) quality on the network is maintained at all times – for instance when someone else is using the same network to transfer large files and taking up a lot of its capacity.

ATcrc and Cortec Systems have defined a series of products that can be added to existing networks to manage the quality and performance of those essential voice and video connections.

Cortec's first product, *Freeway*, fully automates provision of guaranteed call quality for each individual phone call or video-conference.

This innovative technology solves two of the major barriers to VoIP adoption – unreliable call quality, and the complex array of specialised skills and tools that are required to provide a reliable VoIP network.

"Users of VoIP demand comparable call quality to their traditional phone systems," says John Siliquini, Chief Technical Officer of Cortec Systems.

"Maintaining a network to support 'real-time' network traffic such as voice is a whole new ball game for the average network administrator. You need to manage the network differently.

"While there are some tools and broad traffic shaping systems available, the quality of each call needs to be guaranteed before it proceeds. Our technology can provide this assurance," he says.

The research team, led by founding member Professor Tony Cantoni and based at the Western Australian Telecommunications Research Institute, has drawn on over 100 years of combined experience to develop Cortec Systems.

The company is in the process of establishing management in the US, developing international marketing and distribution, and accelerating product development.

Dr Leith Campbell says Cortec's success in raising the \$6m in venture capital is the result of good technology, marketing nous and a close partnership between the researchers and industry. The investment will now allow them to expand more aggressively overseas to take full advantage of the VoIP boom.

More information: 08 9266 3432

## Spinoff jackpot

A spinoff company from Australia's Co-operative Research Centres (CRCs) has signed an historic export deal potentially worth hundreds of millions of dollars.

RBN Inc, a spinoff firm incubated by the **Australian Photonics CRC**, has signed a 5-year agreement with the Marconi Corporation, one of the world's largest communications technology suppliers, to resell the Australian-developed technology for expanding the capacity of existing communications networks.

In a boost for the knowledge economy which is already being compared with the \$US300m sale of Radiata Pty Ltd in 2000, RBN has secured partners for its CWDM (coarse wavelength division multiplexing) technology in Europe, America and Asia, while retaining the intellectual property in Australian hands.

RBN was founded by Dr Richard Lauder, a Photonics CRC researcher from the University of Melbourne, and Ross Halgren, who led the Sydney node of the CRC's networking vehicle, Redcentre PL.

RBN is an innovative designer and developer of carrier class optical transport and switching platforms for the access and metro markets. It develops cost effective technology for use in offices, enterprises and telephone exchanges enabling carriers to offer lower cost broadband services.

"Designed with a small form factor, low power consumption and low cost of ownership, RBN is pushing the boundaries of optical networking closer to the end user," says Dr Lauder. The company's administrative headquarters are now in California while its research centre remains based in Sydney where it employs 70 staff.

"The overall world network market has been flat for a couple of years but our segment is one area that is showing strong growth," Dr Lauder says.

"Today the game is all about getting greater capacity out of existing networks at a lower cost, rather than putting in new networks. That's exactly what CWDM does - it complements existing technology. And it is very cost competitive."

Dr Lauder says the world market for coarse wavelength technology was \$US100M in 2003, was estimated to be \$US200M in 2004 and expected to double again by 2006. The Australian technology is well positioned to capture a major slice of that growth.

The fledgling company was nurtured in the Photonics CRC with help from the Commonwealth Government's Technology Diffusion Program. Lauder and

Halgren pooled their ideas to develop a new product which addressed a key gap in the metropolitan communications network market.

Around the same time, the Australian Photonics CRC, through its commercial agent, Australian Photonics Pty Ltd, established incubator company Redfern Photonics Pty Ltd, which successfully raised over \$220M between 2000-02. Redfern Photonics, in turn, invested in subsidiaries including RBN, enabling it to further develop its product and break into global markets.

In the process, says Dr Lauder, RBN received strong support from local venture capitalists Macquarie Technology Fund and Allen & Buckeridge and found further capital for expansion from partners in the United States, leading to the launch of international company RBN Inc. in which Australians are majority shareholders.

"We had great support from Australian venture capitalists, but there just wasn't enough to fund the rapid expansion we were planning, so we looked for a US partner," Dr Lauder says.

The second challenge to be overcome was building market confidence in the ability of a small startup like RBN to service the exacting needs of major telecommunications suppliers - and the answer was found in partnership with major technology suppliers.

"Marconi is our largest partner so far, though we have four others and now cover all the main markets. The Marconi contract means we can give telecommunications carriers everything they need to get the most out of their existing networks," he says.

Despite its early success, RBN is upping the pace. New technologies are being readied for launch in the coming months, and returns from sales anticipated from the Marconi arrangement will be substantially ploughed back into R&D in Australia to stay ahead of the game, he says.

"By combining our optical network offerings with RBN's CWDM product, we're providing carriers with the ability to implement leading edge technology that overcomes most of the cost issues associated with the provisioning of a broadband network, reducing the cost of service delivery," says Martin Harriman, chief marketing officer, Marconi Corporation.

Australian Photonics CRC CEO Professor Mark Sceats says the success of RBN highlights the role of Co-operative Research Centres as business founders and incubators, capable of delivering 'born global' technology companies in Australia.

"This would have to number among the largest ICT export deals done by an Australian-owned company," he says.



"This one deal has the potential to pay for a very large slice of the taxpayer investment in the CRC program through new export income for Australia - and there are plenty of promising young spinoffs in the pipeline from ours and other CRCs," he says.

Prof. Sceats says the 5-year deal also highlights the value of embedding leading edge hardware and software together, to build commercially viable technology products that have a good market life.

The RBN technology addresses Australia's third national research priority, frontier technologies for building and transforming industry.

More information: 02 9209 4790

## **Real sound**

Researchers from the **Smart Internet Technology Cooperative Research Centre** (Smart Internet) have developed a technology to revolutionise the quality and reality of real-time voice communication in cyberspace – from networked games to teleconferencing.

Smart Network Program Researchers from the University of Wollongong have developed an audio communication system that enables players in crowded virtual spaces such as multiplayer games to experience group conversation as close to reality as possible. Bringing the equivalent of a 3D experience to sound with spatial accuracy and ambient plus real-time sound interaction, the Dense Immersive Communications Environment (DICE) project was developed with support from Smart Internet, Telstra Corporation, the University of Tasmania and the University of Wollongong.

The software will enable players to hear a spatially-accurate rendering of the voices of others in their virtual vicinity as they happen. The voices are adjusted based on orientation and distance from the listener, as well as their loudness (whispering versus shouting). This is expected to significantly enhance the player experience and create new opportunities to improve the game such as eavesdropping on the enemy (perhaps by planting bugs in their quarters).

The enhanced audio capability will be available to game players by downloading an applet and using a DICE-enabled game server.

"Anyone who has played one of the new generation of games will be familiar with the graphic richness and realistic renderings of everything from alien planets to downtown city environs," said Professor Farzad Safaei, Smart Networks Program Manager.

“While rapid increases in computational power has led to highly detailed and realistic graphics, *communication* between participants in these environments has so far lagged behind, often limited to a text-based ‘chat window’ or a single audio channel for everyone to share.

With DICE, the voices of others in one’s virtual vicinity are heard in perfect harmony with their visual representation (location, distance and spatial placement with respect to the listener). Each participant can hear a realistic and personalised mix of voices in their ‘hearing range’ and this mix is dynamically changed as people move within the virtual environment (and consequently in and out of each other’s hearing range).”

Live trials of Project DICE’s immersive audio communication took place at the Telstra Launceston Broadband e-Lab, involving local game players who are members of the Launceston Broadband Project.

Mr Satya Anupindi, General Manager Business Innovation and Development, Telstra Research Laboratories, said Project DICE was a significant example of how Telstra (a participant in the Smart Internet CRC) supports Australian R&D and fosters collaboration between academia and industry.

“For collaborations such as this, Telstra offers a real-market testing environment for cutting-edge broadband applications. We expect that Launceston participants will be among the first to trial this innovative audio offering,” Mr Anupindi said.

Preliminary research into immersive audio communication over a network started in 2002 when Professor Safaei and his team looked into ways to improve teleconferencing. As the idea evolved, the team researched ways to add natural voice communication to network games in a bid to enhance the players’ experience and to make playing the game a lot more fun.

The worldwide interactive entertainment industry is estimated at about \$AUS40 billion a year. The Australian computer game industry currently employs over 700 developers and exports more than \$AUS100 million worth of software annually.<sup>1</sup>

“Network games are challenging and fun as they are now. The enhanced audio capability we’ve developed will make them even more enjoyable and challenging as players can employ new strategies and tactics in the game with the help of voice and other audio components,” said Paul Boustead, DICE Project Leader.

Darrell Williamson, CEO of Smart Internet said the opportunities and applications for immersive audio communication will deliver great enhancements not only to network game players but possibly to other applications where a large number of users in a distributed environment are involved.

More information: 02 8374 5086

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<sup>1</sup> Victorian Government Game Plan: Game On

# Mining & Energy

## Sludge success

A world breakthrough in the science of thickening coupled with groundbreaking technology transfer has helped save \$295 million dollars along with billions of litres of precious water.

A fundamental advance in understanding of processes for separating fine particles from water is being captured by the minerals industry through a unique partnership between government, scientists and 27 companies, says the CEO of the **AJ Parker Cooperative Research Centre for Hydrometallurgy**, Mark Woffenden.

The research is revolutionizing one of the mineral industry's most unpredictable and erratic operations – the use of gravity thickeners, huge tanks used to concentrate mineral slurries for extraction or disposal in the alumina, gold, base metals and mineral sands industries.

The research has produced new insights into the behaviour of flocculants – the substances used to clump and separate particles from water.

“These flocculants are long molecular chains like spaghetti that attract fine particles of sediment. If you disperse and stir them in the right way they take up the particles very efficiently - but if you stir too vigorously, they snap and the effect is lost,” explains project leader Dr John Farrow.

The breakthrough lay in combining a better understanding of the basic chemistry of flocculants with computational fluid dynamics, supercomputer modelling of the turbulence which takes place as the thickener tanks are stirred.

The resulting model enables mineral companies to design an optimum process for concentrating suspended particles, saving as much water as possible and improving throughput.

But the collaborative framework which turned fundamental science into a major payoff for Australian industry and the environment has also played a crucial role, says the Parker Centre's Mark Woffenden.

The pure research took place in the Parker Centre – funded jointly by government and industry and involving leading scientists from across Australia. Pre-competitive research was carried out through the Australian Minerals Industry Research Association (AMIRA) and involved 27 minerals companies, including several world leaders, and the Parker Centre. The project is now

moving into its third phase, fine-tuning the technology to suit the needs of individual companies and situations.

“This structure has enabled government, science and industry to leverage their investment in the technology many times, achieving outcomes that have not been achievable anywhere else in the world.

“At the same time it is also ensuring far more effective and widespread uptake of new technology by industry,” Mr Woffenden says. “This was achieved through built-in technology transfer mechanisms, by the companies having a strong interest in the outcomes, and by internal ‘champions’ working in each company.

“We recognised at the outset that effective technology transfer needs to be continuous, from the earliest planning stages throughout the project - not just left to the end with the hand-over of a technical report. The success of this project lies in constant engagement with the companies and their technical experts, and the demonstrated solution of specific on-site challenges.”

Thus, an R&D project costing \$10 million has generated an estimated \$295 million (net present value) in current benefits and is expected to yield a further \$250 million in efficiencies flowing from wider use of current technologies, according to an independent industry-based study compiled by Strategic Technology Evaluation and Management (STEM).

Individual companies have saved million of dollars by not having to build new thickeners, as they have been able to greatly improve the performance of existing plant, says Dr Farrow.

“And if you concentrate a mineral slurry from 55 per cent sediment up to 60 per cent, you save billions of litres of water, which is an important gain for the environment.”

Dr Farrow says the new technology is applicable across a wide range of mineral processing industries, but has enormous potential for making sewage treatment and water purification plants more efficient and could also be applied in industries such as pulp and paper making.

The development addresses National Research Priorities one and three – a sustainable Australia and frontier technologies for transforming industry.

More information: 08 9360 6361

## Gold finder

Australian scientists have developed a powerful new technique for uncovering hidden gold deposits.

The world-first technology developed by **the Co-operative Research Centre for Predictive Mineral Discovery (pmd\* CRC)** enables mineral explorers to predict where buried gold deposits are most likely to occur – even when there isn't a trace detectable at the surface.

At the heart of the team's advance are 3D computer visualisation and modelling tools that relate deformation in the rock to the flow of mineral fluids containing gold. This involves modelling the shapes and distortions of buried structures such as basalt 'domes' and then using the model to predict where fluids are most likely to flow and pond to produce the buried gold lodes.

The technique has the potential to have a major and fundamental impact on gold exploration in difficult regions of Australia that are buried beneath a sandy shroud and also deeper within the earth's surface. This will open up new opportunities for exploration in Australia, says **pmd\* CRC** Chief Executive Dr Bob Haydon.

"Over the past 150 years we've found just about all the 'easy gold' that is detectable at the surface. In modern times, explorers have been unable to explore effectively under this blanket of cover because of their inability to 'lift the blanket'. Just how do you find a gold deposit that leaves no surface trace of its existence, and is buried under hundreds of metres of soil, sand and silt?"

Dr Haydon says that recent new gold discoveries in Victoria's "Golden Triangle" have established the credentials of a technique which has been dreamed of by mineral explorers for decades – predictive mineral discovery, the ability to foretell where rich deposits are most likely to occur using scientific models.

"It also opens the way for large savings in exploration by reducing the number of drill-holes needed to find gold mineralisation. This offers the Australian gold industry an important technical edge in a hotly competitive world gold market.

"In an industry where money - and lots of it - is literally poured into the ground in the quest for new mineral deposits, explorers need a way to remove the uncertainty from where to drill. There is no crystal ball - just smart science from the Predictive Mineral Discovery CRC."

Working with partners MPI Mines in Victoria's Goldfields, CRC researchers used detailed drilling and geophysical information from the well-understood orebody at the Stawell Gold Mine to construct an accurate 3-dimensional model of its subterranean basalt dome.

The team then ran numerical simulations of fluid flow and deformation to determine where areas of high fluid flow and high shear-strain in the rock coincided. Drilling then found these areas contain high grade gold deposits.

“This was a resounding confirmation of our theory that the gold was concentrated by the interaction of these two factors,” says Dr Haydon.

Impressed at this initial success, MPI Mines then used the predictive model in their regional exploration program to help define drilling targets in already identified prospect areas.

The company began diamond drilling of targets identified using CRC technology – and have already discovered significant gold mineralisation.

MPI Mines Managing Director, Brian Phillips, announced in a recent briefing to the Australian Stock Exchange: “We are very encouraged by the results from the program so far. The Stawell Corridor has only been lightly drilled but the first two targets we defined have potential gold systems similar to the Stawell orebodies”.

Dr Haydon explains “One of the two new gold zones discovered, the Wildwood Prospect, had been explored previously using a systematic, but unfocused, near-surface drilling pattern – with limited success. Without our new predictive tools, this new discovery may not have been made at all, as the company would have probably wound back its exploration of the area, as have previous explorers, because of the lack of success.”

“The minerals and energy sector is Australia’s largest export earner, expected to bring in around \$58 billion in 2004-05. Exploration is a key link in the metals supply chain. Unless our resources are continually replenished through successful exploration and discovery, the wealth generated for Australia by the mining sector will decline in the longer term.

“This project is clearly an example of the development of frontier technologies that have the capacity to transform and build Australian industry and as such aligns perfectly with one of Australia’s national research priorities.”

The techniques and tools developed in this project are being transferred to the Australian mineral exploration industry to assist explorers prioritise and focus their exploration activities.

More information: 03 8344 6514

## **Greener coal**

Australian scientists have developed a new way to slash greenhouse emissions from brown coal, smoothing the path for the use of a resource capable of powering southern Australia's industries and homes for centuries to come.

The **Cooperative Research Centre for Clean Power from Lignite** (CRC CPL) reports the successful trial of a revolutionary process for drying brown coal which can reduce greenhouse emissions from power generation by a third or more.

The CRC's Mechanical Thermal Expression (MTE) technology removes more than 70 per cent of the water from the brown coals found Victoria and South Australia, resulting in huge greenhouse savings when the dry coal is burnt in a power station.

Brown coal – or lignite – may contain up to two thirds water, producing low energy efficiency, high CO<sub>2</sub> emissions and high capital costs in power generation. Offsetting this, reserves are plentiful and estimated to last another 500 years.

MTE dries the coal by a process of mild heating and squeezing, reducing it to a state far more suitable as a feed for efficient power generation.

“Using our technology to dry coal for a new “state of the art” power station, greenhouse gas emissions can be reduced by more than 30 per cent compared to today's power stations,” says CRC CPL Chief Executive, Dr Peter Jackson.

“Even bigger reductions - over 40 per cent - will be achieved if the dry coal is fed to the next generation of integrated coal gasification combined cycle (IGCC) plants.”

Drying brown coal in this way has the potential to far exceed the greenhouse gas savings from the Federal Government's Mandated Renewable Energy Target Scheme (MRET), saving 9 million tonnes of CO<sub>2</sub> a year if applied to remove half of the lignite water in existing power stations, against the MRET target of 6.5 million tonnes, he adds.

Dr Jackson says that while renewables and natural gas will play an increasing role in the national energy mix, brown coal will need to shoulder much of the energy load, especially as Bass Strait gas production declines and modern coal-fired power stations come on line over the next 8-10 years.

CRC researchers initially demonstrated the Mechanical Thermal Expression process on a laboratory scale plant at Monash University, and subsequently successfully scaled up the process to 1 tonne per hour pilot scale.

In 2004 they worked on a design for a continuous-feed pilot plant capable of drying 15 tonnes of coal per hour, as a test-bed for industrial application of the technology and as a forerunner to a commercial scale demonstration plant.

The research has also identified potential uses for the large amounts of water removed from the coal by the MTE process. The MTE product water could readily replace some of the lower quality water requirements in a power station - such as cooling water make-up and ash pond water - thus reducing the consumption of fresh water.

The CRC plans to extend trials to include overseas lignites and low-rank coals, with a view to developing export markets for its patented MTE technology.

The research addresses two of Australia's four National Research Priorities – An Environmentally Sustainable Australia and Frontier Technologies for Transforming Industry.

More information: 03 8542 0800

## **Growing nuggets**

Gold nuggets may grow underground 'like potatoes', according to a dramatic scientific discovery by researchers in Australia's **Co-operative Research Centre for Landscape Environments and Mineral Exploration (CRC LEME)**.

The prized pieces of bullion have long puzzled prospectors and geologists because they show up in places where there is no obvious local gold concentration from which a large piece of pure metal could have come.

An investigation by CRC LEME doctoral researcher Frank Reith has yielded evidence that the formation of gold nuggets may be the product of generations of soil microbes hard at work. This could lead to significant enhancements in gold discovery and exploitation in Australia.

Mr Reith was studying some microscopic "bubbly" formations on the surface of naturally-occurring flakes of alluvial gold, thought by researchers to be microfossils - the eons-old remnants of bacteria.

"I found some areas on gold flakes that were covered with apparent biofilms - traces of bacterial action. I stained for DNA, and got a positive result, which was suggestive, although this could have come from recent organisms," he explains.



But the test came when Frank tried to grow his own gold nuggets in the lab, and showed that certain tiny soil organisms - both fungi and bacteria - readily deposit gold, building it up in layers "like a miniature coral reef". They did this within a matter of days, piling up the gold atom by atom.

Researchers have long known certain microbes can dissolve gold out of rock. Mr Reith's work indicates they can also transport and precipitate it, or lay it down in a steadily-growing lump, which expands over a long period of time from a tiny flake to a prospector's delight.

The Chief Executive of CRC LEME, Dr Dennis Gee, says Mr Reith's work opens up a new way of thinking about Australian and other landscapes, and may lead to better ways to both find and extract gold and other minerals.

"The gold originated a few billion years ago, several kilometres down in the earth's crust. Over time erosion brought it to the surface and weathering distributed it across the landscape.

"Traditionally we tend to think of gold as a noble element, an inert metal that is mobilised mainly by chemical action. This research opens up the possibility that living organisms are involved in the whole process of mobilising, transporting and re-concentrating alluvial and elluvial (up-slope) gold."

The discovery of signs of bacterial action on gold flakes was made on material from the Tomakin Park gold mine in southeast NSW, and Palmer River in North Queensland but Dr Gee considers that a similar process may apply to all the main alluvial goldfields in Victoria, at Bathurst in NSW, in the Northern Territory and possibly at Coolgardie in WA.

"At Fly Flat, Coolgardie, the early prospectors saw gold nuggets lying on the surface, sparkling in the sun.

"We think these nuggets were formed metres down in the soil by microbial action, and were then gradually exposed by wind erosion and deflation (shrinking) of the surface sediments.

"Possibly these secondary nuggets grew like potatoes in the soil - although it may take millions of years to form a really large one."

"Frank has managed to reconstruct this biological process in the laboratory - making it a very strong probability that this is one gold nuggets may be formed."

The discovery could have significant commercial implications for gold discovery and exploitation in Australia.

Dr Gee says that the new information may help guide gold exploration in future - by geologists searching for traces of the right microbes in soil.

Mr Reith considers it could also be used to develop an economic and environmentally-friendly biological method for gold extraction and concentration.

Dr Gee adds it could also help improve the "biox" process used to extract gold from the 'refractory' (hard to dissolve) ores, which make up a third of Australia's gold reserves, including some that cannot be economically exploited with present technology.

In this way, the research addresses two of four Australia's National Research priorities - frontier technologies for industry and sustainability.

The discovery also illustrates how much we still have to learn about what lives in the continent of Australia - more than 99 per cent of our soil microbes remain undescribed by science, Dr Gee says.

More information: 08 6436 8786

## **Robot mines**

Australian scientists have taken a critical step towards automation of underground coal mining for efficiency and safety, with the development of a tool to detect, log and identify production stoppages.

As part of the CSIRO/CRCMining Landmark Project on Longwall Automation, researchers at the **CRCMining** have developed a computer system for on-line analysis of trend monitoring data to detect and locate coalface equipment faults.

Without effective fault detection, the dream of fully automating longwall coal mining operations and removing miners from the riskiest places will not be achievable, says the Centre's Prof Hal Gurgenci.

"The key to automation is reliability. From the information we are gathering we are creating models that not only log what goes on - tremendously valuable for the industry - but should soon be able to predict faults and breakdowns before they occur."

"As underground coal mining costs amount to several billion dollars annually, the ability to reduce delays and downtime could save the industry tens of millions of dollars."

With up to 10,000 variables to be constantly monitored at the coalface the task is a huge one, requiring broadband communication and the latest in complex systems analysis, Prof Gurgenci says.

One outcome of the project is already available for application in the mine. This is automatic processing of data to generate daily or weekly reports on:

- uptime/downtime
- average production delay
- a log of stoppages in each shift and their durations.

"We demonstrated that the particular data-driven techniques adopted in this project enable us to correctly detect and isolate over 90% of the target faults with misclassification rates lower than 20%," he says.

In Australian longwall mines, machine downtime due to planned and breakdown maintenance accounts for over 35 per cent of the total mine hours. With underground mining contributing one third of the coal industry's \$12 billion export revenue, reducing stoppages has major implications not only for industry profitability but also for the economy.

The work is being carried out in two major underground mines in Queensland's Bowen Basin, where equipment-related delays account for over 50% of all lost production time.

Prof Gurgenci says the next step in the research is the development of ways to predict the loads and stresses that lead to breakdowns in key longwall machinery - the shearer, the armoured face conveyor and roof support, in particular, which between them account for a quarter of all downtime.

Besides helping to improve productivity in existing mines, the work is aimed at even greater efficiencies in future, Prof Gurgenci says. "The typical longwall is 250 metres in length but there's already talk of going to 400 metres. This means we need a much clearer understanding of the load factors if we are to design machines that can reliably withstand them."

He adds that the logging of reliable data on faults will in itself yield significant short-term dividends for the coal industry, enabling engineers to target the most troublesome areas and equipment.

In the next phase this will then lead to more accurate fault prediction and avoidance.

"All this contributes to the ultimate goal of automating the process of longwall mining, through a combination of robotics and remote control and using advanced geophysics to predict exactly where the coal seam is."

The Australian Coal Association Research Program (ACARP) has designated automation of longwall mining as one of the industry's key strategic challenges. The CRCMining and CSIRO are partners in the ACARP Landmark Project on Longwall Automation.

"The benefit for the industry will be a potentially higher, more consistent production rate and the removal of face workers from more hazardous and dusty areas, Prof Gurgenci explains.

The CSIRO/CRC Landmark project has been running for two years and achieved several important milestones:

- On-line 3D shearer position information is now routinely available.
- Wireless Ethernet has been shown to be a viable, robust coal face communications system
- EtherNet/IP has been adopted as the standard for communications.
- Condition monitoring analysis suggests the feasibility of implementing an on-line trend and condition monitoring system.
- Major longwall mining companies are actively supporting the project and are partnering technical developments
- The benefits of other-industry technology such as INS, thermal imaging, processor control, data communications are being transferred successfully to longwall automation.

"Although the task remains complex, the risks are relatively low as many of these technologies have been proven in other areas," Prof Gurgenci says.

"The focus on productivity and designing the system for coping with exceptional issues will also ensure a lower risk and provide an incentive for progressive uptake of automation technology in Australia's coal mines - making them among the world's first to do this."

The research addresses National Research Priority three - frontier technologies to transform industry.

More information: 07 3365 5641

## **Mercury debunk**

A study by Australia's energy CRC the **Cooperative Research Centre for Coal in Sustainable Development** (CCSD) has found that an international report depicting Australia as the world's worst emitter of the toxic heavy metal mercury got it wrong.

A recent global anthropogenic (man-made) mercury emission inventory claimed that Australia emitted more than 105.5 tonnes of mercury per year making it the world's largest mercury emitter on a per capita basis.

The inventory covered emissions to the atmosphere from all sources – power generation, transport, domestic and bushfires.

However a new study by the CCSD, shows these international estimates of Australian mercury (Hg) emissions may have been in error by a factor of almost ten times.

The CCSD report shows that the much larger emission estimated in previous studies was caused by the use of inappropriate mercury emission factors, particularly those used for the combustion of Australian coals to generate power.

Author of the CCSD report, Professor Peter Nelson, from the Graduate School of the Environment at Macquarie University says "The origin of the error lies mainly in the fact that the international estimates were based on burning northern hemisphere coals. Australian coals are different, and in general have lower levels of mercury."

The CCSD study also shows that mercury emission inventories are subject to significant uncertainties.

CCSD estimates that the correct total for annual Australian anthropogenic mercury emissions is about 10 tonnes – less than one tenth the international estimate.

"This estimate of 10 tonnes might be increased by a further 2.6 tonnes if mercury emissions from the combustion of vegetation during bushfire hazard reduction, bush regeneration and agricultural land clearing were included," Prof. Nelson adds.

Mercury emissions from natural sources (including re-emission) were estimated to be in the range of 130-270 tonnes per annum, with the lower value being more likely.

"Our report demonstrates that Australia is not the world's largest per capita emitter of mercury," Professor Nelson says.

More information: 07 3871 4400

## Salinity search

Scientists have developed new ways to stalk the 'White Death', the deadly salt that spreads unseen beneath the surface over vast expanses of Australia.

The thudding rotors of helicopters are ushering in a new phase in the war on salt, deploying the sophisticated detection techniques used in oil and mineral exploration to the task of combatting the nation's gravest environmental menace.

Researchers in the **Co-operative Research Centre for Landscape Environments and Mineral Exploration (LEME)**, in a multi-agency project with South Australia's Department of Land, Water and Biodiversity, CSIRO and the Bureau of Rural Sciences, are using airborne sensors to build a fuller picture what is taking place beneath the surface – and especially, whether surface water is likely to leak into lower layers and release salt.

Their battleground is South Australia's Riverland, currently the source of 30 per cent of the vast tonnage of salt that drains into the Murray River each year posing, potentially, a major threat to Adelaide's drinking water by 2050.

And their target is an elusive buried layer, the Blanchetown clay, that decrees how much of the water used by farmers at the surface can leak into the saline aquifers below, augmenting to their salty discharge to the river.

"It's about obtaining a much better understanding of Australia's buried landscapes—particularly the top 50 metres of the 'regolith', the sand, clay and weathered rubble that blankets most of the continent," Dr Ken Lawrie, CRC LEME's Salinity Mapping Program Leader, explains. "Without this insight you can't be sure you really understand what's happening at the surface."

Because it has taken millions of years to accumulate, Australia's regolith is even more complex and confused than that of other continents. The pathways of salt through this hidden and labyrinthine world are obscure and hard to predict. Get it right, and we may be able to better target the areas where salinity will reach the surface and prevent so much entering our rivers.

Now the choppers are deploying to help gather the intelligence to head off a looming crisis – an increase of 500 tonnes of salt a day draining out of the SA Riverland as a consequence of the irrigation that supports an \$800m horticultural industry and entire communities such as Berri, Loxton, Waikerie and Renmark.

“The Blanchetown clay acts like a pool liner under the irrigation areas,” Dr Lawrie explains. “Using airborne electromagnetics we are building up a picture of the depth of this clay layer which can be used to guide decisions about land and water use on the surface above.

“In areas where the clay is thin or nonexistent, irrigation water drains rapidly into the deeper salty aquifers, increasing their flow to the river. Where the clay is thick, it retards or prevents this from happening and it is more suitable for irrigation.

“It’s about having a better understanding of what’s really going on beneath our feet.”

Dr Lawrie says the helicopter geophysical data is assisting the region’s anti-salinity strategy by helping to create much better regional planning tools to:

- predict ground water recharge rates up to 100 years into the future.
- model the impact of human activities on the river floodplain on salt loads entering the Murray - and so predict the impact of future irrigation development.

It is contributing to the South Australian Salinity Mapping and Management Support Project and is part of the National Action Plan for Salinity and Water Quality.

“There have been some vigorous debates in the earth sciences community about the contribution of airborne geophysics to the war on salinity, but we think the Riverland project has demonstrated it has a real role to play in helping us understand where sustainable development can and cannot take place.”

The CRC LEME salinity project addresses the first National Research Priority, and environmentally sustainable Australia.

More information: 08 6436 8786

## **Carbon capture**

The skills of Australian geoscience researchers are being sought worldwide for major carbon dioxide (CO<sub>2</sub>) capture and geological storage (geosequestration) projects.

The **Cooperative Research Centre for Greenhouse Gas Technologies** (CO2CRC) is working on a number of international projects in addition to conducting research into CO<sub>2</sub> geosequestration in Australia.

CO2CRC international activities include:

- the joint Australia-US Frio Project in Texas, which aims to explore the storage of CO<sub>2</sub> in an underground saline aquifer;
- capture and storage research with the University of Regina and the Petroleum Technology Research Centre in Canada;
- a study of the carbon storage potential of a number of Asian countries for the Asia-Pacific Economic Council; and
- the production of a major report for the Intergovernmental Panel on Climate Change (IPCC) on carbon capture and storage.

The CO2CRC is headed by Dr Peter Cook, a geologist who first began working on CO<sub>2</sub> geosequestration during the time that he was Director of the British Geological Survey in the early 1990s.

“We are looking at expanding our international efforts further in the Asia-Pacific region and Europe,” Dr Cook said.

Dr Cook and CO2CRC researchers have a major role in the next major greenhouse report from the IPCC. As Coordinating Lead Author on the CO<sub>2</sub> geosequestration chapter, Dr Cook is helping lay the technical assessments that will be so important to the next round of global negotiations and responses in the post-Kyoto period.

Australia’s research efforts have also been recognised by the global Carbon Sequestration Leadership Forum in September where the Minister for Industry, Tourism and Resources, Ian Macfarlane, launched Australia’s roadmap to the hydrogen economy.

The major Australian project for Dr Cook and his team of 70 researchers is the development of a pilot research project that is scheduled to begin next year in one of the four basins identified as being suitable for CO<sub>2</sub> geosequestration.

“Our research has shown that Australia has the potential capacity to store CO<sub>2</sub> for many hundreds of years.

“In order to start to assess that capacity and to test the carbon capture, storage and monitoring technologies, we are planning for a pilot research project, which will be one of only four such projects in the world.



“While the capture, storage and monitoring technology is being used successfully in Europe and North America, it is important that we find out, through the pilot research project, how the technology works in Australia.

“The national and international perceptions are that through projects such as the pilot research project, Australia is contributing significantly to global carbon capture and storage research,” Dr Cook said.

More information: 02 6200 3362

## Energy drill

A revolutionary Australian mining technology capable of tapping vast new energy resources, saving lives and slashing greenhouse emissions is entering the global market.

In 2004, the **Co-operative Research Centre for Mining** signed a licensing agreement with the world’s largest diversified resources company, BHP Billiton, to further develop and commercialise its novel water-based tight-radius drilling (TRD) technology, initially in Australia and New Zealand.

“TRD enables us to tap centuries’ supply of natural gas reserves currently locked away in unmineable coal beds,” says CRCMining chief executive Professor Mike Hood.

“It’s also the perfect way to drain the gas from mineable coal seams, and so prevent explosions. This makes them much safer to mine.

“And, in a third possibility which we’re very excited about, it may also help combat global warming by enabling CO<sub>2</sub> to be injected into unmineable coal seams, where it will be locked away.”

The TRD technology consists of a 65mm high-pressure water-powered drilling bit that rotates like a fierce garden sprinkler, connected to a 25mm high-pressure hose. This bores its way through the coal, driven forward by jets, and carrying an on-board navigation package, so the driller can steer it from the surface.

The most remarkable feature of TRD is that, being connected to a flexible hose instead of a steel drill-pipe, it can swivel sideways and drill at 90 degrees to the line of the main well, needing little space to perform this feat. Using water energy instead of a steel bit, it also drills a more permeable hole, enabling more gas to be extracted than from normal drilling. Prof. Hood says that drilling using TRD allows the methane gas to effectively be harvested from an area 400 metres in diameter.

The drill whipstock passes down a narrow vertical shaft till it reaches the target coal seam. The water-powered drilling head then emerges from the whipstock at right angles to the vertical well and begins to bore a series of holes into the seam, which allow the methane to drain out.

“Using this, you drill a fan of holes into unmineable coal seams to extract the natural gas, which can then be harvested and use to generate clean electricity,” Professor Hood says.

The burning of natural gas in power stations would lower greenhouse emissions on its own, but as technology to capture the resulting CO<sub>2</sub> becomes cheaper, the carbon can be re-injected down the hole and stored back in the coal seam, he explains.

“Normally when you drill a coal seam, you only get out about half of the gas that’s there. If you re-inject the CO<sub>2</sub> under high pressure it drives out the rest of the gas, enabling you to access far more energy and reduce greenhouse impact still further.”

Prof. Hood speculates that by drilling what is known as a ‘five spot’ – a series of wells distributed like the spots on the 5-side of a dice and by pumping CO<sub>2</sub> down the four outer holes, the residual gas will be driven up the centre well.

In addition to around 200 years’ supply of mineable coal, Australia has vast energy resources in unmineable seams, Professor Hood says. TRD offers a practical and economic way to tap some of this energy without having to mine them – and take another step towards the industry holy grail of “zero emissions” with 15 years.

Prof Hood says the TRD technology has been tested over a number of years at the Moura and Grasstree mines in Queensland, and will be further trialled in BHP Billiton’s reserves near Wollongong, NSW, to develop the commercial system.

“There has been strong interest in the technology from both the US and China, and I think it will really take off in a very big way overseas once the trials are complete,” Prof. Hood predicts.

“The technology addresses three of Australia’s national research priorities – frontier technologies to transform industry, environmental sustainability and health. You could say it also enhances our security, by opening up access to another major energy resource to power our future.”

More information: 07 3365 5640

# Agriculture & Rural-based Manufacturing

## Beef breakthrough

Australia has taken a lead in the world race to turn grass – or feed – into succulent, mouthwatering steak.

Three scientific breakthroughs in the **CRC for Cattle & Beef Quality** have combined to give the nation's \$10 billion beef cattle industry a world lead in breeding animals that convert feed to meat with superior efficiency.

The result will be a cattle herd that is gentler to the environment, more competitive on world markets, more profitable - and which produces more lean beef to satisfy Australian consumers.

The latest development – a simple, low-cost blood test which enables cattle producers to identify the bulls to use to produce the most efficient converters of feed-to-beef, puts clear daylight between Australia and its international rivals, says Beef CRC CEO Prof. Bernie Bindon.

“No other beef industry in the world has made this sort of progress in identifying what causes variation in feed efficiency.”

But the breakthroughs have not come easy. Scientists first identified the challenge to spot the most efficient animals back in the 1950s, and serious research began in 1991. It then entailed a huge experiment, involving 12,000 cattle from 7 breeds across the continent, to identify the tell-tale traits that signal an animal is a superior feed converter.

The three breakthroughs were:

- Australian researchers were first to understand the genetic basis for why cattle vary so much in feed efficiency
- Australia was first to establish breeding values for bulls on the basis of feed efficiency, and to develop an efficient way to test feed intake for weight gained in individual animals
- We were first with a low-cost test that helps cattle producers rank bulls according to the ability of their progeny to turn feed to meat.

The test has been patented and commercialized by Adelaide-based firm Primegro Ltd., ensuring it is available throughout Australia before other cattle producers round the world can get access to it, Prof. Bindon says.

“They’ll have to do a lot of homework to make it work in their environment – and this gives the Australian cattle industry a head start with the technology. It’s up to us to make sure we take full advantage,” he says.

Conservatively, the Beef CRC puts the benefits of this test to the economy industry at about \$200 million a year by 2020, a benefit averaging \$13 per cow in herds which use the test. There are also potential gains for the environment - as more beef can be produced without increasing the area of farm land and there will be a reduction in the greenhouse gas (methane) output from cattle.

The new test will help breed breeders identify the most productive animals to breed from. “70 per cent of the costs in a beef enterprise go down the neck of the breeding cow,” the CRC’s Dr Robert Herd explains. “Anything that can reduce those costs, or increase the amount of beef produced, is a plus.”

The test will also be a boon to Australia’s burgeoning \$4 billion feedlot industry, which has a strong interest in turning the millions of tonnes of feed it buys into more beef for the high-quality, high-value Japan trade. It will enable feedlotters to source those animals which are the best converters.

Dr Herd says the test works because of a correlation between a substance in the blood – insulin-like growth factor, or IGF-I – and feed efficiency. “It’s not a perfect correlation, but the research consistently shows that bulls with low IGF-I are likely to father good converters.”

In the lab, the CRC’s scientists are closing in on another, major, breakthrough – the world’s first genetic markers for feed efficiency. These will revolutionise the business of selecting the most efficient animals, he predicts.

Dr Herd says that the new feed conversion evaluation techniques serve three of Australia’s national research priorities – industry transformation, environmental sustainability and good health.

More information: 02 6773 3501

### **Self-managing sheep**

Sheep that muster, weigh, draft, medicate and manage themselves without human intervention sound like a pastoralist’s dream.

But they will soon be a reality in Australia, thanks to a technology breakthrough from the **Australian Sheep Industry Co-operative Research Centre**.

Researchers in the Sheep CRC are developing a system know as RIAM (remote individual animal management), in which sheep are automatically logged,

weighed and checked for certain health conditions as they come to water or move from one paddock to another.

Offering, potentially, the biggest boost to sheep industry productivity since the shepherds deserted *en masse* in the 1850s gold rush, RIAM opens the way for sheep to be individually monitored and managed by remote control, says Sheep CRC chief executive officer, Professor James Rowe.

The first part of the RIAM technology is already under trial on properties and research stations in Queensland and NSW. Sheep equipped with an electronic tag are automatically logged and weighed as they pass through a race on their way to feed or drink. The trailer-mounted system is completely self-contained, runs on solar powered 12-volt batteries, and has been designed to operate from remote locations.

Development is under way of the second phase of RIAM, adding automatic gates to the walk-through scales, so animals that are underweight and need extra feeding can be separated from those doing well.

This will enable the grazier to fine-tune the nutrition of individual animals, without having to go out in the paddock to do it.

In its third phase the technology will add sensors that can detect flystrike or heavy worm infestation, and separate out those animals requiring special treatment – in effect, self-medicating sheep. This will not only help in selecting for healthier sheep, but also curb the use of chemicals, delaying the buildup of parasite resistance.

The RIAM technology is being developed by a scientific consortium which includes CSIRO, the University of New England, the State agriculture departments of NSW, Queensland and WA and the Australian Meat Processor Corporation.

“The technology sounds simple enough in concept, but there are formidable technical problems to be solved to ensure it works reliably, and is well adapted to conditions on the farm. That calls for a national scientific effort – and that’s where the Sheep CRC approach pays dividends,” Prof. Rowe says.

“Just as dairy farmers, for generations, have had the ability to monitor the performance of individual animals in the bail, this will give the extensive sheep producer the ability to vary the feed and treatments which different animals in the flock receive, leading to overall gains in productivity and a more even product.”

The automatic weigher will, for the first time, give producers the ability to study the results of feeding strategies on individual animals as well as the whole flock.

The addition of sensors to detect fly strike or heavy worm burdens will also allow afflicted sheep to be separated and treated, without wasting treatment on the

healthy ones. This should lead to a significant reduction in drenching and jetting and the use of chemicals.

Because sheep will “self-muster” without pressure from humans or dogs, researchers expect that stress levels will also be lower, leading to better growth rates and improved flock health.

Information collected on individual sheep by the logger, scales and sensors will be reported directly to the property’s computer by wireless link.

Remote sensors will also monitor water troughs; gates may open and feed supplements be automatically dispensed.

The automatic race technology also offers cost savings. Based on NSW Department of Primary Industry estimates, a basic unit costing \$15,000 would pay for itself in saved mustering and water checking in less than a year on a typical pastoral grazing property.

Sheep producer Cam Banks, “Lakeview”, Uralla, NSW has been involved in the initial farm trials of RIAM: “I see this as a tremendous breakthrough. It gives us, as farmers, the ability to measure what’s happening on a regular basis without the stresses of going through yards. And it saves on labour costs and time.”

The research addresses National Research Priority 3, frontier technologies for transforming industry.

More information: 02 6776 1465

### **More rice, less water**

A new Australian method for selecting low water-use soils for rice production is increasingly being adopted by rice farmers.

Australia is already one of the world's most water-efficient rice producers in the world, says Mr Geoff Beecher of the **Cooperative Research Centre for Sustainable Rice Production** (CRC SRP). The new technique takes us one better.

The approach uses electromagnetic induction to create a picture of the soil to a depth of five metres or more allowing targeted soil sampling that is combined with evaluation of soil chemical properties particularly soil sodicity. Soil sodicity levels have been related to decreased soil permeability especially in clay soils. Electromagnetic induction surveys combined with soil sodicity assessment will minimise deep drainage to the groundwater system.

A Geonics EM-31 instrument is mounted on a 4WD motor cycle to carry out rapid field surveys to help pick the land likely to use the least water.

“Rice is a major export crop, worth over \$350 million in a good year,” says Mr Beecher, “but today’s rice farmer must meet stringent controls to keep the industry sustainable and to satisfy environmental standards.

“The main threat to all irrigated agriculture in southern Australia is salinisation due to rising water tables,” he says.

“Since the 1960s soil assessment of rice growing areas has been undertaken to identify where the soil doesn’t ‘leak’ – that is, where irrigation water cannot escape into groundwater and raise the water table. Until the introduction of the new electromagnetic techniques, soil sampling to establish where rice could be grown was relatively simple, says Mr Beecher.

“The rule of thumb related the depth of clay in the soil to the amount of ‘leakage’ through the soil into the groundwater,” says Mr Beecher. “Soil evaluation sites were selected on a grid basis, with one site per four hectares. There was also some attempt to use aerial photography to locate sites where the subsoil clay could be insufficient.

“But a multitude of chemical and physical factors can affect groundwater recharge, as well as local management practices,” says Mr Beecher. “The grid system gave a fair indication of soil characteristics on a regional basis, but was far from accurate.”

Mr Beecher says that electromagnetic induction surveys enables the farmer to make a rapid and comprehensive survey of land to select those areas most suitable for rice growing.

“The instrument senses variation in bulk electrical conductivity in the soil. The instrument responds to variations in salinity, clay content, moisture, and the bulk density of the soil. This electromagnetic surveying is then backed up by targeted soil sampling combined with evaluation of soil chemical properties.”

Mr Beecher foresees many possible uses for the soil electrical conductivity data collected during the electromagnetic surveying technique developed by the CRC.

“Electromagnetic induction surveying maps may have an important role to play in precision farming allowing zoned management of fields for more controlled use of fertilizers /soil amendment inputs (lime/gypsum), saving the farmer money, giving higher yields for every dollar spent and protecting the environment,” he says.

The technique may also be useful for locating suitable sites for dams and off-river water storage facilities.

Australia's rice crop grows on an average area of around 150,000 hectares. The industry's goal is a production standard of more than ten tonnes of grain per hectare.

Mr Beecher says that the industry also has a target of one tonne of rice per megalitre of water; the current figure is about 700 kilos/ML.

The new soil testing approach, which is now available to farmers through the CRC, will be a major step in achieving both goals - while at the same time helping to prevent salinity and provide water for the environment.

This research serves National Research Priorities One (an Environmentally Sustainable Australia) and Three (Frontier Technologies for Building and Transforming Australian Industries).

More information: 02 6951 2713

### **Tenderer meat**

A tender lamb chop or a juicy steak comes from an animal with a calm temperament, says animal researcher Kelly Drake.

Australian scientists are now applying “behavioural tests” to individual sheep and cattle to select those that are the easiest to manage and ultimately produce the best meat.

Ms Drake, of the **Cooperative Research Centre for Cattle and Beef Quality**, has been working with sheep at CSIRO's McMaster Laboratory in Armidale (NSW). And, contrary to popular belief, she says sheep do have individual personalities.

“The life of farmed animals can be quite stressful,” says Ms Drake. “But despite appearances not all sheep or cattle are the same, even in the same flock or herd. Some animals are able to cope with stress much better than others, and ultimately these are the ones which we should select.

“Animals which are content with their lot are less disease-prone, grow faster, and are less likely to injure themselves, others or their handlers,” she says.

According to Ms Drake, different breeds of domestic and farm animals have markedly different temperaments, but there are also significant differences within a breed. Ms Drake is studying what underpins individual differences in temperament with the view to improving our capacity to select animals that are better able to cope and adapt in their production environments.



Ms Drake says that a number of tests can be applied to determine an animal's temperament, or more specifically, the overall reactivity of the animal to a fearful challenge.

"Tests involve simulated escape and/or avoidance situations. For example, flight time is used in cattle to measure the speed in which an animal leaves the crush.

"The responses to these tests relates to an animal's temperament," she says.

"What we are looking for are the mechanisms that regulate differences in temperament between animals," she says. "We want to answer the question: why are some animals more or less fearful than others?"

Ms Drake says that she is conducting a suite of experiments in collaboration with the University of Western Australia using a Merino flock, which has been selected for both calm and nervous temperaments.

She is also tapping into the considerable amount of information from human and animal anxiety research.

"We know that there are specific neurological pathways which regulate traits such as fear and anxiety in both human and animal research models," says Ms Drake.

"Using pharmacological treatments, it's possible to increase or decrease the actions of neurotransmitters involved in these pathways. We can then quantify whether the animal's behavioural and physiological responses to a stressful challenge have been affected," she says.

Ms Drake says that she is particularly interested in utilising a 'psychological stress model' in these studies.

Ms Drake's work on sheep will provide a model for similar assessment of cattle and other farmed animals, where improved animal temperament can deliver a better outcome for both the animal itself, and for the farmer who is seeking an improved product from a better animal.

Ms Drake says that all her animal experiments are routinely and thoroughly vetted by the appropriate animal ethics committee.

"We're looking at the sorts of stresses created in animals by normal farming activities," she says. "The experimental situations that we use are similar to the situations that occur on a normal farm: being yarded, going through gates, isolation (as happens during shearing), and being moved by dogs or humans.

"The point is that different animals react differently to these routine events, and we're attempting to find out why."

This CRC research project supports Australia's National Research Priority Three – frontier technologies for transforming industry.

More information: 02 6773 3501

### **Beating rootrot**

Clean boots and hairy vetch are two weapons that cotton farmers can use in the fight against the pest black root rot, according to research by the **Australian Cotton Cooperative Research Centre**.

Black root rot (*Thielaviopsis basicola*) affects cotton crops across Australia, and can lead to a twenty to thirty per cent loss of yield, says plant pathologist Stephen Allen.

"There's no single easy solution to black root rot," says Dr Allen. "The CRC has devised a Best Management Practice manual to help farmers develop an integrated control program. One of the best remedies is quite simple: come clean, go clean."

Dr Allen says that in controlled tests farm vehicles, implements, and even farmers' boots have been implicated in spreading the fungus.

"When I first identified black root rot in Australian cotton in 1990, we had no idea where it was coming from – it could even have been a native strain of the fungus, which appears in various forms in cotton growing areas around the world," he says. "Now we have established that the particular strains that we are dealing with are unique to cotton, and are being spread from farm to farm."

"Unfortunately we are also dealing with pathogen-friendly farming systems," says Dr Allen. "Our transport infrastructure, movement of crop residues, and above all our irrigation networks make an ideal environment for the spread of the fungus through the cotton-growing districts."

Dr Allen says that delaying planting may have a good effect, but depends on favourable weather later in the season. Fungicides have little impact, and no fungus-resistant strains of cotton have so far been developed or discovered.

However Dr Allen says that two areas of research are showing promise, now that scientists from the Cotton CRC have definitely established that the fungus is being spread from farm to farm.

"We are developing a two-pronged strategy," he says. "We're getting very promising results from biofumigation, and the pathologists are testing treatments

which induce resistance – that is, chemicals which have no direct effect on the fungus, except to stimulate the cotton's own natural resistance to attack.”

Dr Allen says that biofumigation has many benefits; by planting a legume green manure crop such as hairy vetch, the farmer fumigates the soil as the vetch plants produce naturally toxic ammonia on breakdown. Vetch has the added benefit of being a nitrogen-fixing plant, so that when the field is cultivated and planted with cotton, it is both free of fungus infestation and is naturally rich in vital nitrogen.

“Biofumigation with vetch means less dependence on chemical fungicides – which so far have been ineffective anyway – and less dependence on expensive chemical fertilisers,” says Dr Allen.

According to Dr Allen, there is considerable interest from overseas in Australia's cotton growing strategies, especially in methods of combating black root rot.

“The cotton-growing industry is in some ways a model for Australian agriculture,” says Dr Allen, “in particular in the recognition that growers give to scientific research. Our researchers are welcomed and valued by growers, and we in turn rely on growers for help with many of our field studies.”

This research project supports Australia's National Research Priority No. 1, an Environmentally Sustainable Australia.

More information: 02 6799 1500

### **Model catchment**

Australia's mighty Murrumbidgee is showing the world how a river catchment can be managed for the best results for the community and the environment.

The Lower Murrumbidgee is the world's first and only 'global reference basin', selected in a competitive process from twenty-five other river basins around the world as part of UNESCO's HELP (Hydrology, Environment Life and Policy) program.

Hundreds of river catchment managements around the world are using the Australian river as a model as they attempt to become members of HELP.

“The HELP program is designed to establish a global network of catchments to improve the links between hydrology and the needs of society,” says Dr Shahbaz Khan of the **Cooperative Research Centre (CRC) for Sustainable Rice Production**, who is the Regional Co-ordinator of HELP.

"We need science to manage the water resource, but we also have to look at the economic, policy and legal aspects," says Dr Khan. "There are many regions of the world where this is done in bits and pieces, but in the Murrumbidgee the CRC and other agencies have managed to pull it all together.

"To become a 'global reference basin' you need to have a catchment of a considerable size with all those aspects of science and society working together," says Dr Khan.

The Lower Murrumbidgee includes nearly a thousand kilometres of river, from the Burrinjuck Dam near Wagga Wagga, to western NSW where the Lachlan River runs into the Redbank Weir near Balranald.

Dr Khan was responsible for putting the case for the Murrumbidgee as the first global reference basin.

"This success recognises the involvement of the Murrumbidgee community in hydrological and environmental research, and the development of integrated catchment management policies," says Dr Khan.

"Policy makers, hydrologists and scientists from around the world are coming to Australia to learn from the local experience," says Dr Khan.

"The modelling tools and participatory hydrologic research methods which we are using in the Murrumbidgee catchment are now also being applied on the Yangste and Yellow Rivers in China and the Indus Basin in Pakistan," says Dr Khan. "There's also strong interest from southern Africa, especially from the Olifants catchment which extends through South Africa and Mozambique."

He says that a suite of computer models developed by CSIRO for natural resource management under the title SWAGMAN (Salt, Water and Groundwater Management) are particularly adaptable to catchment conditions in other parts of the world.

Dr Khan says for the next ten-year phase, more than a hundred catchments around the world have been invited to become part of the HELP scheme, and asked to use the Murrumbidgee as a model in drafting their submissions, describing their own level of integrated catchment management.

A HELP management panel, including Dr Khan, will be meeting in Bonn in April to assess the results of these submissions, identifying strengths and weakness, and planning the most useful international linkages between them.

Dr Khan stresses that the HELP program aims to achieve a multidisciplinary approach to water management by breaking paradigm locks between

hydrologists, policy makers and water managers through examples such as the Murrumbidgee.

“Even though the hydrology research done by CSIRO with the Rice CRC Sustainability program in the Murrumbidgee has been selected as a global reference basin, this does not mean that it is the only model,” says Dr Khan.

“It is not a one-way traffic of knowledge,” he says. “There is a lot of knowledge in catchments in Pakistan, India, China or the Philippines which is coming back to catchments in Australia. For example, even though the Indus or Yellow river catchments are similar arid catchments to the Murray-Darling Basin, the ‘drivers’ which determine water use in the community may be different, leading to different outcomes.

“This may be in the form of examples where population pressures cause increased water usage, and the consequences of this; or it may be the result of the need to share water resources with different groups or even nations, and how such conflicts are resolved,” he says.

Dr Khan says that the HELP program is able to break down communication barriers.

“We all speak different languages, and even within the same language, there are groups which don’t understand one another,” he says. “Policy makers often use a totally different language to scientists, for example. We’re able to cut through these language barriers.

“And our science is driven by the stakeholders,” he says. “There’s no point in doing good science and publishing many papers, if nobody uses it.

“Within the HELP framework we know that the science we are doing is world-class, and that it will be put to good use by the people in the catchments,” he says. “We are also helping to achieve Australia’s National Research Priority No.1: an Environmentally Sustainable Australia.”

HELP is an open-ended joint project of the United Nations Educational Scientific and Cultural Organization and the World Meteorological Organization, to make hydrology more relevant to land and water managers, farmers, and the general community, and to establish a network to enable people around the globe to share their expertise and their experience.

“The aim of HELP is to bring real outcomes to real people in real catchments,” says Dr Khan. “Although HELP has no powers to enforce good management, experience shows that good practice is readily accepted when there is an efficient global mechanism for knowledge exchange.”

More information: 02 6951 2713

## Sugar plastics

Scientists foresee a brighter future for Australia's hard-hit sugar industry as it becomes a producer of bio-plastics.

Bio-plastics are just one of a number of diversification opportunities for the sugar industry, according to researchers from of the **Cooperative Research Centre for Sugar Industry Innovation through Biotechnology** (CRC SIIB).

"Every household will be using bio-degradable plastic bags, bottles and containers, every car will have bio-degradable plastic dashboards and fittings, fine clothing will be crafted from these biopolymers to replace petrochemical plastic and nylon with bio-nylons and bio-fabrics all made from renewable resources," says the CRC's Dr Steve Brumbley.

Dr Brumbley says that research being carried out by the CRC is building on an already proven process for making plastics from sucrose, needing only a minor shift in economics for the process to become a market leader. In this lies Australia's opportunity, he says.

"There's hardly an area of modern life which will not be using products derived directly from sugar cane," says Dr Brumbley. "And when the product has reached the end of its working life, it will go straight into the compost heap to feed a new generation of plants."

Australia's cane farmers can look forward to the recognition of sugar cane as one of the most versatile and sought-after agricultural products, he says.

Dr Brumbley says that the sugar industry, especially in Australia, suffers periodic declines linked to world market conditions, because it has a very limited product range, compared with the dairy industry for example.

"From one basic product, the dairy industry creates more than a hundred marketable items, and has become one of Australia's leading export industries," says Dr Brumbley.

"By contrast, the sugar industry produces just four: sugar, molasses, alcohol, and bagasse (waste matter)." However, in the future, sugar will be seen as the carbon source for materials and energy production. Australia will capitalise on this only if the sugar industry survives the period of transition.

This transition phase will take a decade or so to optimise the science, and build the infrastructure to get the industry from a sucrose based industry to a sugarcane industry producing lots of new products. The production of ethanol could create the breathing space to make this transition.

"In the future we could be producing not just sucrose, ethanol, energy (burning bagasse), and molasses, but a whole range of bio-polymers with a vast array of properties, not the least of which is biodegradability. This will greatly reduce the impact of world price fluctuations on our producers," he says.

It could also change rural economies. As the sugar industry starts producing new biopolymers, sugar mills will become the hub for a range of manufacturing industries making the new products to feed into the growing Asian markets. Industries will be attracted to this source of raw materials to convert them into the range of plastics required by the automotive, electronics, household goods, fabrics and even the carpet industries. These will be clean green industries using renewable resources.

Dr Brumbley says that research into the production of polymers by the fermentation of sucrose - the juice of the sugar cane - has attracted enormous interest from the world's major manufacturers of plastics and nylon. Some synthetics manufacturers have already replaced production of petrochemical plastics like nylon with plastics derived from high fructose corn syrup.

"They are fermenting the high fructose corn syrup to produce polymeric compounds which can be made into a wide range of products including fabrics which are entirely produced from living renewable resources: fabrics which touch not only touch the body but touch the soul.

"At today's prices, polymers derived from sugar are slightly more expensive than petrochemical polymers," he says. "However, as Asian countries come on line as major players in the industrial world, we will see a time in the near future when the demand for petroleum outstrips the supply and the economics of petrochemical production will rapidly change.

"This will create a demand for alternative products for the various plastics currently produced from petrochemicals. Production of bio-polymers from the 'oil wells' of the future - sugar producing plants - will take the front seat in this revolution which will drive the economies of the 21<sup>st</sup> century."

These clean green technologies will help reduce our dependency on petrochemicals, replace nonbiodegradable plastics with biodegradeable one, and reduce green house emissions.

Dr Brumbley says that the focus of his research is in the improvement by molecular biology of the sugar cane plant itself, so that a new strain of cane will better able to meet the demand for sugar as a 'bio-factory'.

"Sucrose is available in quantity, and can be readily fermented to produce polymers," he says. "What is less well appreciated is that the whole sugar cane plant - not just the juice - can be turned into plastic.

"Bagasse contains sixty per cent cellulose, long chains of sugars, the basics feedstock for production of bio-polymers," he says. "Using both the sugars in the cellulose biomass and the readily available sucrose as feedstock either for fermentation or by engineering the plants themselves a wide range of new and valuable products from the sugarcane industry."

Dr Brumbley notes that United States Government predictions suggest that the price of petrochemicals will become radically higher within the next three decades, and that it has become US policy to replace petrochemicals with biomass as a primary source of polymers to replace the current array of plastics.

This research serves National Research Priorities *One* (an Environmentally Sustainable Australia) and *Three* (Frontier Technologies for Building and Transforming Australian Industries).

Dr Brumbley says that commercial production of bio-polymers is a reality in some overseas countries, and that a market already exists for such products derived from Australian sugarcane.

More information: 07 3365 7502

### **Flavour saver**

A revolutionary water-saving Australian vineyard technology has been found to deliver a better glass of Shiraz or Cabernet Sauvignon.

In a four-way win for the environment, grapegrowers, winemakers and wine drinkers, new research also shows that the enhanced colour and flavour in grapes grown using partial rootzone drying (PRD) do not come at the expense of high yield, says Professor Peter Dry, of the **Cooperative Research Centre for Viticulture**.

"Accepted wisdom among grape growers has been that better colour had to mean smaller grapes," says Professor Dry. "This turns out not to be the case with PRD.

"Research conducted by Keren Bindon for her PhD took a hard look at two important red wine varieties, Cabernet Sauvignon and Shiraz, being grown under PRD system in two of South Australia's premier wine-growing areas, the Barossa Valley and Langhorne Creek," he says.



“Unexpectedly, the measurable increase in wine colour was matched by high fruit volume and excellent aromatic characteristics.”

Partial Rootzone Drying applies water to just half of a vine's root system at a time, alternating the irrigation pattern every three to ten days, on average, depending on the site characteristics. This means that half of the root system is in drying soil at any one time.

The vine reacts to the drying soil by allowing less water to escape through the pores on its leaves (stomata) which it normally uses to regulate its water use. At the same time, the water applied to the other half of the root system prevents the plant from becoming seriously ‘water stressed’.

PRD was originally developed as a way to substantially reduce water use in the grape industry, says Prof Dry.

“As well as causing the plant to send signals to its stomata to cut back on water loss, PRD has a marked effect on the growth and development of the fruit,” he says. “Certain chemical compounds are responsible for colour and aroma in red wine, and PRD causes a higher concentration of these compounds.

“Among these are the anthocyanins and phenolics, which determine the final colour in reds such as Shiraz and Cabernet Sauvignon. And unexpectedly we’ve found that this higher concentration doesn’t mean that the berries are smaller.

“What is happening is a higher concentration of anthocyanins in the grape skins, rather than just a higher ratio of skin to fruit volume,” he says.

As well as this effect, says Prof Dry, the research team (which also included Dr Brian Loveys of CSIRO Plant Industry) has found a further ten per cent increase in wine colour in response to PRD, caused by a process called co-pigmentation, where enhanced binding of wine pigments forms larger, more stable coloured compounds.

“This also improves the quality of wines produced by PRD because it leads to improved stability of wine colour,” says Prof Dry.

The Partial Rootzone Drying process appears to cause a biochemical reaction in the fruit which leads to improved fruit aroma and flavour.

“Volatile compounds called norisoprenoids are usually present in tiny quantities in wines, but they have huge effect on the aroma and flavour,” says Prof Dry. “A very small change in their production in the fruit can have a marked effect on the final glass of wine.”

It was thought that the production of these volatile compounds was affected by the density of the leaf canopy, and the amount of sunlight reaching the developing fruit. However recent PRD research has shown that water deficit in the fruit can have a much greater effect.

“PRD is becoming a powerful tool for the Australian wine industry,” says Professor Dry. “Growers will be able to produce better wine, with finer colour and enhanced aroma and flavour, while minimising water use. The technique is now well enough understood to be applied across a wide range of soil and climatic regions.

“Improved export opportunities go hand in hand with a better product for domestic consumption,” he says.

Researchers in different countries are testing PRD on a wider range of crops, including tomatoes, olives, cotton, stone fruits and citrus.

This CRC research project supports Australia’s National Research Priorities One and Three – a sustainable Australia and frontier technologies for transforming industry.

More information: 08 8303 7374

# Environment

## Climate impact

A Cooperative Research Centre report commissioned by the Queensland Government predicts potentially catastrophic results of climate change along Australia's eastern seaboard.

The report *Environmental Crisis: Climate Change and Terrestrial Biodiversity in Queensland* was presented to the Queensland Premier in March 2004.

"Scientists worldwide agree that global climate change is already happening," says Chief Executive Officer of the **Rainforest Cooperative Research Centre**, Professor Nigel Stork.

"The consequences of climate change for Australia are very serious and potentially catastrophic, and it is our concern that ministers fail to recognise the severity of the situation. The funding for the production of this report by the Queensland Government however, indicates that they are taking the situation seriously."

"The first effects of climate change are already apparent in Australia and around the world," says Professor Stork. "Heat alone killed hundreds of people in the northern hemisphere in 2003 and we can already see changes in biological systems."

Professor Stork says that while the report concentrates on the effects of climate change in Queensland, the coming physical and biological changes will take no account of man-made boundaries. However in Queensland, the effects on the rich and unique biodiversity of the Wet Tropics ecosystems could be particularly severe.

Dr Steve Williams, CRC researcher who co-authored a recent paper on climate change in the international weekly journal of science *Nature*, says "Median predictions of a rise of 3.5 degrees Celsius over the next fifty to one hundred years will severely threaten most of our icon species of rainforest birds, reptiles, frogs and mammals, possibly sending many of them extinct. At the same time, as population balances are upset, there is a severely increased risk of the spread of pest and weed species."

The report details how at the ecosystem level, functions such as nutrient cycling, soil development and the provision of clean water will be damaged, with reduced

runoff, loss of habitat, and deterioration of water quality leading to increased blooms of toxic algae.

Increased droughts, high winds, dust storms and bushfires are also predicted.

"Even under the mildest possible climate change scenario, ecosystems are going to be redistributed," says Professor Stork. "We will need a 'whole-of-landscape' approach in Australia, which in turn requires a 'whole-of-government' response."

Professor Stork says that although Australia's tropical rainforests are among the best-documented landscapes in the world, the report draws urgent attention to the fate of arid rangelands, mountainous areas, rivers and wetlands.

Dr Andrew Krockenberger, lead author of the report, points out that it is important to remember that the effects of climate change will exacerbate the many other serious threats to natural systems, such as clearing of vegetation and invasive species.

"Any strategy for dealing with global climate change must start with two things," says Dr Krockenberger. "Firstly, effective local and international CO<sub>2</sub> emission controls to limit the eventual extent of change; and secondly, to minimise the impacts of climate change on biodiversity, we have to halt the widespread clearing of vegetation. In this light, we congratulate the Queensland Government for their program to halt tree clearing. Conserving areas of regrowth is the next issue that must be tackled."

Professor Stork says that the looming threat to biodiversity must not be seen as a matter of concern only to scientists.

"The better we understand complex relationships within the various ecosystems, the better we realise how human well-being and economic activity depend on a healthy environment," he says. "Human-induced climate change and damage to biodiversity are not just regrettable in themselves, but lead to a chain of potential unwanted effects ranging from physical damage to property (and ensuing insurance claims), to weed infestation, water shortages, loss of agricultural productivity and the spread of disease.

In the longer term, the major direct threat to human health in Australia will be the spread of insect-borne tropical diseases such as dengue and malaria."

"In Australia, the driest continent, we should be especially sensitive to the issue of decreasing rainfall brought about by forest clearance," he says. "Clearing of natural vegetation also worsens greenhouse gas build-up and reduces the resilience of the landscape to climate change."

Professor Stork argues that the certainty of climate change makes it imperative that Australia takes a 'whole-of-government' approach.

The Report suggests a number of measures that it recommends should be brought into immediate effect. These include:

- Integrated management of reserves and off-reserve conservation, to maximise landscape resilience to climate change;
- Rapid phasing out of landscape clearing;
- Environment and water management planning to take account of climate change;
- A review of weeds, feral animals and pests that might profit from climate change; and
- Preparation for probable increased bushfire activity.

Professor Stork says "There is no doubt that there is now enough scientific information about climate change to warrant an immediate and comprehensive response from Federal and State governments. The research addresses the Federal Government's national research priority one – sustainability."

"It is crucial that managing the impacts of climate change be informed by an on-going, comprehensive and strategically-prioritised program of research with clearly identified funding and links that trigger management actions," he says. "In this way, the best management will be founded on the best scientific knowledge."

Mr Andrew Mitchell, Director of the Global Canopy Program says "Throughout geological time, climate change has been earth's most potent weapon of mass destruction extinguishing at times up to 90% of all life on earth.

"This time it appears that humans are causing the change but we also have a chance to mitigate the problem, if we act now. The Queensland Government has taken a valuable step by commissioning this report and by linking pioneering efforts in Queensland into a new global network of targeted research being co-ordinated by the Global Canopy Programme, which will help to monitor and assess the impact of climate change on forests," says Mr Mitchell.

"Climate change is a global phenomenon and will impact biodiversity most severely, where most biodiversity is located - in the forest canopies of the world," he says.

"Queensland is rich in biodiversity beyond most countries' dreams. Millions of people visit its forests and reefs to experience their magnificence. These are riches Australians and the world cannot afford to lose."

The report addresses National Research Priority 1 - an environmentally sustainable Australia.

The report *Environmental Crisis: Climate Change and Terrestrial Biodiversity in Queensland*, published by the Rainforest CRC, is available from the Rainforest CRC, PO Box 6811, Cairns, QLD 4870. Email: rainforestcrc@jcu.edu.au.

More information: 07 4042 1246

### **Hairy canary**

Hairy canary clover may be just what's needed to help combat dryland salinity: the perennial legume is under investigation in the fight to save nearly twenty million hectares of Australia from a slow death from rising salt.

Scientists are excited about the ability of this introduced forage plant to keep the water table well below the soil surface.

"*Dorycnium hirsutum* – or hairy canary – has deep roots, but the really important thing about it is that it is perennial," says Lindsay Bell of the **Cooperative Research Centre for the Plant-based Management of Dryland Salinity**. "It mimics the behaviour of Australian native plants which have long been cleared from our pastures and cropping land.

"The root system penetrates as deep as the roots of lucerne, which has been recognised as a very effective tool for the remediation of dryland salinity," says Mr Bell.

Deep rooted plants (such as the native vegetation which has been largely replaced by pastures and crops) act as pumps to keep the water table from rising to the surface. The rising groundwater brings with it salt from the ancient deposits which lie just under the surface in many parts of arid and semi-arid Australia.

"*Dorycnium* species have not been used commercially previously anywhere in the world," says Mr Bell. "Until recently they have been entirely undomesticated.

"Hairy canary clover is not a true clover, but rather is closely related to *Lotus* species, currently used as commercial pasture plants.

"The plant appears to be very hardy and a great survivor. Its hairy leaves and deep roots make it drought tolerant," says Mr Bell.

"It has the potential to be a useful new perennial pasture for Australia's dry pastoral and cropping regions," he says. "However it will not be commercially available for some time.

"Hairy canary has some limitations in establishment and grazing quality, but it is hoped these may be improved with breeding" says Mr Bell. "Its likely role may be to provide valuable summer and autumn forage when other feed sources are not available."

Mr Bell says that *Dorycnium hirsutum* is a native of the Mediterranean region and north Africa, like subterranean clover and many species of grass, which originated in that region and readily adapted to Australian conditions.

Any plant being introduced to Australia has to meet stringent importation controls. Limited permission has been given by Australian quarantine authorities for the import of the hairy canary, and Mr Bell is confident that the characteristics of the plant will ensure that it will play an important role both as a forage species and in the continuing battle against dryland salinity.

Mr Bell's research is in part funded by an AW Howard Fellowship which was awarded to him in 2003.

This CRC research project supports Australia's National Research Priority No.1, An Environmentally Sustainable Australia.

More information: 08 9380 2555

## **Water bugs**

Scientists have discovered that water is teeming with thousands more microscopic creatures than previously thought – many of them still largely unknown.

"Only about one in ten water-borne bacteria have even been identified," says Daniel Hoefel, a PhD student at the **Cooperative Research Centre for Water Quality and Treatment**. "There are several million species which we know by name, but the vast number of creatures that live in our water are still unknown - we haven't named them, described them, or discovered anything about their behaviour."

According to Mr Hoefel, this is about to change. Some ingenious lateral thinking has given water researchers a novel high-speed means of coming to grips with the teeming microbes.

"The main reason that we haven't been able to identify all these microbes is that they are very hard to grow in a laboratory culture," he says. "This is quite a laborious process, it takes several days, and many species simply don't like being cultured in a glass dish on a laboratory bench."

Mr Hoefel and his PhD supervisors at the Australian Water Quality Centre, in conjunction with the University of South Australia, had the idea of using a piece of hospital equipment known as a flow cytometer to assess water quality.

A flow cytometer has until now mainly been used for examining human and animal blood cells, says Mr Hoefel.

"We found that by applying a stain to water samples, the active bacteria glow under the laser beam of the flow cytometer, and each individual cell is counted as it passes through the beam," he says.

"This means that we can count up to a thousand bacterial cells per second," says Mr Hoefel. "We can take a sample, treat it with the dye or stain, count hundreds of thousands of bacteria, and have a result within an hour of receiving the sample.

"This also gets around the problem of detecting those bacteria which can't be cultured in the lab," he says. "Now we can access the whole range of bacteria in the water and start to understand the role that the various species play."

"This technique also gives us another tool to be used in the treatment of water," he says. "Until now, the success of a treatment process was assessed solely on the bacteria which we could culture in the lab."

"Now we can assess whether the process is removing and inactivating all of the bacteria, not just those that are culturable; in other words, we can now accurately monitor the efficiency of water treatment plants and understand the challenges involved in water treatment in a way which was not previously possible."

"We have also found that the water treatment processes currently being used in Australia are effective in removing or inactivating bacteria", he said. "The benefit of our new technique is that it is easier to use and more accurate for monitoring the status of our water supplies to our treatment facilities".

Mr Hoefel hopes that due to the convenience and accuracy of the new test it can be adopted in parts of the world where water quality monitoring has previously been difficult. "Portable in-field flow cytometers have recently been developed," says Mr Hoefel, "but in most cases a sample can readily be sent to a laboratory for assessment."

"Apart from the flow cytometer, the actual assay itself doesn't require any special equipment other than a few pipettes for working with each sample," he says.

This research project supports Australia's National Research Priority No. 1, an Environmentally Sustainable Australia.

More information:08 8259 0351



## Reef watch

Every Australian can now keep an eye on the condition of the Great Barrier Reef via the new Reef Futures website, a joint venture by **CRC Reef Research Centre** and the Australian Institute of Marine Science.

"With only a few mouse clicks, viewers can access information normally reserved for scientific publications," says CRC Reef researcher Mr Stuart Kininmonth from the Australian Institute of Marine Science (AIMS).

"Although we have a history of reef observation, and have been monitoring continuously for the past thirty years, it is only in the past four to five years that technological advances have enabled us to share it through the internet," says Mr Kininmonth.

"Satellite technology now gives us daily access to sea surface temperatures that, combined with advances in computing, enable us to measure the temperature of the waters bathing the three thousand and more reefs which make up the Great Barrier Reef," he says.

"At the same time, statistical methods (Bayesian systems) have been developed which allow us to combine data from our historical records with the very latest observations, and to integrate different types of data," says Mr Kininmonth.

The first topic on the Reef Futures website is coral bleaching. Maps on the Reef Futures website show sea surface temperatures across the Great Barrier Reef. The maps allow users to explore past bleaching events either across the whole Great Barrier Reef or on individual reefs. Web-users can also link from the Reef Futures site to information about current conditions on the Reef.

Web-users can investigate interactive maps of aerial and in-water surveys of coral bleaching from the worst bleaching events on record – in 1998 and 2002. In 2002, up to 70 percent of reefs on the Great Barrier Reef showed evidence of bleaching.

There are interactive graphs on the Reef Futures website that predict the potential impacts of coral bleaching on corals out to 2050 on the Reef. There are also powerful search engines provide rapid access to publications and links to relevant websites around the world.

The website is an outcome of extensive research over many years by the Reef CRC and addresses the first national research priorities – a sustainable Australia. More information: 07 4753 4334

## Bat threat

The tropical fruit bat, the spectacled flying fox, is in serious trouble from a range of threats, researchers at the **Rainforest Cooperative Research Centre** have warned.

The bat is thought to play a key role in maintaining rainforest plant diversity, and its decline could have serious implications for Australia's World Heritage rainforest ecosystems.

"Human activities are causing major changes to the landscape, and the spectacled flying fox has always had a limited range in the Queensland wet tropics and PNG," says Samantha Fox.

"Land clearing is probably one of the major causes of the decline in the number of bat colonies, but there is no empirical data to support or refute this," she says. "The perception that there are more bats attacking fruit farms is likely to be due to a change in foraging behaviour of the bats, rather than to greater numbers.

"Since the 1980s there's been a change in the foraging behaviour of bats on the Atherton Tablelands to include an introduced weed, Wild Tobacco (*Solanum mauritanium*).

"This has berries, which the bats quickly learned to appreciate," she says. "Unfortunately for the bats, feeding from the low shrub has made them vulnerable to a native tick which causes deadly paralysis in bats.

"Native ground-dwelling species such as wallabies or bandicoots, which are the natural host to the paralysis tick, build up a resistance to the toxin but the spectacled flying fox has no immunity and the toxin is almost always fatal," says Ms Fox.

According to Ms Fox, the spectacled flying fox is believed to play an essential role in the ecosystem of the World Heritage listed wet tropics of Queensland. The bats contribute to the processes that help maintain plant diversity. Researchers at CSIRO on the Atherton Tablelands are currently studying this aspect of the species' ecology.

"Flying foxes eat large quantities of flowers and fruit," she says. "This means that they have a direct effect on the plants from which they feed; they assist with pollination; and above all they play a major role in seed distribution of tropical plant species."

Ms Fox says that the large number of flying foxes affected by paralysis has given her a unique opportunity to study the species at close hand, but has also led to some unexpected results.

Spectacled flying foxes are thought to be a long-lived species, living up to twenty years in captivity, which become sexually mature at three years. A mother produces only one baby bat per year.

Ms Fox says that she has examined close to four hundred specimens which died of tick paralysis. Nearly all of these were young adults, not more than six years old.

This may be evidence, she suggests, that the longevity of the species is being reduced as it copes with an increasingly restricted environment. This in turn means that there is a shorter 'window' of fertility in the life of a flying fox, and less chance of its producing two young, the minimum for a sustainable population.

Ms Fox says that her research is funded in part by the Queensland Bat Hospital, in part by the Queensland Parks and Wildlife Service, and in part by the Queensland Fruit and Vegetable Growers Association.

"Each of these organisations has good reason to be interested in the future of the spectacled flying fox," she says. "Farmers in particular are becoming increasingly aware that native animals such as the flying-fox do play a vital role in tropical ecosystems and that in the long term this has an impact on the viability of all their activities."

This CRC research project supports Australia's National Research Priority No.1, An Environmentally Sustainable Australia.

More information: 07 4042 1246

## **Ocean warning**

Australian researchers have issued a global warning over the dangers of uncontrolled 'bioprospecting' - the hunt for valuable lifeforms and new drugs - in the deep oceans.

"The Law of the Sea fails to adequately protect the biodiversity of the open oceans and the ocean floor," says Dr Julia Jabour-Green of the **Cooperative Research Centre for Antarctic Climate and Ecosystems** (CRC ACE) and the University of Tasmania.

The warning follows an international marine science meeting in New Zealand which recommended three new policies to prevent the plunder of deep ocean resources be considered by the United Nations Food and Agriculture Organisation, and ultimately be included in any legal arrangements.

"Even though some concepts in Law of the Sea are centuries old, the Convention itself has only been in force globally for ten years " says Dr Jabour-Green. "This is a window of opportunity which marine researchers are keen to use in the interests of protecting and developing biological resources that are presently poorly protected by any international law.

"Ships and shipping on the surface are the subject of a network of international laws, and minerals on the seabed have their own legislation - but biological resources are effectively there for the taking," says Dr Jabour-Green.

Dr Jabour-Green says researchers are keen to replace the notion of 'bioprospecting' with the less-exploitative concept of 'biodiscovery'.

"'Bio-prospecting' for commercial purposes can only be the second phase of the process of exploration, when enough knowledge has been gathered to ensure that we understand the consequences of exploitation of potential ocean wealth."

Dr Jabour-Green says that Australia has a significant role to play in establishing internationally binding legal protection for the biodiversity of the high seas.

Just as continental Australia is regarded as biologically 'mega-biodiverse', so the oceans which surround Australia are the home to at least five types of 'mega-biodiversity hot-spots', she says.

"The richest sites for oceanic biodiversity are coral and temperate reefs; volcanic vents on the ocean floor; the abyssal plains deep between undersea mountain ranges; and the recently explored seamounts, especially between Australia and New Zealand and south of Tasmania," says Dr Jabour-Green.

These areas are particularly vulnerable to certain commercial fishing practices such as deep bottom-trawl fishing, she says.

"We are also discovering unexpectedly prolific life in the currents of cold Antarctic water which move under the surface of the oceans, and which also play such an important role in driving the world's weather," she says.

Dr Jabour-Green says that a meeting of marine scientists, government representatives and NGOs in Dunedin (NZ) proposed three ways forward to be adopted by the United Nations Food and Agriculture Organisation, and ultimately to be included in the Law of the Sea, the Convention on Biological Diversity, or as the basis of a new legal regime:

- Access to international waters and the biodiversity which they contain must be regionally and globally consistent, and the Convention for
- Biological Diversity must be given effect even in hitherto unregulated international waters and at any depth in those waters;
- Scientific collection of samples and data must be sustainable and must be subject to Environmental Impact Statement;
- Any benefit which accrues from the exploration or exploitation of the international deeps should be returned to the international community, as scientific information freely available to all comers.

Dr Jabour-Green says that the Dunedin meeting also proposed the establishment of international legislation for the formation and management of deep ocean 'marine protected areas'.

More information: 03 6226 2265

### **Roo retreat**

New scientific evidence suggests that northern Australia is experiencing a widespread decline of native mammal species, including the antilopine wallaroo.

Scientists say that this could be the first significant decline of a large kangaroo species since European settlement.

According to Euan Ritchie of James Cook University and the **Tropical Savannas Cooperative Research Centre**, the decline is almost certainly happening in parts of antilopine wallaroo's range, but the reasons at present are unknown.

"There are three main populations of the wallaroo (*Macropus antilopinus*): the Cape York Peninsula and Einasleigh Uplands of Queensland, the Top End of the Northern Territory and the Kimberley region of Western Australia," he says. "Until now, the species has never been systematically or scientifically studied in Queensland, and studies in the Northern Territory were conducted more than 20 years ago and at a local-scale. The species has not been studied at all in Western Australia.

"Roo numbers have important economic implications, because of their perceived competition with grazing stock, and some kangaroo species may have significant environmental requirements which are at odds with pastoral development," he says.

"There are also very important conservation implications if the antilopine wallaroo is declining."

The wallaroo is important to indigenous people from a cultural perspective as well as providing a food source in some areas.

Mr Ritchie says that the antilopine wallaroo is a large, robust animal, comparable to Red and Eastern Grey kangaroos, both of which have benefited from landscape modifications associated with the intensification of pastoralism.

“The antilopine wallaroo fills a similar ecological niche to that of the Eastern Grey kangaroo in other parts of Australia” he says. “This makes its apparent decline more puzzling.”

The antilopine wallaroo is the only one of Australia’s six large kangaroo species which is restricted entirely to the tropics, making it both a high conservation priority and an interesting study animal.

Mr Ritchie says that graziers in the savanna regions are generally tolerant of kangaroos and wallaroos in their grazing lands, and some even welcome them.

“Roos and dingoes have a natural predator-prey relationship,” says Mr Ritchie. “Graziers know that if there are fewer roos, there is a far greater chance that valuable calves may become the target of dingo attack.

“In the future, the managed harvesting of kangaroos and wallaroos may become an important economic activity while not threatening the viability of the species’ survival,” he says.

Mr Ritchie conducts pre-dawn surveys using a 4WD vehicle, because, he says, the big marsupials are unafraid of a vehicle, while they flee from any human silhouette. During his five kilometre transects, he counts the number of animals, the composition by age and sex of the groups, their diet, and the grasses and other plants along the survey transect.

“Local people report that the number of antilopine wallaroos is going down,” he says. “But because the animals have never been appropriately studied at a large scale, there’s no baseline data.

“We have to take account of natural population fluctuations, but our working hypothesis is that the species is in decline, at least in some parts of its range, and that this may be associated with changing land management practices in the tropical savannas,” he says.

“Important changes include the introduction of exotic grasses – becoming increasingly common – but most important is the significant change in fire regimes. Traditionally, indigenous people worked with frequent, but small-scale, low-intensity fires, which created a habitat mosaic. In comparison, current practice is to use frequent, large-scale, high-intensity fires, resulting in a more

uniform habitat. This change in the vegetation may well be having an effect on populations of wallaroos, as well as many other native animals inhabiting tropical savannas.”

Mr Ritchie says that information gathered during his study of the antilopine wallaroo, and the study methods that he has developed, will be applicable in other sites where native animal population studies are being considered.

This CRC research project supports Australia’s National Research Priority No.1, An Environmentally Sustainable Australia.

More information: 08 8946 6834

### **Coral chart**

A simple colour chart has become a key weapon in the fight to save Australia’s coral reefs.

Tourists, schoolkids, anglers, divers and other reef users may soon take a role as front-line scouts, on the lookout for threats to the nation’s marine icons.

The Coral Watch colour chart has been developed by visual neuroscientist Associate Professor Justin Marshall in a joint project between the **Cooperative Research Centre for Sustainable Tourism**, the University of Queensland, and Heron Island Resort.

“It’s quick and easy and you don’t need to be an expert to use it,” says Dr Marshall. “At the same time, it delivers excellent and copious research data to the scientific community who are studying the threats to coral reefs.”

Dr Marshall says that until now, assessing coral health has been an extremely laborious process, requiring complicated laboratory equipment and considerable time delays.

“It meant also that living or dead samples of corals had to be taken to the laboratory, and that there had to be researchers available to work on the problem.

“With the introduction of coral colour charts, untrained tourists, school children and students, divers and anglers can all take part in what is becoming a global project to monitor the world’s coral reefs.”

Dr Marshall says that the Coral Watch colour charts, which are durable and inexpensive, are based on painstaking laboratory study of corals in various stages of bleaching.

“Most of the colour of coral is provided by the symbiotic coral algae. Coral in poor health has fewer algae, and becomes bleached, so the colour of the coral can be directly related to its state of health,” he says.

Dr Marshall says that far more than the health of the coral is at stake.

“Vision and colour play a vitally important role in the function of the reef ecosystem,” he says. “Just as, on land, the colour of a fruit against a background of green leaves is an important signal to a fruit eater, the colour of reef inhabitants is a signal to other creatures, many of whom have far more sophisticated colour vision than humans.

“Coral reefs, both deep and shallow, are the icons of marine biodiversity, and the health of the seas and oceans is directly related to the health of the coral reefs,” says Dr Marshall. “And coral reefs are under threat around the world.”

Scientists, school children and tourists are using the Coral Watch colour charts to monitor Australia’s Great Barrier Reef, and other reefs worldwide and providing data which is analysed and made available on the Coral Watch website.

Dr Marshall says that commercial tourism operators have been actively involved since the launch of the project on Queensland’s Heron Island Resort.

“I don’t know how many Coral Watch charts there are being used today, “ says Dr Marshall. “Through our collaborators, we know we’ve reached more than eighty countries.

“The problems of coral are global, and we’ve found a way of involving the global community,” he says. “With the help of the Coral Watch chart, anyone in the world can monitor the health of the coral on their doorstep, and the data they collect will be essential in addressing the problem on a global scale.”

This CRC research project supports National Research Priority One, an Environmentally Sustainable Australia.

More information: 07 5552 8172



# Medical Science & Technology

## Bio-terror watch

An Australian research team is developing early-warning tests for the lethal diseases and toxins that could possibly be used in an attack by bio-terrorists.

Professor Ian Gardner, Chief Executive of the **Cooperative Research Centre (CRC) for Diagnostics** says his team has developed the capability to rapidly identify a number of possible bio-terrorism agents, such as smallpox, anthrax, botulinum and salmonella.

"When a lethal disease has been released into the community, there's no time for traditional laboratory-based diagnostic methods taking several days," Prof Gardner warns.

"The diagnosis has to happen before the disease gets a foothold. If possible, even before any symptoms can be seen," he says.

"Diagnostic testing is now being taken out of the laboratory and right to the place of the suspected outbreak, so immediate action can be taken to protect the community's health and safety."

The team – from the Diagnostics CRC and Defence Science and Technology Organisation (DSTO) – is also working on ways to identify potentially new and unknown strains of lethal bioweapons.

"Just as computer hackers try and develop 'viruses' that are ahead of existing defence strategy, we have to assume that bio-terrorists may be genetically modifying diseases and pathogens in quite unexpected ways, and be prepared for them," he says.

"Even without the agency of bio-terrorists, modern international travel has made it extremely difficult to restrict epidemic infectious diseases, such as SARS, to their countries of origin," he says.

"Australia will need to be continually vigilant, and have its own armoury of rapid tests so we can seal off any outbreak before it takes hold," he says.

Professor Gardner says that the Diagnostics CRC research effort is focussed on using cutting-edge biotechnology to diagnose potential threats on the spot.

This may involve methods such as high throughput flow cytometry and high-sensitivity signal generation and capture, for rapid quantitative assays.

"Biosensors with great sensitivity are now being developed," he says. "We need tests where just a few molecules of an infectious disease agent or a toxin in a sample taken from a patient is enough to alert the system to the presence of the threat, allowing early and rapid preventative measures to be taken."

Professor Gardner says the Australian research is being carried out in an atmosphere of international collaboration. At the same time many Western countries are pursuing their own diagnostic tests for bio-terrorism agents.

He expects that state-of-the-art diagnostic technology - at present confined to research and public health organisations - will become routine clinical testing within a decade.

"As a CRC, we are developing diagnostic tests for a commercial purpose," says Professor Gardner, "but at the same time there is a strong 'public good' element in our work and we identify strongly with the Government's stated National Research Priority of 'Safeguarding Australia'."

The CRC is taking a two-pronged approach to the urgent need for high-efficiency diagnostic procedures. Research is identifying large numbers of marker molecules which can betray the presence of a pathogen often before it shows any visible effects.

A parallel research push is the development and utilisation of 'libraries' of proteins, peptides and novel binding agents associated with known and still-unknown diseases.

"Emerging diseases demand a suite of new 'markers' and tests," says Professor Gardner. "Novel organisms such as SARS, the Hendra virus, the Nipah virus, have demanded the immediate deployment of diagnostic tests, some of which have been developed within our CRC.

"Other familiar pathogens such as anthrax have long had standard diagnostic procedures - but there is a fresh urgency to develop rapid diagnostic tests when one strain has already been used as a bio-terrorism agent.

"You can't sit around and wait for days for a microbiology laboratory to confirm that its anthrax," he says.

"We are developing biosensors which can detect the organism even before anyone even becomes ill, enabling us to take steps to protect others who might have been exposed before they become symptomatic."

Professor Gardner cautions that people living a so-called 'Western' life-style may be more susceptible to invasive diseases than traditional rural communities.

The research addresses National Research Priorities 2 and 4 - promoting and maintaining good health and safeguarding Australia.

More information: 07 3864 4015

### **Skin danger**

Skin infections are a major factor in the very high rates of kidney disease in Australia's indigenous communities and may be linked to world-record rates of rheumatic heart disease, researchers at the **Cooperative Research Centre for Aboriginal Health** (CRC AH) have found.

The team has shown that kidney failure due to glomerulonephritis and cumulative heart damage caused by repeated bouts of rheumatic fever has a direct link to skin infections caused by the streptococcus bacterium, usually induced by the scabies mite.

"The evidence is building that scabies is a critical factor in the continuing high incidence of rheumatic fever in indigenous communities," says Associate Professor Jonathan Carapetis.

"Rheumatic fever has become rare in more affluent societies, but in Australia's indigenous communities it is a recurrent scourge and leads to serious and permanent heart damage."

"Rheumatic fever occurs at the highest rates in the world among the Aboriginal population," he says. "Many Aboriginal people have severe heart damage by their late teens or early twenties."

"Rheumatic fever is known to be caused by streptococcal infection of the throat," says Prof Carapetis. "We believe that in indigenous communities, it is also caused by streptococcal skin infection resulting from scabies infestation."

Prof Carapetis says that the potential link between skin diseases and other parts of the body is always present, but in indigenous communities where rates of skin infection are often high, the threat of further illness is very much more serious.

"We also believe that the high rate of children's skin disease is also linked to high rates of other ailments such as gastroenteritis and pneumonia," he says. "When children are covered in skin sores, their immune system becomes pre-occupied with fighting the skin infection, and that lowers their defences against other diseases."

Prof Carapetis also has a kind word for the dogs which are part of many indigenous communities. "Accepted wisdom for years has been that dog mange is a source of human scabies infection," he says. "However work at the Menzies School of Health Research in Darwin (part of the CRCaH) over the past few years, using careful laboratory testing of the DNA of the mites which cause dog mange, and the mites which cause human scabies, has shown that they are a different species and that dogs are not implicated in the spread of human scabies."

Until recently, community health officers and veterinarians had spent considerable time and funds attempting to control dog mange.

"While this is desirable from the point of view of the dogs, it is not an effective means of combating human scabies," he says. "Scabies is passed from one human to another during close physical contact. It is often a disease of overcrowding or inadequate housing."

"We've shown in recent years that we can reduce scabies in indigenous communities, and so reduce streptococcal infections, if we take a community-wide approach," says Prof Carapetis. "The aim is to involve everyone in the community, on a single day if possible, treating every single person; and then to follow this with regular screening, particularly the children, two or three times a year."

"These small scale community 'scabies days' have been very successful and very well received by the people," he says. "There's a festive atmosphere and almost total participation."

"Our new project involves the entire East Arnhem region. We are co-ordinating the Healthy Skin program throughout the whole region, involving many communities. The region is largely separated from the rest of Australia by distance, and most of the population movement takes place within the East Arnhem communities."

"As researchers we have worked in a collaborative way with the communities, to try to provide them with what they feel is important," he says. "We hope to demonstrate from the Healthy Skin program that community and regional involvement can lead to long-term sustainability of the program."

"In Aboriginal communities, skin infections are the single most common reason for seeking medical attention. We hope one outcome of the program will be a practical strategy to save the communities many thousands of dollars in avoidable medical costs as well as improving their overall health."

Prof Carapetis and his colleagues have published a report on the link between scabies and rheumatic heart disease in *The Lancet Infectious Diseases*

(McDonald M, Currie BJ, Carapetis JR. Acute rheumatic fever: a chink in the chain that links the heart to the throat? *Lancet Infect Dis* 2004; 4 (April): 240-5).

The work of the CRC on scabies supports Australia's National Research Priority No.2, Promoting and Maintaining Good Health.

More information: 08 8922 8473

### **Protective bugs**

A revolutionary approach to understanding typhoid fever and other killer diseases is being developed by a team from Australia's **Cooperative Research Centre for Vaccine Technology** (CRC-VT).

The average person carries some 90 trillion bacteria around with them, on and in their bodies. Many of these are still unknown to science, but some are proving extremely valuable in the fight against deadly diseases like typhoid (*Salmonella typhi*), says CRC researcher Maja Galic.

A CRC-VT team is investigating whether the protection given to people by oral vaccines may be significantly enhanced by altering the composition of microbe populations in their gut.

The variability of oral vaccine protection has challenged scientists for decades. An oral vaccine must interact with the microbes that are resident in the intestinal tract. However, traditional screening methods can only identify about 40 per cent of the bacteria which naturally inhabit the human gut, she says.

Now, using new DNA-based technology, Ms Galic and her team have identified a great many new bacterial species.

"We are investigating whether any of these previously-unknown bacteria play a pivotal role in protecting the body against *Salmonella* infection," says Ms Galic

Ms Galic says that the difficulty faced by researchers in the past was that many gut bacteria, benign or otherwise, have a strong aversion to oxygen. This meant that traditional means of culturing bacteria in the laboratory to study them were not possible, and they remained unknown.

Researchers also faced with the problem that almost nothing was known of the nutritional needs of these unknown bacteria, making it impossible to sustain a laboratory culture of them.

However using a global database of bacterial gene sequences, Ms Galic was able to identify many new gastrointestinal bacteria, including those which cannot be cultured in the laboratory.

"Species of *Lactobacillus* were common," says Ms Galic. "These are the benign bacteria found in probiotic foods like yoghurt. Other benign bacteria in the gut play a crucial role in providing us with nutrients and vitamins, and stimulating the normal development of the intestines.

"The most significant result of our research has been to establish the protective role of these intestinal bacteria in reducing an invasion of *Salmonella*," she says.

"Earlier researchers found that the efficacy of oral vaccines against typhoid fever varied greatly," says Ms Galic.

"We found that different individuals and groups have different intestinal microbial communities – and we are trying to ascertain whether the variation in efficacy of the vaccine depends on the make-up of these communities.

"New bacteria which enter the intestine, whether benign or disease-causing have to compete with the resident microbes both for an attachment point and for nutrients," says Ms Galic.

"Only when *Salmonella* is established in the gut can it spread to other organs such as the spleen and liver, causing serious disease - but not before it has survived a confrontation with the resident gut bacteria."

Ms Galic says that by understanding of the complex interactions between the resident bacteria, incoming pathogens and the host, researchers may be able to explain variation in vaccine efficacy, which leads to some people being more successfully protected against the disease than others.

"Live oral vaccines, such as the human typhoid fever vaccine, are harmless modified strains of *Salmonella typhi*, which trigger an immune response and so protect the host from the lethal form of the disease," she says.

"The difference in efficacy of oral vaccines may be attributed to the different intestinal bacteria communities. So, by manipulating these populations, we may be able to improve the efficacy of the vaccine and increase the number of people it protects."

Ms Galic says that her identification of many new and probably benign species of intestinal bacteria also has a direct bearing on the use of antibiotics to treat bacterial infections.

“It’s long been known that some antibiotics can have a broad effect on the body’s natural microbial populations,” she says. “We have found that in the case of *Salmonella*, experimental mice given a dose of antibiotics before being infected with the disease, become much more susceptible to infection.

“This is because the antibiotic treatment killed off some of the resident ‘good’ bacteria, which would otherwise have competed with the *Salmonella*.”

Ms Galic says that some species of *Lactobacillus* appear to give good protection against bacterial infection, but that the role of probiotics like yoghurt, which contain live *Lactobacillus*, needs further research.

This research project supports Australia’s National Research Priority No.2, Promoting and Maintaining Good Health.

More information: 07 3362 0430

### **Asthma emergencies**

Asthma sufferers in Australia have a high probability of ending up in a hospital emergency ward – and yet the prevention and treatment of asthma in this country is amongst the world’s best.

Research by the **Cooperative Research Centre for Asthma Ltd.** shows that this paradoxical situation is due to a combination of social and medical factors.

These include the high cost of medication, and the perceived danger of unwanted side-effects.

“We have one of the highest per capita occurrences of asthma and other respiratory complaints in the world” says Ms Dianne Goeman of Melbourne’s Alfred Hospital.

“However we also have a number of very effective procedures and medications which should be able to deal with all but the most severe asthma attacks,” she says.

Asthma should not be seen as a ‘minor ailment’, says Ms Goeman; although for many sufferers it is relatively mild, around four hundred Australians die each year from asthma.

“The puzzle for medical researchers has been the implementation gap: treatments which are highly effective in clinical trials, leading to extremely optimistic forecasts about the future control of asthma and related ailments, turn out to be far less effective in ‘real life’ situations.”

Ms Goeman says that central to the treatment of asthma is the effective use of the 'asthma action plan'.

"The 'asthma action plan' is a familiar strategy to both clinicians and patients, but the application of the plan can vary widely," she says. "In recent research studies we have found that many doctors simply don't have enough time with individual patients to develop a plan; and in many cases, where patients do have a plan, they modify it according to past disease experience. Doctors need to be aware of this."

Ms Goeman says that 'a good asthma doctor can help people with asthma to improve their quality of life'.

"Being a good asthma doctor means that the GP devotes enough time to individual patients to form a real partnership with the patient in dealing with the disease," she says. "Doctors must engage in a dialogue with asthma sufferers, and provide them with a written asthma action plan, if treatment is to be successful."

Even where these conditions are met, Ms Goeman says that research in Victoria show that there are many other factors which hinder effective asthma treatment.

"Although asthma treatments can take different forms, many patients are concerned about the costs involved," says Ms Goeman. "We have found that patients attempt to 'manage' their costs by lowering doses to prolong medication use, or even by simply giving up the medication entirely.

"In at least some cases, this was the cause of later hospital presentation," she says.

Three quarters of asthma patients interviewed are also concerned about possible side-effects of medication, change in skin or body appearance, tremors, mouth or throat soreness, and osteoporosis now or in the future.

"For many patients, it's a question of weighing up the perceived risk of side-effects against the benefits of medication," says Ms Goeman. "Some patients who we interviewed told us that they have modified their medication plan because of this concern."

According to Ms Goeman, asthma may be more prevalent amongst lower-paid workers, but frequently it is the possibility of asthma attack which can lead sufferers to choose low-paid or temporary employment.

"Asthma contributes directly to their low socioeconomic status through diminished employment opportunities," she says. "Many people with asthma are forced to



lose significant numbers of working days, adding to the fear and discomfort already associated with the disease.”

Ms Goeman says that the investigation carried out in the CRC for Asthma has reinforced the importance of the doctor-patient relationship in the treatment of asthma.

“We urge doctors to engage with asthma patients in a real partnership, to understand the affordability and acceptability of medication for each individual patient, and to ensure that each patient has – and understands – a written asthma action plan,” she says.

“Asthma has been recognised as the Sixth National Health Priority Area in Australia, and costs the Australian community heavily in both personal and economic terms.

“Yet we have proven and effective treatments available,” says Ms Goeman.

Ms Goeman says that the work of the CRC for Asthma supports Australia’s National Research Priority No.2, Promoting and Maintaining Good Health.

More information: 03 9036 3130

## **Deafness diary**

A simple diary has become an important tool in managing hearing loss in very young children around the world.

The Diary of Early Language (Di-EL) developed by Australia’s **Cooperative Research Centre for Cochlear Implant and Hearing Aid Innovation** (CRC HEAR) enables systematic recording of how deaf infants acquire language.

“Very young children who have not yet developed speech are a special problem for educators, hearing clinicians and physicians,” says Dr Robert Cowan, Chief Executive Officer of CRC HEAR. “This is particularly important in cases where the child has received a cochlear implant.”

Unlike a hearing aid which simply amplifies or filters sounds to assist a deaf person to hear them, a cochlear implant electrically stimulates the acoustic nerve, which is connected to the hearing centres in the brain.

“Detecting deafness in young babies is a problem in itself which has recently been overcome through use of universal newborn screening programs in Australia and world-wide,” says Dr Cowan. “In the case of babies under the age

of twelve months, who have received a cochlear implant or a hearing aid, the question has been: how can we be sure that the device is in fact working to develop language?”

In an older child the clinician or therapist can use speech perception tests as an indicator of whether an implant or a hearing aid is functioning correctly. But until the development of the Di-EL there was no simple objective measure of ongoing language acquisition in the very young.

Researchers have compiled data about language acquisition, including the first hundred words and the first use of sentences in the normal hearing child. Most children start to acquire words, and start creating sentences, between twelve and twenty-eight months.

Research Officer Ms Pauline Nott, who is developing the Di-EL as her Doctoral project at the University of Melbourne, discovered that there was no such data available for the hearing-impaired, in particular those using modern cochlear implants.

“Would they follow the same patterns?” she asked. “Is the data similar for cochlear implant and hearing-aid users? These questions led to the development of the Di-EL, which is a structured diary maintained by the parents of the hearing-impaired child.

“Parents who have use the Di-EL receive tutorials that inform them about early language development – and also reduces the clinical time needed by each child,” she says.

Dr Cowan says that a pilot study carried out by Ms Nott and other staff at CRC HEAR showed that the ‘normal’ pattern of language acquisition at between eighteen months and two years is similar in severely hearing-impaired children – but that the starting point is at the fitting of the hearing aid or cochlear implant.

“This meant that we can make a real comparison between ‘normal’ and hearing-impaired children,” he says.

“The clinician can be more confident that the device is doing what it is supposed to do, which is helping that child develop language, the building block of their communication, their education, and their involvement in the community,” he says.

The Di-EL system provides clinicians and parents with a measurable daily on-line measure of language progress.

“Other tests are normally done over six to twelve month interval. The Di-EL system picks up detailed development over shorter intervals, which can be

critical if, for example, a young child with a hearing aid in fact needs a cochlear implant.”

Through Di-EL, the parents have objective information to enable them to assess their child’s progress in acquiring meaningful language and they can compare this against the newly-developed norms for the peer-group of children who are also implant or hearing-aid users.

“This allows for very early intervention where it is necessary, and can identify problems in the child which may in fact not be hearing-related,” he says.

Dr Cowan says that international paediatric and hearing institutions have welcomed the development of Di-EL, which fills world-wide niche in the management of hearing loss in young children. CRC HEAR is working with international partners in Spain, Germany and the United States.

This research by the CRC HEAR supports Australia’s National Research Priority No.2, ‘Promoting and Maintaining Good Health’.

More information: 03 9667 7500

## Appendix A: Index of Stories by Participating CRCs

CRC	Media release title	Media release date	Science in Action Title	Science in Action Page # Summaries	Science in Action Page # Full
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CRC for Railway Engineering & Technologies	Technology to make trains run to time	13 <sup>th</sup> May 2004	Timely trains	4	28
CRC for Welded Structures	Aussie Welding Technology Takes off Globally	24 <sup>th</sup> Feb 2004	Welding success	4	34
CRC for Wood Innovations	Hot Technology for Australian Timber	19 <sup>th</sup> Oct 2004	Hot wood	3	26

### INFORMATION AND COMMUNICATION TECHNOLOGY

CRC for Australian Telecommunications	\$6M bid for Communication Explosion	2 <sup>nd</sup> March 2004	Internet calling	8	50
CRC for Enterprise Distributed Systems Technology	Setting New World Health Records	27 <sup>th</sup> July 2004	Healthcare advance	6	38
Australian Photonics CRC	Optic Fibre in Medical Breakthrough	6 <sup>th</sup> Jan 2004	Imaging breakthrough	7	43
	Australia's new super-light, super-powerful radar	12 <sup>th</sup> Feb 2004	Radar revolution	7	47
	Australian ICT Hits the Jackpot	4 <sup>th</sup> May 2004	Spinoff jackpot	8	52
CRC for Satellite Systems	Australian Space Engine for Satellite Trial	16 <sup>th</sup> March 2004	Space engine	8	48
CRC for Sensor Signal and Information Processing	Breakthrough in Radar, Water Control	10 <sup>th</sup> Feb 2004	Neater networking	7	45
CRC for Smart Internet Technology	Opening a Treasure Chest of Memories	24 <sup>th</sup> Aug 2004	Keeping in touch	6	39
	Real Sound in Cyberspace	24 <sup>th</sup> Aug 2004	Real sound	9	54
CRC for Technology Enabled Capital Markets	Blow to Economic Terrorism	17 <sup>th</sup> Feb 2004	Blow to fraudsters	6	41

### MINING AND ENERGY

A J Parker CRC for Hydrometallurgy	\$295 M payoff flows from thicker sludge	6 <sup>th</sup> July 2004	Sludge success	10	56
CRC for Clean Power from Lignite	Greenhouse Cut Brightens Energy Future	3 <sup>rd</sup> Aug 2004	Greener coal	10	60
CRC for Coal in Sustainable Development	Claims over High Australian Mercury Emissions Shown to be False	31 <sup>st</sup> Aug 2004	Mercury debunk	11	65
CRC for Greenhouse Gas Technologies	Global Recognition for Australian Geosequestration Research	15 <sup>th</sup> Nov 2004	Carbon capture	12	68
CRC for Landscape Environments and Mineral Exploration	The secret of nuggets	27 <sup>th</sup> Jan 2004	Growing nuggets	11	61
	Staking a Killer in an Invisible Landscape	20 <sup>th</sup> July 2004	Salinity search	12	67
CRCMining	Towards the World's First Automated Coal Mines	6 <sup>th</sup> April 2004	Robot mines	11	63
	Drill to tap vast new energy reserves	16 <sup>th</sup> Nov 2004	Energy drill	12	70
CRC for Predictive Mineral Discovery	Breakthrough in Gold Discovery	18 <sup>th</sup> May 2004	Gold finder	10	58

## Appendix A: Index of Stories by Participating CRCs

CRC	Media release title	Media release date	Science in Action Title	Science in Action Page # Summaries	Science in Action Page # Full
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### AGRICULTURE AND RURAL BASED MANUFACTURING

Australian Cotton CRC	Come Clean, Go Clean, Beat Root Rot	10 <sup>th</sup> Aug 2004	Beating rootrot	15	79
CRC for Australian Sheep Industry	Here comes the self-managing sheep	14 <sup>th</sup> Sept 2004	Self-managing sheep	14	73
CRC for Cattle and Beef Quality	Breakthrough in Beef	5 <sup>th</sup> Oct 2004	Beef breakthrough	14	72
CRC for Cattle and Beef Quality	Cheerful Animals Give Tender Meat	3 <sup>rd</sup> Nov 2004	Tenderer meat	15	77
CRC for Sugar Industry Innovation through Biotechnology	Plastics promise a sweeter future for Sugar	9 <sup>th</sup> March 2004	Sugar plastics	16	83
CRC for Sustainable Rice Production	More Rice for Less Water	23 <sup>rd</sup> March 2004	More rice, less water	14	75
	Murrumbidgee as World's Reference Catchment	13 <sup>th</sup> April 2004	Model catchment	15	80
CRC for Viticulture	Scientists turn less water into better wine	21 <sup>st</sup> Dec 2004	Flavour saver	16	85

### ENVIRONMENT

Antarctic Climate & Ecosystems (ACE) CRC	Warning on Bio-Treasure Hunt in Deep Waters	2 <sup>nd</sup> Feb 2004	Ocean warning	18	96
CRC for the Great Barrier Reef World Heritage Area	Reef website keeps an eye on Australia's Icon	20 <sup>th</sup> Jan 2004	Reef watch	18	94
CRC for Plant-based Management of Dryland Salinity	"Hairy Canary" to help beat salinity	28 <sup>th</sup> Sept 2004	Hairy canary	17	91
CRC for Sustainable Tourism	Visitors to help save the Reef	14 <sup>th</sup> Dec 2004	Coral chart	19	100
CRC for Tropical Rainforest Ecology & Management	Catastrophic Changes demand Govt response	29 <sup>th</sup> March 2004	Climate impact	17	88
	Rainforest bats "at risk"	12 <sup>th</sup> Oct 2004	Bat threat	18	95
CRC for Tropical Savannas Management	The decline of the tropical wallaroo	7 <sup>th</sup> Dec 2004	Roo retreat	19	98
CRC for Water Quality and Treatment	Scientist Reveals the Hidden World of Water Microbes	7 <sup>th</sup> Sept 2004	Water bugs	17	92

### MEDICAL SCIENCE AND TECHNOLOGY

CRC for Aboriginal Health	Skin Disease Link to Heart, Kidney Failure	24 <sup>th</sup> May 2004	Skin danger	20	104
CRC for Asthma Ltd	Asthma emergencies: What's going wrong?	20 <sup>th</sup> Apr 2004	Asthma emergencies	21	108
CRC for Cochlear Implant and Hearing Aid Innovation	Early Language Diary for Profoundly Deaf Children	15 <sup>th</sup> June 2004	Deafness diary	21	110
CRC for Diagnostics	Australian early alert to Bio-Terror	30 <sup>th</sup> March 2004	Bio-terror watch	20	102
CRC for Vaccine Technology	Ninety Trillion Aliens that help keep us healthy	13 <sup>th</sup> July 2004	Protective bugs	20	106

## Appendix B: Contact details of CRCA CRCs (14/02/05)

### Sector: Manufacturing Technology

#### CRC Advanced Composite Structures

Professor Murray Scott  
Ph: 03 9646 6544  
Fax: 03 9646 8352  
E: [crc-accs@crc-accs.com.au](mailto:crc-accs@crc-accs.com.au)  
W: <http://www.crc-accs.com.au>

#### CRC for Bioproducts

Dr Doug Hawley  
Ph: 03 9706 9730  
Fax: 03 9706 8936  
E: [dhawley@hellay.com.au](mailto:dhawley@hellay.com.au)  
W: <http://www.bioproducts.org.au>

#### CAST Metals Manufacturing

Professor David St John  
Ph: 07 3365 3574  
Fax: 07 3365 3888  
E: [cast@cast.crc.org.au](mailto:cast@cast.crc.org.au)  
W: <http://www.cast.crc.org.au>

#### CRC for Construction Innovation

Prof. Keith Hampson  
Ph: 07 3864 1393 (PA)  
Fax: 07 3864 9151  
E: [k.hampson@construction-innovation.info](mailto:k.hampson@construction-innovation.info)  
W: <http://www.construction-innovation.info>

#### CRC for Functional Communication Surfaces

Mr Rod Urquhart  
Ph: 03 9905 3456  
Fax: 03 9905 3413  
E: [rod.urquhart@eng.monash.edu.au](mailto:rod.urquhart@eng.monash.edu.au)  
W: [www.crc-fcs.com](http://www.crc-fcs.com)

#### CRC for Intelligent Manufacturing Systems

Mr David Galvin  
Ph: 03 9480 0400  
Fax: 03 9480 0413  
E: [info@crcimst.com.au](mailto:info@crcimst.com.au)  
W: <http://www.crcimst.com.au>

#### CRC for Microtechnology

Mr Clive Davenport  
Ph: 03 9214 8557  
Fax: 03 9214 8008  
E: [info@microtechnologycrc.com](mailto:info@microtechnologycrc.com)  
W: <http://www.microtechnologycrc.com>

#### CRC for Polymers

Dr Ian Dagley  
Ph: 03 9558 8111  
Fax: 03 9558 8122  
E: [polymers@crpc.com.au](mailto:polymers@crpc.com.au)  
W: <http://www.crpc.com.au>

#### CRC for Railway Engineering & Technologies

Mr Dudley Roach  
Ph: 07 4930 9597  
Fax: 07 4930 6984  
E: [d.roach@cqu.edu.au](mailto:d.roach@cqu.edu.au)  
W: <http://www.railcrc.cqu.edu.au>

#### CRC for Welded Structures

Dr Colin Chipperfield  
Ph: 02 4252 8889  
Fax: 02 4226 9841  
E: [colin\\_chipperfield@uow.edu.au](mailto:colin_chipperfield@uow.edu.au)  
W: <http://www.crcws.com.au>

#### CRC for Wood Innovations

Professor Peter Vinden  
Ph: 03 8344 5250  
Fax: 03 9349 4172  
E: [pvinden@unimelb.edu.au](mailto:pvinden@unimelb.edu.au)  
W: <http://www.crcwood.unimelb.edu.au>

### Sector: Information & Communication Technology

#### Australasian CRC for Interaction Design (ACID)

Professor Jeffery Jones  
Ph: 07 3337 7821  
Fax: 07 3337 7834  
E: [idx@qut.com](mailto:idx@qut.com)  
W: <http://www.interactiondesign.com.au>

#### CRC for Australian Telecommunications

Dr Leith Campbell  
Ph: 03 8610 8115  
Fax: 03 8610 8111  
E: [info@atcrc.com](mailto:info@atcrc.com)  
W: <http://www.telecommunications.crc.org.au>

#### CRC for Integrated Engineering Asset Management (CIEAM)

Professor Joseph Mathew  
Ph: 07 3864 1471  
Fax: 07 3864 4459  
E: [j.mathew@cieam.com](mailto:j.mathew@cieam.com)  
W: <http://www.cieam.com>

## Appendix B: Contact details of CRCA CRCs (14/02/05)

### **CRC Enterprise Distributed Systems Technology**

Mr Mark Gibson  
Ph: 07 3365 4310  
Fax: 07 3365 4311  
E: Orme.Appleford@dstc.edu.au  
W: <http://www.dstc.edu.au>

### **Australian Photonics CRC**

Professor Simon Fleming  
Ph: 02 9209 4790 02 9351 1926 (Div)  
Fax: 02 9209 4795  
E: [info@photonics.crc.org.au](mailto:info@photonics.crc.org.au)  
W: <http://www.photonics.com.au>

### **CRC for Satellite Systems**

Dr Andrew Parfitt  
Ph: 02 6281 8529  
Fax: 02 6281 8521  
E: [satsys@crcss.csiro.au](mailto:satsys@crcss.csiro.au)  
W: <http://www.crcss.csiro.au>

### **CRC for Sensor Signal & Information Processing**

Prof. Mathew Cuthbertson  
Ph: 08 8302 3942  
Fax: 08 8302 3124  
E: [info@cssip.edu.au](mailto:info@cssip.edu.au)  
W: <http://www.cssip.edu.au>

### **CRC for Smart Internet Technologies**

Professor Darrell Williamson  
Ph: 02 8374 5080  
Fax: 02 8374 5090  
E: [darrell.williamson@smartinternet.com.au](mailto:darrell.williamson@smartinternet.com.au)  
W: [www.smartinternet.com.au](http://www.smartinternet.com.au)

### **CRC for Spatial Information**

Mr Peter Woodgate  
Ph: 03 8344 9200  
Fax: 03 9349 5185  
E: [peterww@unimelb.edu.au](mailto:peterww@unimelb.edu.au)  
W: [www.spatialinfocrc.org](http://www.spatialinfocrc.org)

### **CRC for Technology Enabled Capital Markets**

Professor Michael Aitken  
Ph: 02 9233 7999  
Fax: 02 9236 9177  
E: [aitken@cmcrc.com.au](mailto:aitken@cmcrc.com.au)  
W: [www.cmcrc.com](http://www.cmcrc.com)

## **Sector: Mining and Energy**

### **AJ Parker CRC for Hydrometallurgy**

Mr Mark Woffenden  
Ph: 08 9360 2552  
Fax: 08 9310 8481  
E: [admin@parkercentre.crc.org.au](mailto:admin@parkercentre.crc.org.au)  
W: <http://www.parkercentre.crc.org.au>

### **CRC for Clean Power from Lignite**

Dr Peter Jackson  
Ph: 03 8542 0800  
Fax: 03 9561 0710  
E: [reception@cleanpower.com.au](mailto:reception@cleanpower.com.au)  
W: <http://www.cleanpower.com.au>

### **CRC Coal in Sustainable Development**

Mr Frank van Schagen  
Ph: 07 3871 4400  
Fax: 07 3871 4444  
E: [Frank.vanSchagen@ccsd.biz](mailto:Frank.vanSchagen@ccsd.biz)  
W: <http://www.ccsd.biz>

### **CRC for Greenhouse Gas Technologies**

Dr Peter Cook, CBE  
Ph: 02 6200 3366  
Fax: 02 6230 0448  
E: [pjcook@co2crc.com.au](mailto:pjcook@co2crc.com.au)  
W: <http://www.co2crc.com.au>

### **CRC Landscape Environments & Mineral Exploration**

Dr Dennis Gee  
Ph: 08 6436 8786  
Fax: 08 6436 8560  
E: [Dennis.Gee@csiro.au](mailto:Dennis.Gee@csiro.au)  
W: <http://crcleme.org.au>

### **CRCMining**

Prof. Michael Hood  
Ph: 07 3365 5640  
Fax: 07 3365 5636  
E: [info@crcmining.com.au](mailto:info@crcmining.com.au)  
W: <http://www.crcmining.com.au>

### **CRC for Predictive Mineral Discovery**

Dr Robert Haydon  
Ph: 03 8344 6514  
Fax: 03 8344 7761  
E: [b.allen@unimelb.edu.au](mailto:b.allen@unimelb.edu.au)  
W: <http://www.pmdcrc.com.au>

## Appendix B: Contact details of CRCA CRCs (14/02/05)

### **CRC for Sustainable Resource Processing**

Mr Stevan Green  
Ph: 08 6436 8734  
Fax: 08 6436 8557  
E: [stevan.green@csrp.com.au](mailto:stevan.green@csrp.com.au)  
W: <http://www.csrp.com.au>

### **Sector: Agriculture and Rural Based Manufacturing**

#### **Australian Biosecurity CRC for Emerging Infectious Disease**

Dr Stephen Prowse  
Ph: 07 3346 8861  
Fax: 07 3346 8862  
E: [stephen.prowse@abcrc.org.au](mailto:stephen.prowse@abcrc.org.au)  
W: <http://www1.abcrc.org.au>

#### **CRC for Australian Cotton**

Mr Guy Roth  
Ph: 02 6799 1509  
Fax: 02 6799 1171  
E: [Guy.Roth@csiro.au](mailto:Guy.Roth@csiro.au)  
W: <http://www.cotton.crc.org.au>

#### **Australian Poultry CRC**

Professor Mingan Choct  
Ph: 02 6773 5121  
Fax: 02 6773 3050  
E: [mchoct@une.edu.au](mailto:mchoct@une.edu.au)  
W: [www.poultrycrc.com.au](http://www.poultrycrc.com.au)

#### **CRC for Australian Sheep Industry**

Prof. James Rowe  
Ph: 02 6776 1465  
Fax: 02 6776 1334  
E: [james.rowe@csiro.au](mailto:james.rowe@csiro.au)  
W: <http://www.sheep.crc.org.au/>

#### **CRC for Cattle & Beef Quality**

Prof. Bernie Bindon  
Ph: 02 6773 3501  
Fax: 02 6773 3500  
E: [beefcrc@metz.une.edu.au](mailto:beefcrc@metz.une.edu.au)  
W: <http://www.beef.crc.org.au>

#### **Grain Foods CRC Ltd**

Dr Jan Mahoney  
Ph: 02 8877 7875  
Fax: 02 8877 7879  
E: [j.mahoney@grainfoodscrc.com.au](mailto:j.mahoney@grainfoodscrc.com.au)  
W: <http://www.grainfoodscrc.com.au>

### **CRC for Innovative Dairy Products**

Dr Paul Donnelly  
Ph: 03 9607 8607  
Fax: 03 960 2044  
E: [paul.donnelly@dairycrc.com](mailto:paul.donnelly@dairycrc.com)  
W: <http://www.dairycrc.com>

### **CRC for Molecular Plant Breeding**

Dr Bryan Whan  
Ph: 03 9479 1698  
Fax: 03 9479 5022  
E: [mpb@molecularplantbreeding.com](mailto:mpb@molecularplantbreeding.com)  
W: <http://www.molecularplantbreeding.com>

### **CRC for Sugar Industry Innovation through Biotechnology**

Dr Peter Twine  
Ph: 07 3365 7502  
Fax: 07 3865 4773  
E: [peter.twine@crcsugar.com](mailto:peter.twine@crcsugar.com)  
W: <http://www.crcsugar.com>

### **CRC for Sustainable Aquaculture of Fin Fish**

Dr Peter Montague  
Ph: 08 8207 5302  
Fax: 08 8207 5406  
E: [peter.montague@aquafincrc.com.au](mailto:peter.montague@aquafincrc.com.au)  
W: <http://www.aquafincrc.com.au>

### **CRC for Sustainable Production Forestry**

Professor Rod Griffin  
Ph: 03 6226 7947  
Fax: 03 6226 7942  
E: [CRCForestry@ffp.csiro.au](mailto:CRCForestry@ffp.csiro.au)  
W: <http://www.forestry.crc.org.au>

### **CRC for Sustainable Rice Production**

Dr Laurie Lewin  
Ph: 02 6951 2713  
Fax: 02 6951 2533  
E: [crc.rice@agric.nsw.gov.au](mailto:crc.rice@agric.nsw.gov.au)  
W: <http://www.ricecrc.org>

### **CRC for Tropical Plant Protection**

Professor John Irwin  
Ph: 07 3365 2790  
Fax: 07 3365 4771  
E: [p.chattin@tpp.uq.edu.au](mailto:p.chattin@tpp.uq.edu.au)  
W: <http://www.tpp.uq.edu.au>

### **CRC for Value Added Wheat**

Dr Bill Rathmell  
Ph: 02 9490 8488  
Fax: 02 9490 8503  
E: [hwarwick@wheatcrc.com.au](mailto:hwarwick@wheatcrc.com.au)  
W: <http://www.wheat-research.com.au/>



## Appendix B: Contact details of CRCA CRCs (14/02/05)

### **CRC for Viticulture**

Dr Jim Hardie  
Ph: 08 8303 9405  
Fax: 08 8303 9449  
E: [jim.hardie@crcv.com.au](mailto:jim.hardie@crcv.com.au)  
W: <http://www.crcv.com.au>

### **Sector: Environment**

#### **Antarctic Climate & Ecosystems (ACE)CRC**

Professor Bruce Mapstone  
Ph: 03 6226 7888  
Fax: 03 6226 2973  
E: [Bruce.Mapstone@acecrc.org.au](mailto:Bruce.Mapstone@acecrc.org.au)  
W: <http://www.acecrc.org.au>

#### **CRC for Australian Weed Management**

Dr Rachel McFadyen  
Ph: 08 8303 6590/07 3362 9388  
Fax: 08 8303 7311/07 3896 9623  
E: [rachel.mcfadyen@nrm.qld.gov.au](mailto:rachel.mcfadyen@nrm.qld.gov.au)  
E: [sue.peters@adelaide.edu.au](mailto:sue.peters@adelaide.edu.au) (pa)  
W: <http://www.weeds.crc.org.au>

#### **CRC for Biological Control of Pest Animals**

Dr Tony Peacock  
Ph: 02 6242 1768  
Fax: 02 6242 1511  
E: [office@pestanimal.crc.org.au](mailto:office@pestanimal.crc.org.au)  
W: <http://www.pestanimal.crc.org.au>

#### **CRC for Bushfire**

Mr Kevin O'Loughlin  
Ph: 03 9412 9601  
Fax: 03 9416 3717  
E: [kevin.oloughlin@bushfirecrc.com](mailto:kevin.oloughlin@bushfirecrc.com)  
W: <http://www.bushfirecrc.com>

#### **CRC for Catchment Hydrology**

Professor Rodger Grayson  
Ph: 03 9905 2704  
Fax: 03 9905 5033  
E: [rodger@civenv.unimelb.edu.au](mailto:rodger@civenv.unimelb.edu.au)  
W: <http://www.catchment.crc.org.au>

#### **CRC for Coastal Zone, Estuary & Waterway Management**

Dr Rob Fearon  
Ph: 07 3362 9398  
Fax: 07 3362 9379  
E: [rob.fearon@nrm.qld.gov.au](mailto:rob.fearon@nrm.qld.gov.au)  
W: <http://www.coastal.crc.org.au>

### **Desert Knowledge CRC**

Dr Mark Stafford Smith  
Ph: 08 8950 7162  
Fax: 08 8950 7187  
E: [Mark.StaffordSmith@csiro.au](mailto:Mark.StaffordSmith@csiro.au)  
W: [www.desertknowledge.com.au](http://www.desertknowledge.com.au)

### **Environmental Biotechnology CRC P/L**

Dr David Garman  
Ph: 02 9209 4963  
Fax: 02 9209 4980  
E: [d.garman@ebcrc.com.au](mailto:d.garman@ebcrc.com.au)  
W: <http://www.ebcrc.com.au>

### **CRC for Freshwater Ecology**

Professor Gary Jones  
Ph: 02 6201 5168  
Fax: 02 6201 5038  
E: [gjones@enterprise.canberra.edu.au](mailto:gjones@enterprise.canberra.edu.au)  
W: <http://freshwater.canberra.edu.au>

### **CRC for the Great Barrier Reef World Heritage Area**

Professor Russell Reichelt  
Ph: 07 4729 8400  
Fax: 07 4729 8499  
E: [info@crcreef.com](mailto:info@crcreef.com)  
W: <http://www.reef.crc.org.au>

### **CRC for Greenhouse Accounting**

Dr Michael Robinson  
Ph: 02 6125 4020  
Fax: 02 6125 5095  
E: [michael.robinson@greenhouse.crc.org.au](mailto:michael.robinson@greenhouse.crc.org.au)  
W: [www.greenhouse.crc.org.au](http://www.greenhouse.crc.org.au)

### **CRC for Irrigation Futures**

Dr Mathew Durack  
Ph: 07 4631 2046  
Fax: 07 4631 1870  
E: [durackm@usq.edu.au](mailto:durackm@usq.edu.au)  
W: <http://www.irrigationfutures.org.au>

### **CRC for Plant-based Management of Dryland Salinity**

Mr Kevin Goss  
Ph: 08 6488 2555  
Fax: 08 6488 2856  
E: [kgoss@fnas.uwa.edu.au](mailto:kgoss@fnas.uwa.edu.au)  
W: [www.crcsalinity.com](http://www.crcsalinity.com)

## Appendix B: Contact details of CRCA CRCs (14/02/05)

### **Sustainable Tourism CRC**

Professor Terry De Lacy  
Ph: 07 5552 8116  
Fax: 07 5552 8171  
E: [info@crctourism.com.au](mailto:info@crctourism.com.au)  
W: <http://www.crctourism.com.au>

### **CRC Tropical Rainforest Ecology and Management**

Professor Nigel Stork  
Ph: 07 4042 1246  
Fax: 07 4042 1247  
E: [Nigel.Stork@jcu.edu.au](mailto:Nigel.Stork@jcu.edu.au)  
W: <http://www.rainforest-crc.jcu.edu.au>

### **CRC Tropical Savannas Management**

Professor Gordon Duff  
Ph: 08 8946 6834  
Fax: 08 8946 7107  
E: [savanna@cdu.edu.au](mailto:savanna@cdu.edu.au)  
W: <http://savanna.cdu.edu.au>

### **CRC for Water Quality and Treatment**

Professor Don Bursill  
Ph: 08 8259 0351  
Fax: 08 8259 0228  
E: [crc@sawater.sa.gov.au](mailto:crc@sawater.sa.gov.au)  
W: <http://www.waterquality.crc.org.au>

## **Sector: Medical Science and Technology**

### **CRC for Aboriginal Health**

Professor Kerin O'Dea  
Ph: 08 8922 8473  
Fax: 08 8927 7797  
E: [ceo@crcah.org.au](mailto:ceo@crcah.org.au)  
W: <http://www.crcah.org.au/>

### **CRC for Asthma**

Mr Philip Bert  
Ph: 02 9036 3130/3125 (pa)  
Fax: 02 9036 3129  
E: [philipb@asthma.crc.org.au](mailto:philipb@asthma.crc.org.au)  
W: <http://www.asthma.crc.org.au>

### **CRC for Chronic Inflammatory Diseases**

Prof. John Hamilton  
Ph: 03 8344 6252  
Fax: 03 9347 1863  
E: [crc-cid@unimelb.edu.au](mailto:crc-cid@unimelb.edu.au)  
W: <http://www.crccid.com>

### **CRC for Cochlear Implant and Hearing Aid Innovation**

Dr Robert Cowan  
Ph: 03 9667 7508 (EA)  
Fax: 03 9667 7518  
E: [r.cowan@unimelb.edu.au](mailto:r.cowan@unimelb.edu.au)  
W: <http://www.bionicear.com.au/crc>

### **CRC for Diagnostics**

Professor Ian Gardner  
Ph: 07 3864 4015  
Fax: 07 3864 1534  
E: [i.gardner@qut.com](mailto:i.gardner@qut.com)  
W: <http://diagnosticsCRC.org>

### **CRC for Oral Health Science**

Professor Eric Reynolds  
Ph: 03 9341 0270  
Fax: 03 9341 0236  
E: [e.reynolds@unimelb.edu.au](mailto:e.reynolds@unimelb.edu.au)

### **CRC for Vaccine Technology**

Professor Anne Kelso  
Ph: 07 3362 0430  
Fax: 07 3362 0104  
E: [CRCVT@qimr.edu.au](mailto:CRCVT@qimr.edu.au)  
W: <http://www.crc-vt.qimr.edu.au>

### **Vision CRC**

A/Professor Deborah Sweeney  
Ph: 02 9385 7409 (PA)  
Fax: 02 9385 7401  
E: [visioncrc@visioncrc.org](mailto:visioncrc@visioncrc.org)  
W: <http://www.visioncrc.org>