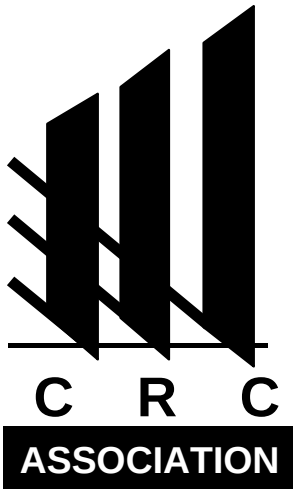

SCIENCE IN *ACTION* 05

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

2005

Contents

Introduction

Australia's Cooperative Research Centres program has an international reputation for focussing the best brains in science and industry across Australia on opportunities and challenges of national priority.

The following 38 stories are examples of the many exceptional outcomes and achievements reported by the CRCs during 2005.

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

The stories were compiled as part of the CRC Association's 2005 National Media Initiative by Julian Cribb & Associates. The original media releases are available on www.crca.asn.au.

The CRC Programme 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 05*

SUMMARIES

Economic impact

Research boost to economy

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Australia is $1.1 billion better off, or $0.60 wealthier for every $1 invested by the Federal Government in CRC research, according to the first investigation ever to quantify the net benefits of a major national R&D program.

The study, by the Allen Consulting Group, looked only at research where the benefits had been delivered, were clearly attributable to CRC research, were validated by industry or other users and would not otherwise have occurred.

Manufacturing Technology

Alloy shines

A new Australian magnesium alloy featuring mirror finish, strength and lightness is exciting huge interest among manufacturers and designers around the world.

AM-lite is a magnesium high-pressure die casting alloy developed by an international research team led by Australian firm Advanced Magnesium Technologies (AMT) and the CAST Cooperative Research Centre (CAST CRC).

New drugs from old

Australian scientists are using the natural processing ability of plants to create new drugs from old, and design the next generation of anti-cancer treatments.

Biotransformation – using plant cells in culture – to create new pharmaceuticals safer, more powerful and effective than the old ones they are made from, is opening new horizons in drug design says Professor Tony Bacic of the Cooperative Research Centre for Bioproducts and the University of Melbourne.

Solar suburbs

Australian scientists are pioneering a world advance in city planning – entire suburbs that save energy and slash thousands of tonnes of greenhouse emissions through better layout.

Passive solar homes are all the rage among new home owners anxious to save money and live more sustainably – but their best intentions can be defeated by poor suburb design, says CRC *Construction Innovation* researcher Michael Ambrose.

Robot repair

Australian scientists have successfully carried out the world's first on-the-spot robotic repair of power station turbine blades, opening the way for potentially huge savings for the global energy industry.

Using a robot, a special 'cool' laser and a 'gun' that fires a surfacing compound, a team from the Cooperative Research Centre for Welded Structures (CRC-WS) demonstrated that damaged steam turbine blades can be totally renovated without removing them from their mounting.

Tracking champions

Australian athletes are going into international competition, including the Commonwealth Games, trained with a high technology that helps them shave fractions of a second off their times.

Traqua, developed by the CRC for microTechnology for the Australian Institute of Sport (AIS), is the leading edge of the next sports revolution – providing hard data in real time on an athlete's motion to reinforce the coach's eye and instincts.

Safer crossings

Pioneering research by scientists in the Co-operative Research Centre for Railway Engineering and Technologies (Rail CRC) has found that driver behaviour is a key factor in crashes at road-rail intersections.

Their research indicates that the best hope for improved safety lies in reducing the risk through changes in driver behaviour.

Healthier projects

An Australian team is developing world-first technology to provide a rapid cure for under-performing construction projects. The development of the tool, *"Project Diagnostics"*, was sponsored by the Cooperative Research Centre for Construction Innovation (CRC CI).

Project Diagnostics is set to revolutionise the field of project management, helping to assist troubled projects before they become disasters. The new software tool identifies specific areas of poor project health, pinpoints the root causes and suggests remedies.

Information and Communication Technologies

Network guardians

Australian scientists have solved a problem that has had the world's safety and security industries tied up in knots – how to watch hundreds of security cameras at the same time, using them to spot trouble and track offenders.

A breakthrough in intelligent surveillance was achieved in the Cooperative Research Centre for Sensor Signal and Information Processing (CSSIP), and is now watching over Sydney's celebrated icons, the Harbour Bridge and ANZAC bridge.

Virtual dreaming

People of all backgrounds will be able to experience an authentic Aboriginal dreaming, as a result of a remarkable fusion between cultural knowledge dating back 40,000 years and 21st century virtual reality technology.

Developed by the Australasian Cooperative Research Centre for Interaction Design (ACID), researchers have taken the concept of 'virtual heritage' – a visit to some ancient place, monument or event – a large stride further.

Rapid reaction

More lives will be saved as emergency and rescue services mount quicker and more comprehensive responses to disasters using revolutionary emergency management technology developed by Australian researchers.

Whether it's a bushfire, a tsunami, a marine oil spill or an industrial accident, the system developed by the Cooperative Research Centre for Spatial Information (CRCSI) puts vital information at the fingertips of crisis managers in seconds – at headquarters, in the bush or at sea.

TV 'mouse'

A revolutionary technology is being developed by a team of Australian researchers that will change the way people watch and use TV.

A team in the Australasian CRC for Interaction Design (ACID) led by Professor Duane Varan has developed what may be the world's first television 'mouse', a clip-on device that enables the user to give commands to their TV with gestures.

Infant ear test

Hundreds of newborn Australian babies will have a better chance in life thanks to a revolutionary hearing test developed by researchers in the Cooperative Research Centre for Sensor Signal and Information Processing (CSSIP).

Hearing impairment affects about 400 of the 250,000 Australian babies born each year and an estimated 20,000 worldwide. Its consequences can include lower IQ, learning, speech and behavioural problems. In many cases the harm is lifelong and the costs to both the individual and society high.

Satellite broadband

Researchers at the Cooperative Research Centre for Satellite Systems (CRCSS) have demonstrated high quality voice services via satellite broadband to remote communities in central Australia.

For the first time some Outback remote communities may even have faster, better connections than city Australia, as the satellite link will leapfrog the bottlenecks caused by phone exchanges and routers on current metropolitan services, says CRCSS chief executive Professor Andrew Parfitt.

Medifraud detector

The world's first real-time health fraud detection system, developed by the Capital Markets Cooperative Research Centre in partnership with The Health Bureau Pty Limited, is being deployed to catch health fund claims cheats.

The technology checks the details of every claim and rates it against recognised treatment pathways and health funds eligibility criteria, says CRC Capital Markets CEO Professor Mike Aitken.

Mining & Energy

Beach bonanza

Australian scientists have uncovered compelling evidence for the oldest, richest and one of the largest deposits of mineral sands yet found on Earth.

Research by scientists in the CRC for Landscape Environments and Mineral Exploration (CRC LEME), Primary Industries & Resources SA (PIRSA) and mining company Iluka Resources PL has pieced together clues to what is shaping as one of the richest mineral provinces in Australian history.

Microbe miners

Scientists in Australia's AJ Parker CRC for Hydrometallurgy are developing a way to dramatically improve the extraction of metals such as gold, copper, zinc and nickel using microbes.

The technology offers a major boost to a technique known as 'heap bioleaching', in which microbes go to work on huge piles of ore and dissolve out the minerals, says Dr Helen Watling.

Carbon hunt

Australia has the capacity to store huge volumes of its future greenhouse emissions in depleted gas fields and saline aquifers and in underground coal beds, some of the nation's leading researchers have reported.

The finding will help Australia's national prospects for curbing its greenhouse emissions from power generation, says Dr Peter Cook, Chief Executive of the Cooperative Research Centre for Greenhouse Gas Technologies (CO2CRC).

Golden gums

Gum trees and mulga may point the way to Australia's next mineral strikes, in a scientific breakthrough with promising implications for the nation's $12 billion gold and base metals industries.

Scientists in the CRC for Landscape Evolution and Mineral Exploration (LEME) have shown that certain native Australian trees provide giveaway clues to mineral deposits hidden beneath the mantle of transported sediment (called regolith) that carpets two thirds of the continent.

Salt into steel

Ironmaking is offering a new way for Australia to tackle three of its greatest environmental challenges – salinity, renewable energy and greenhouse emissions.

In an imaginative solution that combines environmental protection with heavy industry, researchers from two Cooperative Research Centres (CRCs) are investigating the use of charcoal from oil mallee trees for making iron and steel.

Big digger

Australian researchers have achieved a technological breakthrough capable of lifting mine productivity up to10 per cent in the nation's $60 billion minerals and energy sector.

New monitoring technology developed by CRCMining and industry partner P&H MinePro Services promises to revolutionise the performance of two of the industry's workhorses – the electric shovel and the large haul truck.

Spectrolaser success

Researchers from the CRC for Clean Power from Lignite (CRC CPL) have designed and commercialised a new, super-powerful tool for analysing the atomic elements in virtually any material, quickly and cheaply.

“The Spectrolaser can determine the elemental makeup all kinds of materials. It produces a bright spark – or plasma – at the surface of the target substance and the composition of the light emitted is analysed by a unique spectrometer and detection system,” explains CRC CPL chief executive Dr Peter Jackson.

Agriculture & Rural-based Manufacturing

Better beer

In a program which promises to boost the nation’s billion dollar barley exports by up to a third, a team at the Molecular Plant Breeding Cooperative Research Centre (MPBCRC) is busy turning cattle feed into top quality beer-making ingredients.

Instead of trying to bolster the performance of established malting barleys, the MPBCRC team used molecular marker technology to turn hardy, feed barleys into elite malt performers.

E-Sheep

The 21st century Aussie sheep will decide for itself when to change paddocks, when to get weighed, and when to go off to market. And making its own decisions will make it a happier, healthier sheep.

According to the Australian Sheep Industry CRC and NSW DPI Project Officer Bill Murray, electronic flock management is better for the sheep, more efficient for the grazier and ultimately better for the consumer, in the form of more tender meat.

Cyber-vineyards

A combination of clever software and world best-practice vineyard know-how are giving Australia’s $3 billion wine industry a fresh global edge.

PAM AusVit contains tools for improving grape quality, reducing crop losses, predicting disease outbreaks and minimising chemical use in the vineyard.

Cold rice

CRC researchers have made an important breakthrough in identifying why cold snaps during flowering cause huge reductions in rice yield.

Researchers with the Rice CRC are cross breeding high yielding Australian cultivars with cold-resistant Tibetan rice to try and develop a strain which has the strengths of each.

Rooting out rot

Scientists from the Cooperative Research Centre for Tropical Plant Protection have developed a rapid identikit that will enable growers to detect and identify the common cause of root-rot, *Phytophthora*.

The deadly disease *Phytophthora* is estimated to cost 10% in lost revenue for the nursery industry each year and another $300 million in losses across Australia's farming sector.

Disease predictor

A major Australian advance in disease prediction is giving health authorities worldwide increased power to predict the impact of an outbreak of an epidemic like avian flu or SARS on the population – and take early action.

The Australian Biosecurity Cooperative Research Centre for Emerging Infections Disease has designed and developed the Pooled Prevalence Calculator and made it available nationally and worldwide through the internet.

Tropical wins

A powerful new scientific weapon against anthracnose – the soft brown rot that spoils avocadoes – is delivering $40 million in benefits to the nation's avocado industry, as well as higher quality fruit to consumers.

The return is just a part of $150 million in benefits being delivered to the Australia's tropical farming industries from ten research projects, according to a new economic analysis. Every dollar spent on these projects has returned eleven dollars in industry and wider benefits.

Environment

Predicting bushfires

Australian scientists are developing reliable tools for predicting fire behaviour which may save lives and help to limit damage.

Fire researchers in the Bushfire Cooperative Research Centre are working on data from extensive experimental burns in Western Australia, New South Wales, and in New Zealand to produce a simple and practical manual which can be used by fire managers and fire fighters on the ground, as well as researchers.

Desert lifesavers

Health-giving foods and life-saving medications may soon be among the gifts of Australia's Indigenous people to the rest of the Australian nation. At the same time, they will help to keep alive the world's oldest living culture, preserving its knowledge and wisdom for future generations.

Desert Indigenous communities are working with researchers from the Desert Knowledge CRC to preserve age-old knowledge and understanding about the healing and health-giving properties of Australia's desert plants.

Pollution preventer

Potentially hazardous pollution is escaping into Australia's waterways from the nation's ubiquitous septic tank systems. Thousands of homes and hundreds of shire councils will soon benefit directly from improved rural building and design standards reflecting world-leading research into the flow paths of sewage.

A combination of field work and computer simulation by the Coastal Cooperative Research Centre to show the flow paths of effluent has important consequences for municipal planning and risk assessment.

Salt-tolerant wheat

A world-wide search for a salt-resistance in wild relatives of wheat may have ended – in West Australia's Wheatbelt, where the search began.

"A common weed called sea barley grass, which is a distant relative of farmed wheats, may be the solution to improving wheat production on our salty soils,"

says Tim Colmer of the Cooperative Research Centre for the Plant-Based Management of Dryland Salinity.

Protecting dugongs

Dugongs are shy creatures which spend their lives peacefully grazing the meadows of seagrass along the northern coasts of Australia, but according to James Sheppard of CRC Reef, they can and do travel vast distances at quite high speeds.

Using GPS tracking technology, the team has built up a detailed picture of the behaviour of a group of some two dozen dugongs from coastal Queensland to study how they respond to major changes caused by urbanisation.

Healthier streams

Streams and waterways in Australia's city areas are ecologically degraded, scientists say - but the answer to the problem is within reach.

A team from the Cooperative Research Centre for Freshwater Ecology has studied streams in Melbourne, Canberra and Brisbane and concluded that that a 'treatment train' is needed to maintain urban and suburban water quality, and that planners of the future need to incorporate the concept into urban design.

Reducing roadkill

Scientists from the Cooperative Research Centre for Rainforest Ecology say adoption of two technologies will help reduce the roadkill of Australian native animals where roads cut through tropical forest.

Dr Miriam Goosem of the Cooperative Research Centre for Rainforest Ecology says while 'fauna underpasses' are not a new idea, with new research they are an idea whose time has come. 'Fauna overpasses' in the form of rope bridges for tree animals are also proving successful.

Medical Science & Technology

Tooth saviour

Australian scientists have discovered a highly effective new weapon in the fight against tooth decay and mouth disease.

Researchers from the Cooperative Research Centre for Oral Health Science (CRC OHS) have filed patents for ‘Kappacin’, a peptide derived from casein, a protein in cows’ milk. Kappacin has a deadly effect on the mouth bacteria which form dental plaque.

Wobbegong diagnosis

The spotted wobbegong may one day save Australian lives and reduce suffering – thanks to its remarkable immune system.

Wobbegongs and other sharks have some of the oldest adaptive immune systems in nature. Australian scientists in the Cooperative Research Centre for Diagnostics have developed a unique ‘library’ of the antibodies produced by shark immune systems for use in detecting and diagnosing a wide range of human diseases and poisons.

SCIENCE IN *ACTION 05*

FULL REPORTS

Economic impact

Research boost to economy

Scientific research in Australia's Cooperative Research Centres is delivering a substantial payoff to the national economy, a new study has shown.

Australia is $1.1 billion better off, or $0.60 wealthier for every $1 invested by the Federal Government in CRC research, according to the first investigation ever to quantify the net benefits of a major national R&D program.

The study, by the Allen Consulting Group, looked only at research where the benefits had been delivered, were clearly attributable to CRC research, were validated by industry or other users and would not otherwise have occurred.

"Gross domestic product (GDP) is cumulatively $1,142 million higher than would have occurred had the money spent on the CRC programme instead gone to general government expenditure," the report finds.

It concludes that real consumption in the economy was up by $763 million, real investment by $417 million and tax revenue by $66m compared to what would have been the case without CRC research.

The study highlighted case studies of science programs delivering measurable benefits to industry, for example:

- $8 million a year in net cost savings to coal miners who fitted the CRC Mining's "dig and dump" dragline automation technology to their machines
- Annual cost savings of $20 million in gas pipeline laying through use of new welding technology developed by the CRC for Welded Structures
- A $99 million reduction in capital costs and annual savings of $20.6 million from advanced thickener technology in the mineral processing industry developed by the AJ Parker CRC for Hydrometallurgy
- A $26 million sale of new heart repair technology developed in the CRC for Cardiac Technology
- Licensing revenue of $2.2 million a year from new contact lens technology developed in the Vision CRC
- Sales of $16.6 million for new fire-proof electric cable technology developed by the CRC for Polymers
- A $6 million reduction in Commonwealth drug spending due to research on corticosteroids by the Asthma CRC
- $6 million in revenue generated from the commercialisation of beef vaccines and gene marker tests developed by the CRC for Cattle and Meat Quality.

- $2.7 million generated by spinoff companies selling environmental management service, via the CRC for Environmental Biotechnology.

The CRC programme was set up in 1990 to bring Australia's best scientific minds from universities, industry and science agencies to bear on problems and opportunities of national importance. Since then a total of $9.6 billion has been committed by government, universities, industry, CSIRO and other partners.

The study is rigorous in that it looks only at research already completed and delivering measurable benefits, and according to the authors is highly conservative.

It also does not include benefits where it was difficult to attribute them fully to a CRC, for example the contribution made by the CRC for Tissue Growth & Repair to the company Gro-Pep, or that from the Hearing CRC to Cochlear Ltd, or the benefits to the nations' $6 billion cattle sector from improvements in feed efficiency developed by the Beef CRC

The Chairman of the CRC Association, Mr Tony Staley, said the report was the first to provide substantive proof of the tremendous benefits which Australia reaps from its research activities – and particularly from cooperative research between different organisations in the public and private sectors.

"Measuring the benefits of science is extraordinarily hard, because they occur over long periods of time, affect large parts of the economy and society, and are, of course, part of the wider process of innovation and investment," he says.

"However the Allen Consulting Group has provided Australia with solid evidence that science is a great economic investment, and that public and private funding in partnership delivers real benefits.

"The CRC model is uniquely Australian, and is much admired around the world. This study provides concrete evidence that we have done something rather special in this country, in the way we have structured the national research effort."

More information: http://www.crca.asn.au

Manufacturing Technology

Alloy shines

A new Australian magnesium alloy featuring mirror finish, strength and lightness is exciting huge interest among manufacturers and designers around the world.

AM-lite is a magnesium high-pressure die casting alloy developed by an international research team led by Australian firm Advanced Magnesium Technologies (AMT) and the CAST Cooperative Research Centre (CAST CRC).

The first magnesium alloy that can be readily electroplated, AM-lite is lighter, more affordable, stronger and more suitable for decorative applications than most of its competitors, including zinc, plastics, aluminium and existing magnesium alloys.

“It’s causing enormous interest in overseas markets already,” says AMT managing director Ian Hartnell. “It has huge potential for virtually any component requiring a decorative finish, such as chrome plating, in a motor vehicle or motorbike. Market research indicates that people who buy quality cars prefer real metal to metal-look-alike coated plastic.”

“When we launched AM-lite to electronics companies in Asia recently, the response was nothing short of phenomenal. They’ve been looking for cost effective solutions to a range of manufacturing problems they are having with current materials in the production of casings for mobile phones, laptop computers and cameras– and AM-lite appears to have it all.”

From chrome plated bathroom fittings to door knobs and taps, to metallic trim on mobiles, cameras and laptops, decorative magnesium is also poised to invade the home and office as the newest designer material of choice. Strong interest is also coming from makers of power tools, chainsaws, fishing tackle and other metallic products where style, strength, lightness, cost and functionality are important, he says.

In the best traditions of science, the development of AM-lite began with a serendipitous discovery. “We were actually trying to develop a low-cost magnesium alloy that resisted deformation for use in engine blocks,” explains CAST CRC chief executive Professor David StJohn. “This particular one didn’t work out for that purpose, but we noticed that castings of the alloy gave a beautiful surface finish.”

The discovery was made by researcher Dr Trevor Abbott, of Monash University, who now heads the AMT research team which is helping commercialise the new technology.

There was also drama when AM-lite underwent initial casting trials in Europe. The first two trials showed the alloy was promising but some essential properties were not up to market requirements. In a flurry of international scientific exchanges and much burning of midnight oil, the team solved the problem - and the third trial was a triumph, Prof. StJohn says.

Mr Hartnell says that the AM-lite technology will be produced under licence by partner companies in China, Japan, Europe and Canada and marketed worldwide under the AMT brand, generating substantial returns to Australia.

While retaining advantages common to magnesium alloys AM-lite diecastings have superior surface quality and definition, and thinner sections can be cast than for other magnesium alloys. It is particularly suited for decorative electroplating, powder coating and electrophoretic painting.

Compared with zinc, the alloy is 70 per cent less dense, produces three times more parts per unit weight of metal and diecast parts cost 10-30 per cent less. Compared with standard magnesium alloys it is cheaper, easier to cast and carries a much better finish, including the ability to be electroplated.

Compared to plastics AM-lite is stronger and stiffer, conducts heat, provides electromagnetic shielding and has the quality look and feel of metal rather than plastic.

The AM-lite development addresses Australia’s national research priorities three and one – frontier technologies to transform industry and a sustainable Australia.

More information: 07 3365 3574

Creating new drugs from old

Australian scientists are using the natural processing ability of plants to create new drugs from old, and design the next generation of anti-cancer treatments with reduced side-effects.

Biotransformation – using plant cells in culture – to create new pharmaceuticals safer, more powerful and effective than the old ones they are made from, is opening new horizons in drug design says Professor Tony Bacic of the Cooperative Research Centre for Bioproducts and the University of Melbourne.

“Plants use enzymes to undertake their own chemical reactions,” he explains. “By growing their cells in culture in a large fermenter, we can use them to modify existing drugs so they become more effective and be used for other purposes.”

The team is working on a number of promising anti-cancer compounds which they have produced by this method and which could not be obtained by other processes.

“The CRC for Bioproducts has built up a collection of different plant cells which are all capable of performing unique chemical transformations of existing compounds – shearing off part of a molecule here, or adding something there, to change the way the drug interacts without our body,” Prof. Bacic explains.

“The goal is to produce drugs which are much more specific in their action and which have far fewer side-effects, at a reasonable price.”

Round the world researchers are experimenting with microbes, fungi and other organisms to transform drugs, but plants have particular attributes and enzymes which make them particularly selective in how they change a drug, Prof. Bacic says.

“The big advantage of biotransformation is that it enables you to change specific parts of a complex molecule, in a water-based solution at room temperature – and to make a lot of product. There is no genetic engineering or anything like that – the plant cells do all the work for you.

“Because of the prohibitive cost of designing a new drug from scratch nowadays, it’s a particularly effective way of giving an old drug a new twist – making it more effective, or able to treat a different condition, at a comparatively low cost of production.

Prof. Bacic says the Bioproducts CRC is currently carrying out a number of transformations of existing compounds for pharmaceuticals companies.

“It’s really a way to generate greater diversity in the drugs and other chemicals we use. Because we have many different plant cells in culture, we can subject a particular compound to a range of different reactions and see what they come up with.

“This is proving far more effective as a way of producing new drugs that the conventional idea of exploring the rainforest or oceans in search of new compounds, because it is more specific.”

The CRC can carry out plant cell biotransformation at anything from small laboratory scale up to semi-industrial-scale production in a 10,000 litre reactor.

“This is probably the only facility of this kind in the world that is accessible for large-scale process development. The others are either small-scale or else tied up in existing commercial operation.”

It offers Australian pharmaceutical and chemical companies an opportunity to compete against the global drug giants by taking advantage of cutting edge chemistry that can produce high volumes at a comparatively low cost.

Prof. Bacic says the technique is also helping to protect biodiversity. “The anti-cancer drug podophyllotoxin comes from a wild plant that is being harvested to extinction in India and Pakistan. Using biotransformation, European scientists have been able to extract the same drug from a common roadside weed.”

The research addresses two of the national research priorities – a healthy Australia and developing frontier technologies to transform industry.

More information: 03 8344 5071

Solar suburbs

Australian scientists are pioneering a world advance in city planning – entire suburbs that save energy and slash thousands of tonnes of greenhouse emissions through better layout.

Passive solar homes are all the rage among new home owners anxious to save money and live more sustainably – but their best intentions can be defeated by poor suburb design, says CRC *Construction Innovation* researcher Michael Ambrose.

“New building regulations are driving builders and home buyers towards more energy-efficient homes, but we’ve found that a poorly laid-out urban subdivision can counteract their best intentions, or cost them a lot more to achieve the desired energy efficiency,” Mr Ambrose explains.

“So we decided to see what could be done by better planning the entire subdivision, so its blocks have the best orientation and shape for energy-efficient buildings to be erected on them.”

The results were astonishing: a well-designed suburb can save its residents 20 per cent on their regular power bills and, if they use solar hot water, up to two thirds of their total power bills.

It would also reduce the greenhouse emissions of the typical Australian home by 700 kilos a year and, with solar hot water, by two tonnes a year!

The problem, says Mr Ambrose, is that suburban development is still driven by a desire for maximum ‘yield’ from the land by cramming as many blocks into it as possible, regardless of the costs that poor layout will then impose on builders and home owners – or the environment.

“There’s good evidence that by doing this, developers get less money for the land, because building costs are higher to achieve the required energy rating,” Mr Ambrose says.

“There’s a strong message from consumers today that they want to live in energy-efficient homes, and both builders and developers are now starting to get it.”

A well laid-out subdivision, where homes face the right way for passive solar heating and cooling, for solar hot water heaters, for natural light and to take advantage of local breezes, can collectively save millions of dollars to its residents in power bills – and thousands of tonnes of greenhouse gas emissions through reduced electricity use.

The concept is being trialled on new urban developments at Brookwater and Kelvin Grove, Brisbane, Queensland. If all the planned 8000 new homes at Brookwater were in a solar suburb, it would save 16,000 tonnes of greenhouse emissions a year – equal to taking 3000 cars off the roads every year, Mr Ambrose says.

“A typical Queensland subdivision can achieve a 3.5 star energy rating for the average home – but one laid out for energy saving can achieve 4 or 4.5 stars per home, simply through better planning.”

The bugbear is the narrow east-west block: even a well-designed energy-saver home may have trouble meeting its ratings on this, he adds. It will probably need extra insulation and blinds, more cooling and heating and use more power for hot water.

“In Queensland and the warmer States, the single biggest consumer of energy in the dwelling is for hot water heating. The use of solar hot water systems can shift up to 90 per cent of this energy need from fossil fuels to renewable energy. Integrating solar hot water into home design from the outset is one way builders and developers can contribute to huge reductions in energy use.”

According to Mr Dayan Jayasekera, Project Manager of Springfield Land Corporation, “The Brookwater JV is committed to helping builders and purchasers arrive at cost-effective and sustainable solutions to building at Brookwater, while at the same time taking on the stewardship of looking after the environment for generations to come. Our partnership with the *Sustainable*

Subdivisions Project will help us meet that commitment."

Besides solar orientation, the CRC team is exploring the use of suburban layout to take better advantage of cooling breezes in summer. Though there has been a lot of research into wind for power generation, little as yet is known about wind patterns in suburban areas and how they can best be used to reduce use of air conditioning.

Construction Innovation CEO Professor Keith Hampson says sustainability is at the heart of the future of Australia's property and construction sector. "This project was the first in a series exploring a broad range of sustainability issues facing new subdivisions. By working closely with our partners, priorities are determined that enable us to target this research to industry needs. The important practical outcomes generated by the project will be shared with industry through publications and seminars," he says.

Prof. Hampson says the research addresses two of the National Research Priorities – a sustainable Australia and frontier technologies to transform industry.

More information: 07 3864 9295

Robot repair

Australian scientists have successfully carried out the world's first on-the-spot robotic repair of power station turbine blades, opening the way for potentially huge savings for the global energy industry.

Using a robot, a special 'cool' laser and a 'gun' that fires a surfacing compound, a team from the Cooperative Research Centre for Welded Structures (CRC-WS) demonstrated that damaged steam turbine blades can be totally renovated without removing them from their mounting.

The trial was conducted at TXU Australia's Torrens Island Power station, near Port Adelaide in SA. A collaborative partner with the CRC-WS since 2003, TXU Australia provided financial and specialist expertise to the project.

The treatment involves re-surfacing the blades – each worth $20-25,000 – with a secret metallic formulation that extends their working life almost indefinitely, says CRC-WS chief executive officer Dr Colin Chipperfield.

By repairing the blades *in situ* the CRC-TXU team has also slashed the costly downtime required to dismantle, repair and rebuild power station turbine blading, he says.

TXU Asset Manager Ralph Villarosa says it was highly successful. With some further fine tuning of the cladding process the technology offers huge potential for the power industry.

“De-blading a turbine rotor for repairs is a major exercise both in downtime and cost, and we have found that conventional welding repairs have not met our stringent safety requirements,” he says. “We are very hopeful that this technology offers a cost effective solution to refurbishing turbine blades.”

Dr Chipperfield says low pressure turbine blades are susceptible to pitting and erosion from wet steam, requiring replacement at 10-15 years depending on operating conditions. “Our technology makes it possible for them to last the life of the power station.

“This could mean a saving of up to $10 million over the life of the average power station. For Australia, that might well save $200 million or more – and for the world, well, the sky’s the limit.”

Dr Chipperfield says the repair philosophy combines three separate technologies – a programmable robot, a direct diode laser and a ‘gun’ that feeds the metallic compound into the eye of the laser, which deposits it along the edge of the turbine blade. The laser is mounted on a coaxial head that enables it to reach into otherwise inaccessible places due to blade configurations.

The direct diode laser – the only one of its kind in Australia – focuses very intense light on a very small spot on the blade surface. This small spot transmits little heat and so avoids causing distortion or heat-stress to the precision-shaped blades. The laser is also transportable, permitting repairs to be conducted ‘in situ’ at the power station.

The laser-cladding process deposits a wear-resistant coating with superior bonding and performance over conventional brazed erosion shields. The CRC believes it last 10 times longer than the original metal of the blade itself.

Dr Chipperfield says the successful trial has triggered intense interest in the technology, both among local power generators and big international firms which make turbines and blades.

“The current challenge is to turn this into a full-blown product and take it to the world,” he says, indicating that talks are already under way with a potential commercial partner.

Despite consisting of state-of-the-art robotics and laser technology, he estimates the price-tag of a robot repair rig is not high – a maximum of perhaps $400k – and would pay for itself quickly.

The CRC is already working to establish the size of the potential Australian market for steam turbine repair. It is possible more than half of our 39 power stations could use the technology.

“We’re very excited at the potential of this Australian-designed technology, not only for steam turbines, but also for use in gas turbines, boilers, impellers, hydroelectric turbines and other applications.”

Dr Chipperfield says the research addresses National Research Priority Three – frontier technologies for transforming industry.

More information: 02 4252 8889

Tracking champions

Australian athletes are going into international competition, including the Commonwealth Games, trained with a high technology that helps them shave fractions of a second off their times.

Traqua, developed by the CRC for microTechnology for the Australian Institute of Sport (AIS), is the leading edge of the next sports revolution – providing hard data in real time on an athlete’s motion to reinforce the coach’s eye and instincts.

Developed originally for rowing, the motion-sensing technology is now extensively used by the nation’s elite swimmers and is being evaluated for other sports such as football, cycling, snowboarding and sailing.

“Coaches are using the Traqua technology to get immediate feedback on athlete performance to support and quantify what they can see with their eye and stopwatch,” explains AIS senior sports physiologist Dr Tony Rice.

“It’s all about efficiency – the 1 per cent gain: how much you put in, and what you get out of it.”

Traqua consists of an unobtrusive plastic case containing micro-machined, high-precision inertial sensors, digital recording and radio equipment. These sense the athlete’s movement and position in the water, analyse it with sophisticated software and report it to the watching coach, who can then provide immediate advice on overcoming any flaws that hamper optimum performance.

In swimmers the device sits in the back of the athlete’s costume and will report things like stroke rate and symmetry, body roll, distance and lap count, split times and turn times. These enable the coach to take a much more detailed look at components of the swimmer’s stroke, body angle and motion such as roll, dip or yaw that might penalise speed through the water.

“Most sports measurements are still fairly basic – often just a stop watch and distance,” says microTech’s Shaun Holthouse. “Traqua enables the coach to analyse the athlete’s motion stroke-by-stroke in real time or play it back after. It reports in 200 times a second which gives you a huge amount of information to work with.”

The technology is now in its fourth generation, having had successful trials in the 2003 World Rowing Championships and the Athens Olympics. “Basically it’s a platform technology you can adapt to almost any sport involving body motion,” Mr Holthouse says.

As it catches on for training, he forsees the technology may also be adopted to eliminate the ‘human factor’ in judging of sports such as boxing and diving.

“We expect electronics to become an integral part of most sports equipment. Whereas today you buy just a tennis racquet, in the future you will buy a racquet that tells you how fast you serve and how clean your forehand was so that you can compare yourself to the champions”

The microTech CRC estimates the world market for such advanced training and coaching devices at tens of millions of dollars – but as they catch on in the big sports like soccer, the sky is the limit.

Individual devices cost a few hundred dollars. The hardware can be generic to a number of sports but the real secret lies in the mathematical algorithms which analyse the crude data for a particular sport or action. Logging ability also allows the coach to examine long-term trends in the athlete’s performance in minute detail and assess the benefits of various training regimes.

The same technology also has potential uses in healthcare – for example in remote monitoring of patients at risk of a fall, for rehabilitation after an accident or the treatment of obesity.

The Traqua technology was development within the CRC for microTechnology by Griffith, Swinburne and RMIT universities and engineering firm iWRX. It addresses National Research Priorities two and three, a healthy Australia and frontier technologies to transform industry.

More information: 03 9214 8557

Safer crossings

More than a dozen Australians die in level crossing accidents between road vehicles and trains each year.

Pioneering research by scientists in the Co-operative Research Centre for Railway Engineering and Technologies (Rail CRC) has found that driver behaviour is a key factor in crashes at road-rail intersections.

While they represent a small part of the national road toll, crossing fatalities can account for up to half of the national rail toll, says Associate Professor Jeremy Davey of the Centre for Accident Research and Road Safety at the Queensland University of Technology.

“And while the numbers killed or injured may seem small, there is always the potential for catastrophe – a major train derailment resulting in a large number of victims.”

Australia has approximately 9400 level crossings, less than 30 per cent of which are equipped with flashing lights and/or boom barriers , says Rail CRC PhD researcher Angela Wallace. Between 1997 and 2002, crashes between road vehicles and trains at level crossings claimed 74 lives, imposing an economic cost of around $50 million.

Associate Professor Davey and Ms Wallace conclude that, mainly because of the cost of installing barriers at all crossings, engineering solutions have limited scope to further reduce the toll. Their studies indicate that the best hope for improved safety lies in reducing the risk through changes in driver behaviour – and that means different things to different groups of drivers.

There are signs that the risk may be growing: heavy haulage traffic on the Eastern Australian corridor is forecast to double in the next 5-10 years, and train drivers have identified large trucks as an emerging concern. Truck drivers are often pushed for time and this can lead to attempts to ‘beat the train’. Their vehicles are becoming longer, increasing the risk that traffic queues ahead of a crossing will leave part of the truck over the crossing. Additionally, trucks have longer braking distances and take longer to clear a crossing.

Other at-risk groups of road users include uncertain older drivers, complacent locals familiar with crossings and younger inexperienced or thrill-seeker drivers. Each group is at risk for different behavioural reasons, and requires a different approach to educate them about the risks, the researchers say. However, almost all groups of road users have a poor understanding of the issues facing the train driver and the distances it takes for a train to stop.

Australia does not currently have any research-based educational programs that address this need. The aim of the research is to develop educational programs that will seek to increase awareness of the risks at level crossings for different groups of drivers and to modify their behaviour in line with other aspects of road safety.

A major factor which has already emerged from the research is that many drivers treat flashing red lights at level crossings differently to red lights at road intersections, Ms Wallace says.

“Drivers tend to be complacent at level crossings as they believe that a train will stop or slow down for them if they are queuing over the crossing. Trains always have right of way and more often than not they are not able to stop in time to avoid a collision. Therefore, it is up to drivers to do the right thing and be alert at all times when driving over rail crossings.”

As there is little enforcement at these crossings, drivers tend to take more risks compared to other road intersections with red light cameras, she says.

“This leads some drivers to ignore, or try to beat, the flashing lights.”

While international programs such as North America’s “Operation Lifesaver” have cut down on crossing accidents through generic awareness programs, the Australian research is the first to identify and investigate the behaviours of different driver groups.

A.Prof. Davey argues that this targeted approach is essential if driver behaviours are to change and level crossing crashes are to be reduced. The research addresses the second and fourth of the National Research Priorities which refer to the nation’s health and safety.

More information: 07 4930 9597

Healthier projects

An Australian team is developing world-first technology to provide a rapid cure for under-performing construction projects. The development of the tool, *“Project Diagnostics”*, was sponsored by the Cooperative Research Centre for Construction Innovation (CRC CI).

Project Diagnostics is set to revolutionise the field of project management, helping to assist troubled projects before they become disasters. The new software tool identifies specific areas of poor project health, pinpoints the root causes and suggests remedies.

Project Director John Tsoukas, of global engineering firm Arup, says *Project Diagnostics* serves as an advanced warning system which is specially tailored for construction projects that are failing to meet their goals.

“There are five basic questions you could ask of any worried Client or project manager: Is your project going off the rails? Do you want to know why? Do you want to know what to do about it? Do you want to save the business case? Do you want to avoid bad publicity?

“If the answer to any of these questions is yes, then they may need *Project Diagnostics.”*

Mr Tsoukas says the toolkit is based on the critical success factors which most influence the success of a project. These are: cost, time, safety, quality, environment, stakeholder value and relationships.

“The value of this approach is that it gives the Client, project manager or other parties the ability to quickly reach a sound understanding of the current status of a project — through a series of comparisons with recognised industry norms — and then be in a position to take remedial action if required,” Mr Tsoukas says.

“Another advantage of the *Project Diagnostics* software tool is the cost. The fee for using the service is insignificant compared with the costs of a failing project,” he adds.

“The financial fallout from unhappy stakeholders and bad publicity alone, is enough to encourage any Client or project manager to consider this tool essential.”

Project Diagnostics assesses whether the critical success factors are on track for project success using a series of key performance indicators. These were chosen because they are easily measured, independent, sensitive, and have broad application across the various project phases, procurement methods, project sizes and levels of complexity. The indicators have been tested for robustness using Australian and international case studies in the construction sector.

Once a critical success factor is found to be under-performing, the root causes are identified using the further assessment of numerous contributing factors. These have been identified from an extensive worldwide literature review and consultation with many parties on active construction projects.

Correct and timely identification of these contributing factors allows the project manager or consultant to develop effective, focused remedies. The *Project Diagnostics* model is cyclic and repeats the investigation until all the identified problems have been ironed out. This enables the Client or project manager to

achieve a continuous improvement in project ‘health’ and delivery, Mr Tsoukas says.

“This is a unique and powerful three-in-one toolkit,” says CRC for *Construction Innovation* Chief Executive Officer Professor Keith Hampson. “It enables an industry consultant to assess the construction project’s condition, pinpoint why it may not be performing to expectations and recommend remedial measures for returning it to good health.”

“It applies to a wide range of procurement methods and all project phases.”

The technology was developed by a CRC Construction Innovation team led by global engineering firm Arup, and includes Queensland University of Technology, CSIRO, John Holland Constructions and the Queensland Departments of Public Works and Main Roads.

The *Project Diagnostics* service is due for release to the construction industry in Australia and internationally in 2006. The research addresses National Research Priority Three – frontier technologies to transform Australian industry

More information: 07 3864 9295

Information & Communication Technology

Network guardians

Australian scientists have solved a problem that has had the world's safety and security industries tied up in knots – how to watch hundreds of security cameras at the same time, using them to spot trouble and track offenders.

A breakthrough in intelligent surveillance was achieved in the Cooperative Research Centre for Sensor Signal and Information Processing (CSSIP), and is now watching over Sydney's celebrated icons, the Harbour Bridge and ANZAC bridge.

Worldwide, millions of security cameras are being monitored by a comparative handful of human eyes and brains, explains the University of Adelaide's Professor Mike Brooks. If a suspicious act occurs, someone has to spot it on camera or else sort through vast reams of video or digital data to find it, and any other vision linked to it. And both spotting trouble and tracking offenders is very hard without automating the camera network, he says.

"In London, where there are over a million surveillance cameras, they say the average Londoner appears on video about 300 times a day. Sifting through all that to find an offender is a nightmare," Prof. Brooks explains.

CSSIP's Image Analysis Program develops automated techniques for analysing images in such varied fields as medicine, radar and security.

"In security we're using computer-based methods to watch an entire network of cameras simultaneously for things like people being where they shouldn't, suspicious objects left behind, items stolen or damaged, violent or erratic behaviour, illegal traffic activity, even graffitists at work.

"Watching a few cameras is possible for a human for a short time – but watching hundreds or thousands constantly is beyond our ability. We're training computers to look for suspicious changes in the scene they watch using some elegant mathematics."

A major challenge, says Prof Brooks, is to teach cameras to work co-operatively, for example tracking a suspect through crowds, traffic and other obstacles, with a series of wide-angle cameras handing the shot from one to another, meanwhile guiding telephoto cameras to zoom in for close-ups. At the moment, no commercial security system in the world can achieve this reliably.

To do it they use a graph-based system that 'knows' where the target is in relation to nearby cameras. To achieve this remarkable feat, the entire network has to learn how to distinguish robotically between suspicious and non-suspicious behaviours and objects and then organise itself to track the suspect.

The first commercial use of the team's "suspicious object" technology was atop Sydney Harbour Bridge and the ANZAC bridge where numerous security cameras are now on the lookout. If the network sees anything suspicious, it immediately sounds an alarm to alert human security officers, and illuminates the activity on-screen.

The unique Australian approach has been the opposite of that being tried by most research groups worldwide, says Dr Rustom Kanga, CEO of Sydney-based iOmniscient Pty Ltd, who have commercialised the patented CSSIP technology.

"Most people were focussed on motion detection. The CSSIP approach has been to focus on non-motion. For example, you can spot a suspicious package in a crowded airport. As a result, Australia is now recognised worldwide as having the best technology."

The system has won best security awards on almost every continent and in places as diverse as Britain, America, Taiwan, Denmark and Australia itself.

"The technology is being very well received all round the world, and it will make a very good export product for Australia," Dr Kanga says. "The potential market is absolutely huge, when you consider how many security cameras are now in use."

CSSIP's image analysis expertise isn't just enhancing security – it will soon be saving lives. Another system is being tested to sort through millions of PAP smear images to help detect cancerous or pre-cancerous cells. If successful, the technology will be extended to screen patients for lung, bladder and oral cancers.

Another application is to help the Australian Defence Forces to screen the vast amount of data generated by optical, infra-red and radar systems as they keep watch over the nation's borders and skies. Under development, says Prof. Brooks, is technology to improve the visual intelligence of unmanned aerial vehicles (UAVs).

The research addresses National Research Priority four, safeguarding Australia.

More information: 08 8302 3477

Virtual dreaming

People of all backgrounds will be able to experience an authentic Aboriginal dreaming, as a result of a remarkable fusion between cultural knowledge dating back 40,000 years and 21st century virtual reality technology.

Developed by the Australasian Cooperative Research Centre for Interaction Design (ACID), researchers James Hills and Brett Leavy have taken the concept of 'virtual heritage' – a visit to some ancient place, monument or event – a large stride further.

Their Digital Songlines project is a narrative that allows the viewer to follow an Aboriginal songline through the landscape, encountering the legends, lore, totemic items and practical issues of day-to-day living as a traditional person would.

Designed primarily to help Indigenous Australians to retain their cultural knowledge and share it with their descendents, the project also offers people of non-indigenous background a unique window into how the continent's first inhabitants see and experience it.

Early on, initial partners who formed ACID identified the opportunity for an experience that could offer a different approach to virtual tours on offer at museums and sites around the world. ACID CEO Jeff Jones and Indigenous community member Brett Leavy quickly saw the need for a different approach, more in tune with the Indigenous perception of landscape as an unfolding story or songline, blending spirituality with reality.

The project aims to protect, preserve and promote Australian Indigenous culture, its practices, myths and legends, expanding and re-vitalizing it through the visualization of its most prized asset – the land.

It is building a virtual landscape of oral histories and mythological stories based upon the eternal sense of land and spirituality understood by the Aboriginal people, where feeling, knowing and touching the country, kin and spirit can be experienced.

"It's simply like being there, as an Indigenous person," Brett Leavy explains. "The experience is that of a person who is owned by the country, not a person who thinks they own the country."

"For example, you might go down to the river to catch a yellowbelly. On your way you encounter various keepers of knowledge, from the elder who instructs you how to do it, to the Creator of the River who explains how it came to be."

Hills and Leavy are using a computer game engine for the simulation, creating an easy-to-use virtual world that individual Indigenous communities can populate with their own landscapes, cultural memories, legendary figures and items of significance.

The first two pilot projects feature the Carnarvon Gorge area in Queensland and the Mill Stream area in the Western Australia Pilbara region. Other projects in Arnhem Land and Far North Queensland are also being discussed.

Their approach fuses topographical data gathered by satellites from outer space with cultural objects and traditional memories that may be thousands of years old

into a living story line which the viewer participates in. It contains animated dreamtime stories and avatars – virtual representation's of the participant.

"You can be a wedgetailed eagle and soar above the landscape. You can be the hunted kangaroo or the indigenous hunter who pursues it. You can view the landscape from the perspective and speed of an echidna. You can follow the cycle of the seasons as you travel from one water source to another," Brett Leavy says.

"The whole project has been carried out in very close consultation with traditional owners. It's designed so they can retain their own cultural and sacred knowledge for their own community and update it themselves - or create their own experience of landscape and tradition to share with others."

The ACID team's goal is to create an authentic experience of landscape that has been validated ethnographically, and a versatile set of tools, methodologies and protocols that allow people to create their own.

The prototype of Digital Songlines is almost complete and interest from investors and participants in the pre-production phase is strong, James Hills says. "We hope to have the first product available commercially in one to two years.

A key goal of the project is to help improve indigenous communities maintain their culture and identify, which will lead to improved quality of life. Outcomes of this project will be export opportunities for the presentation of arts, culture and heritage using the virtual Songlines toolkit.

The project addresses national research priorities one and three – a sustainable Australia and frontier technologies which transform industry.

More information: 07 3337 7821

Rapid reaction

More lives will be saved as emergency and rescue services mount quicker and more comprehensive responses to disasters using revolutionary emergency management technology developed by Australian researchers.

Whether it's a bushfire, a tsunami, a marine oil spill or an industrial accident, the system developed by the Cooperative Research Centre for Spatial Information (CRCSI) puts vital information at the fingertips of crisis managers in seconds – at headquarters, in the bush or at sea.

The prototype online emergency management system was trialled in 2005 with the emergency services in four states – NSW, Vic, Queensland and WA – and with Commonwealth agencies.

“The Australian public has a high expectation that emergency services will respond fast to any event that threatens lives or property – but this is a big country, there are many agencies and jurisdictions, and sometimes its hard to get all the information you need quickly enough to respond as fast as you’d like,” explains CRCSI project leader Mark Carniello.

“In a bushfire crisis, for instance, you need not only fire front details but also information on the weather, current hotspots and incidents, topographic and road information, the local bushfire history, details about who may be in the path of danger and much more. This involves a host of different organisations, in and outside government, and it can be very time-consuming trying to assemble an accurate picture on which to base the response.”

The emergency management system brings it all together in a single, web-based interface that enables managers to make good decisions faster – potentially saving more lives and reducing the damage and cost of disasters.

The prototype online emergency management system canvasses three scenarios – bushfire management, on- and offshore incidents and a hazard alert service – but is designed to extend to virtually any kind of emergency, including defence counter-terrorism and all kinds of natural disasters, Mr Carniello says.

“A particular feature is our hazard alert service, which lets every organisation know about a risk that may be affected by it.”

“For example if you’re a bushfire team planning a big burn-off, you’d want to notify the railways, who might have track workers in the area, Telstra who may have a service team nearby, local government, other emergency services and so on. Our system does this automatically, by email and SMS.”

Another example is using satellites to watch for fire outbreaks near powerlines, with the EM system providing automatic early warning to the power corporation and other services.

The system gives emergency managers access to up-to-date information from agencies like the Bureau of Meteorology so they can be confident of its reliability and currency.

“As a crisis manager you can also be on-line in the field, with all the latest information available to you via phone or satellite. Even if you happened to be travelling overseas, you could manage an Australian emergency from anywhere in the world through an internet connection.”

Peter Woodgate, CEO of CRCSI, says that the system “brings together a wide range of disparate information sources from many organisations, across the country in real time. This gives crisis managers more timely information with which to make early and effective decisions about what needs to be done. It also helps them stay on top of the latest developments, even if they are moving around.”

“Australia has a global reputation for the speed, thoroughness and quality of its emergency services. This technology offers us an added edge in response time that just might spell the difference between life and death for people caught up in a disaster. This project has been a truly collaborative effort combining the expertise of individuals from the government and private sectors in the most effective way.”

Involved in developing and testing the innovation were: WA Department of Land Information, NGIS Pty Ltd, NSW Department of Lands, Queensland Department of Emergency Services, Victorian Country Fire Authority, Victorian Department of Sustainability and Environment, WA Fire and Emergency Services Authority, WA Department of Conservation and Land Management, WA Department of Industry and Resources, as well as corporations like Telstra, Western Power, Ergon, Sinclair Knight Merz and Energex. NGIS, a WA company with a growing reputation for innovation, has been instrumental in helping develop the systems architecture.

More information: 08 9336 1102

TV ‘mouse’

A revolutionary technology is being developed by a team of Australian researchers that will change the way people watch and use TV.

Simple hand gestures will replace button-pushing and frustratingly complicated remotes as the era of fully-interactive TV arrives.

A team in the Australasian CRC for Interaction Design (ACID) led by Professor Duane Varan has developed what may be the world’s first television ‘mouse’, a clip-on device that enables the user to give commands to their TV with gestures.

“Once upon a time you had to type commands laboriously into your computer as hard text codes to get it to do anything – then along came the mouse, which greatly simplified and extended what you could do,” Prof. Varan explains.

“As television becomes more and more interactive, viewers want to have greater control over what we see and do with it. We want the ability to give it commands in straightforward ways, such as with voice or gestures.”

ACID’s prototype gesture recognition device clips on the hand. It has accelerometers which measure the movement and orientation of the user’s hand in various directions, and a thumb-button to lock in the command.

In time, Prof. Varan predicts, it will replace all those fiddly little remote buttons and arrow keys for record, stop, fast forward, menu and so on, with a series of gestures that are intuitive – like a hand up for stop, or palm-up for fast forward.

“In fact, we think we can go way beyond existing remote controls with a device like this,” he adds.

The team is currently fine-tuning the prototype device so it can recognise a wide variation in people’s gestures – speed, extent and things like left-handedness.

Unlike a mouse, Prof. Varan believes the gesture recognition device will accommodate natural gestures by the user without risking RSI or strain injury.

Just as the mouse replaced keystrokes with clicks to revolutionise computer interactivity, he believes the gesture recognition device will transform television from the today’s passive format into something more tunable to the viewer’s needs and wishes.

“TV will contain far more interactive content. If you see something interesting and want more information on it, you’ll be able to ask for it as you view. If you want to watch something again, you’ll be able to stop the show, go back and review, then keep on watching without missing anything.

“You’ll be able to change the narrative stream so that stories end differently, to suit yourself.

“You’ll be able to edit out the boring bits and take control over your viewing experience, if you want. You’ll be able to tell your TV to accumulate your favourite content and automatically record it so you can watch any time. If you want to fast forward, you’ll be able to go right to the end of a program.

“In other words viewers will be able to manipulate their TV experience quite radically, and please themselves far more about what and how they watch.”

The key to all this, Prof. Varan says, is having a command device that is simple, robust and versatile – and which anyone can use without having to read a long book of instructions.

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

More information: 07 3337 7821

Infant ear test

Hundreds of newborn Australian babies will have a better chance in life thanks to a revolutionary hearing test developed by researchers in the Cooperative Research Centre for Sensor Signal and Information Processing (CSSIP).

Hearing impairment affects about 400 of the 250,000 Australian babies born each year and an estimated 20,000 worldwide. Its consequences can include lower IQ, learning, speech and behavioural problems. In many cases the harm is lifelong and the costs to both the individual and society high.

“Testing only infants with pertinent risk factors detects only 25% of infants born with a hearing impairment by 12 months of age. The average age of diagnosis is around two years,” says CSSIP team leader Dr Andrew Bradley.

“It’s extraordinarily difficult to tell if a newborn infant has hearing problems. By the time you find out – and this can be after several years – it may be too late to make good the learning losses caused by deafness.

“Our technology enables newborn babies’ hearing to be tested within days of birth, in a way that is very quick, totally safe, non-intrusive and very accurate.”

The research is part of a program funded by Queensland Health to develop leading-edge technology for diagnosing hearing problems in newborn babies and give them the best possible start in life.

The CSSIP technology is a new generation advance on the widely-used Auditory Brainstem Response (ABR) technique which accurately measures the nerves’ response to sounds through small sensors attached to the baby’s head.

It uses a random series of ‘chirps’ which have special mathematical properties that make them easier to pick up with the sensors on the baby’s head, and separate them from the mass of other nerve signals using sophisticated digital signal processing and analysis.

The test takes just 10-20 seconds to perform, compared with many minutes for existing technology on a sleeping infant.

It can be performed using standard equipment, though Dr Bradley says the aim is to produce a small hand-held device, so hearing screening can be carried out on babies just about anywhere, including the Outback.

“Because it is robust, quick and easy to use, it can be applied by medical staff in rural and remote communities as effectively as in a big city hospital, where they test many babies every day.

“The test is also sensitive enough to indicate how serious the hearing loss is. This means that babies with severe hearing problems can be diagnosed and treatment started much sooner, so avoiding learning problems later.”

Dr Bradley says that although the testing of newborn infants for hearing impairments is the immediate goal of the project, the technology has many other medical applications, including monitoring traumatic brain injury patients and detecting growths and cancers. It could also be developed to measure hearing loss in older patients.

“ABR is used for a variety of medical applications in many countries of the world. Developing a superior ABR device that is not only faster but also more accurate in picking up and processing signals is of great benefit,” he says.

“The commercial potential is also large. The current market for hearing screening for babies in Australia is $3.7 million a year and expected to grow to $12.5 million. There are big export opportunities, especially to the United States and Europe, where ABR is regularly used, though it will also be equally suitable for use in the Third World.”

The research addresses the Federal Government’s National Research Priority two – promoting and maintaining good health.

More information: 08 8302 3477

Satellite broadband

In a major blow against the “tyranny of distance”, researchers at the Cooperative Research Centre for Satellite Systems (CRCSS) have demonstrated high quality voice services via satellite broadband to remote communities in central Australia.

For the first time some Outback remote communities may even have faster, better connections than city Australia, as the satellite link will leapfrog the bottlenecks caused by phone exchanges and routers on current metropolitan services, says CRCSS chief executive Professor Andrew Parfitt.

“Satellite broadband, coupled with terrestrial networks, allows us to aggregate a range of telecommunications services and make them available to many dispersed communities at the same time,” Dr Parfitt explains. “It is the only realistic way to provide flexible, high quality services to remote places with no infrastructure, at a reasonable cost.”

“This trial produced advanced services that challenge all our previous assumptions about affordability, quality, quantity and availability.”

Professor Parfitt emphasises that the technology to deliver quality communications to remote places across the continent already exists. The trial was simply to demonstrate its potential.

The main service provided initially to the remote communities were affordable high quality voice communications and internet connections. In time, the whole suite of broadband services including news, cable TV, entertainment and education will be possible.

Professor Parfitt says that satellite broadband will give Outback businesses a huge boost, enabling them to contact customers around the world at the speed of light.

“Satellite high-speed Internet distinguishes itself from every other broadband technology by its ability to provide true nationwide service. It does not require access to the local telephone exchange or laying costly cable in low population density areas. By targeting a satellite beam toward a particular region of Australia, satellite-based services can reach every part of the country, even the most isolated areas,” he says.

This would yield huge advantages for small-to-medium businesses in regional or remote areas, giving them communication access to markets on a par with their city-based competitors. It also has particular significance to remote indigenous communities seeking to build new enterprises in areas like bush foods, art, tourism and culture.

“Satellite broadband can also make a big difference to emergency service delivery,” Professor Parfitt adds. “It enables them to deploy more rapidly to deal with emergencies, to bypass network congestion, expand bandwidth at need, pass information and images to where they are needed in microseconds and operate with high security.”

Because satellites are in space, the network is much less vulnerable to natural disasters like cyclones, earthquakes, fires and floods.

Professor Parfitt says that satellite broadband should make internet and voice services available anywhere in Australia for the same price as normal ADSL or

ISDN. While remote communities are the main target of this project, there is no reason why the service should not expand to cover the entire continent in time.

The trial is also expected to show how Australia could position itself as a leading international supplier of remote area communications technology and expertise, he says.

“There is potentially huge global demand for this,” he says. “The idea of optimizing satellite networks, with guaranteed quality-of-service for highly coveted services such as web access, peer to peer networking, VoIP and VPNs, opens new market opportunities that go far beyond traditional one way broadcasting and multicasting markets that are well-matched to satellite’s unique capabilities.”

Professor Parfitt says there is a large latent demand for attractively bundled broadband communications services that can be provided quickly, reliably and at the right price – and this includes city as well as rural and remote areas.

The research addresses National Research Priorities three and four – frontier technologies to transform industry and safeguarding Australia.

More information: 02 6281 8529

Medifraud detector

The world’s first real-time health fraud detection system, developed by the Capital Markets Cooperative Research Centre in partnership with The Health Bureau Pty Limited, is being deployed to catch health fund claims cheats.

The technology checks the details of every claim and rates it against recognised treatment pathways and health funds eligibility criteria, says CRC Capital Markets CEO Professor Mike Aitken.

“In both Australia and the US it is estimated that at least 4 per cent, and up to 10 per cent, of medical insurance claims may be fraudulent or exaggerated in some ways. In this country that amounts to potential losses of around $360 million to $900 million a year,” Prof. Aitken says

The new technology has been spun off by the partners into a new company, Dtecht Pty Ltd, and several health insurance funds are trialling its services. The company has been in full operation since October 2005.

Prof. Aitken said the Dtecht technology combines the CRC’s expertise in data mining – the processing of vast amounts of data for useable information – data

management and data visualisation, using algorithms (mathematical formulae) which have already proven highly effective in identifying fraudulent dealing on the stock exchange and other capital markets with the health domain expertise of The Health Bureau team.

“The basic problem is that there is so much information pouring through stock exchanges and health funds all the time that it is beyond human ability to scan it and spot anomalies that point to someone trying to rort the system in time to catch them.

“So our researchers developed an intelligent system that can ring the alarm bell very quickly if something unusual shows up,” he says.

“Health funds have vast numbers of insurance claims flowing through their processing systems all the time. Fraudulent claims, which often look very normal, can escape attention unless there is a way of monitoring all of the detail, all of the time.”

A limited trial run of the software – now known as “Health Dtechtive” - on 1.8 million dental, physiotherapy, chiropractic, orthopaedic and optical claims in 2004 found that up to 4 per cent could have been fraudulent. Taken across the whole of the Australian health fund claims, this would amount to a loss to the health system of $360 million a year.

“That is a conservative estimate,” Prof. Aitken says. “Nevertheless it would mean a contribution saving of more than $200 for each private health insurance membership.”

Managing Director of the spin-off company, Dtecht Pty Ltd, Chris Bertinshaw, says “In effect, it’s like having a huge team of people with extensive domain knowledge looking at every individual claim before it is paid and checking it for fraud and errors.

“Dtecht employs the experience gained by the CMCRC from developing real-time market surveillance systems for 22 national stock exchanges worldwide and the domain expertise of several health professionals to build a solution for organisations that process payments for health services.

Dtecht’s solution is unique because it combines data from multiple health funds allowing Dtecht to identify patterns of behaviour that the insurers themselves may not be able to see. An alert is generated so the insurer can intervene and respond to the claim before payment is made.

“Most health insurance fraud goes undetected and therefore unrecovered. Anecdotal evidence suggests that rorting is widespread and continues to rise

because efforts to control it are almost universally applied after claims are paid," Mr Bertinshaw says.

Also, health fund claims are very complex and information is summarised using codes. Often anomalous transactions are coding errors, not fraud.

"Dtecht helps ensure that payments are made correctly in the first place and anomalies dealt with up front."

The research addresses National Research Priorities two and three – a healthy Australia and frontier technologies for transforming industry.

More information: 02 9233 7999

Mining & Energy

Beach bonanza

Australian scientists have uncovered compelling evidence for the oldest, richest and one of the largest deposits of mineral sands yet found on Earth.

The minerals are deposited in ancient fossil beaches, which formed almost 40 million years ago, along a huge inland extension of the Great Australian Bight called the Eucla Basin.

Ancient rivers, erosion, wave and tidal action and tectonic movements over millions of years have concentrated a veritable bonanza of heavy mineral sands along a 2000-km arc of country straddling the WA/SA border.

Research by scientists in the CRC for Landscape Environments and Mineral Exploration (CRC LEME), Primary Industries & Resources SA (PIRSA) and mining company Iluka Resources PL has pieced together clues to what is shaping as one of the richest mineral provinces in Australian history.

To find it, researchers had to recreate landscape processes that took place along the continent's southern coastline between 41 and 37 million years ago, says LEME assistant director John Keeling, of PIRSA.

In a remarkable case of geological sleuthing, a team led by Dr Baohong Hou has used advanced satellite mapping and fossil pollen analysis to piece together the pattern of beaches, strandlines, dune fields, marshes, channels, lagoons and estuaries from this vanished coast, now part of the continental mainland.

The sands, particularly along the eastern side of the Eucla basin, are proving spectacularly rich in minerals such as rutile, zircon, ilmenite and leucoxene – extensively used in the manufacture of high tech metals such as titanium, advanced ceramics and electronic components. These have been highlighted in the recent Jacinth and Ambrosia discoveries by Iluka Resources.

Typical mineral sands prospects contain around 5 per cent ore. These, in places, range as high as 80 per cent, Mr Keeling says. They are also exceptionally rich – around 55 per cent - in the high-value mineral zircon, used to make advanced ceramics. "By any standard these are world-class deposits," he says.

The minerals were eroded out of the ancient landmass, the 1-2 billion year-old Yilgarn Block in WA, Musgrave Province and Gawler Craton in SA, and swept hundreds of kilometres down fossilised rivers and creeks to be deposited into ancient beach systems.

Here wind, wave and tide sorted and trapped the tiny metallic grains in huge deposits which were then buried under a coastal barrier dune system, the 700 km Ooldea range. The rising sea then worked over this ancient dune barrier, sweeping away the finer particles, and further concentrating the heavy minerals to create today's super-rich deposits.

The scientists discovered this partly by tracking fossil pollens, perfectly preserved in the sediments for 40 million years, which reveal the ebb and flow of the ancient shoreline. These changes in sea level relate to the continental separation of Australia and Antarctica.

"It's a fantastic story about the evolution of Australia," says CRC CEO Dr Dennis Gee. "It's also a tribute to Baohong and his colleagues how they have unravelled the enormously complex stratigraphy of this part of Australia to give us what looks likely to be one of the richest mineral sands provinces on Earth."

Exploration so far has concentrated on the eastern end of the Eucla Basin, in SA, where Iluka Resources plans to complete a further 55,000 metres of drilling by the end of 2005. Iluka Managing Director Mike Folwell said in his AGM address that resources found to date have an inferred value of $4 billion.

The richness of the deposits, both in titanium and zircon, makes them especially attractive, as this offers at least two major product streams to offset market gyrations.

Whether or not similarly rich deposits exist along the western end of the Eucla Basin is still unknown – it all depends on the pattern of wave, wind and tide over the eons, says Mr Keeling. Only drilling will show. But the scientists are hopeful, as the source material in the west is similar to that in SA.

The research addresses National Research Priority Three – frontier technologies to transform industry.

More information: 08 8463 3135

Microbe miners

Scientists in Australia's AJ Parker CRC for Hydrometallurgy are developing a way to dramatically improve the extraction of metals such as gold, copper, zinc and nickel using microbes.

The technology offers a major boost to a technique known as 'heap bioleaching', in which microbes go to work on huge piles of ore and dissolve out the minerals, says Dr Helen Watling of the Parker Centre and CSIRO Minerals.

It opens the way for bio-heaps to replace costlier or less-green methods of mineral extraction, to be used for ores that are low grade or hard to process. It may mean a big cut in transport costs, as only the metal - not the ore - is trucked from the site.

The Parker Centre, together with the University of British Columbia in Canada and the University of Cape Town in South Africa, have formed an international team with the goal of building a computer model that factors in all the fundamental microbial, chemical and physical processes that occur in the bio-heap.

“This is absolutely a major scientific research effort on a hugely complex problem, and we’re working to the world market as well as Australia on it,” says Parker Centre CEO Mark Woffenden.

“It means that the era of microbe mining has truly arrived: from now on ‘bugs’ will play a growing role in low-cost, efficient and clean discovery, extraction and processing of Australian minerals,” Dr Watling adds.

Technically, microbes mainly extract minerals by oxidising ferrous iron to ferric iron and sulphur to sulphates. This generates the oxidising conditions that dissolve the target metal out of the ore into a solution. From this it can be easily extracted chemically or using electricity.

But microbes, being living organisms, are far less predictable and less easy to control than a chemical or physical reaction – and this has deterred some mining companies from moving to bio-heap processing.

The model, being developed in partnership with some of the world’s leading mining houses, will yield new guidelines to help miners design bio-heaps that are far more productive and reliable.

It includes a computer aid for designing and monitoring heaps, a method of assessing the suitability of different ores for heap leaching and the precision control needed to bio-extract copper and nickel from difficult chalcopyrite ores.

“Heap leaching has been in use in Australia for 10 years, for certain ores – but it has not caught on more widely here largely because of these uncertainties. In South America there are many heap operations, some of them bio-heap,” Dr Watling explains.

“We’re hoping the new technology will persuade more Australian mining operations this is the way of the future.”

Dr Watling says the ‘art’ of heap bioleaching is to maintain a perfect environment for microbial activity through careful design of the heap and management of its internal conditions – temperature, aeration, water flow, nutrients and acidity.

“Like a good farmer, you need to be constantly thinking about the needs of the “livestock”, and make sure you provide them with the conditions they need to thrive.”

“We are looking at new ways to assess the overall health of the heap and how well it is performing – and that’s a good step towards the kind of process control achieved with chemical and hydrometallurgical mineral extraction.”

Dr Watling says the makeup of the ‘consortium’ of microbes used to process ores is becoming a key factor in efficient mineral extraction: “A lot of the ‘art’ goes into developing the right mix of microbes. Some process the ore, others keep the heap clean by serving as garbage collectors and removing surplus carbon. There are hundreds of different species of micro-organisms in a heap, and we need to know a lot more about what they do, how they work together and the best ways to monitor and manage them.”

Rising global interest in bio-processing of minerals has sparked a new kind of gold rush – a ‘bug rush’. Researchers are scouring the world for the best microbial talent for mineral extraction, peering into volcanoes, hot springs and seabed black smokers as well as old slag heaps, and tailings ponds where the ‘right’ bugs congregate naturally.

Rather than seeking individual microbe species some researchers are using forensic technology, DNA fingerprinting, to leap ahead by testing for the presence of the genes which are used by the bugs to process minerals.

The research addresses two of Australia’s National Research Priorities – Frontier Technologies for Transforming Industry and a Sustainable Australia.

More information: 08 9360 6361

Carbon hunt pays off

Australia has the capacity to store huge volumes of its future greenhouse emissions in depleted gas fields and saline aquifers and in underground coal beds, some of the nation’s leading researchers have reported.

Geologists have concluded the nation can potentially sequester CO_2 from the burning of fossil fuels in coal strata that already hold methane gas. The

characteristics of coal seams, which produce coal seam methane, make them most likely to allow injection and long-term geological storage of carbon dioxide.

The finding will help Australia's national prospects for curbing its greenhouse emissions from power generation, says Dr Peter Cook, Chief Executive of the Cooperative Research Centre for Greenhouse Gas Technologies (CO2CRC).

However, locating suitable local storage for CO_2 emissions from the Sydney-Newcastle-Wollongong industrial hub requires more work and CO2CRC and its collaborating organisations are planning on increased research efforts in the area of CO_2 storage in coals over the next two years.

Currently, the most promising storage sites are in the offshore Northwest Shelf, Browse and Timor Sea areas and the Otway, Bass and Gippsland Basins with some potential also in the onshore Bowen-Surat, Cooper and Galilee Basins

The Gippsland region appears to have potential to store separated CO_2 emissions resulting from the burning of brown coal in the Latrobe Valley.

"There is also scope to potentially store significant volumes in some Queensland basins such as the Bowen and the Galilee Basins in the central region of the State.

Dr Cook says the hunt is also on to find suitable sites for large-scale carbon storage close to major industrial centres such as Sydney and Brisbane.

"We will start to look for potential sites both onshore and offshore, and also consider the option of storing CO_2 in a number of 'boutique' sites in unminable coal seams on land in coal that is unsuitable for mining, but which is capable of holding CO_2 for long periods of geological time.

"Sites currently used for the extraction of coalbed methane (CH4) may be very well suited to the long-term storage of CO_2. However, the actual volumes they can hold remain to be assessed.

Injection of CO_2 into coalbeds could also enhance the extraction of methane gas for generating electricity, adds Dr Cook.

"While much remains to be done to quantify the volumes that can be stored in various locations and to satisfy ourselves the gas will stay where it is put, you could certainly say that, thanks to our geology, Australia appears to be one of the most promising countries in the world for underground disposal of CO_2.

"The latest work is starting to address the issue that our main greenhouse production is on the east coast, whereas the identified potential geosequestration potential was seen to be mainly on the west coast

The findings of the study have been presented to industry and government meetings in NSW, Queensland, the ACT and WA, as well as at international carbon sequestration meetings. CO2CRC has as its collaborating research organisations CSIRO, GA, University of NSW, University of Melbourne, Adelaide University, Curtin University and University of Queensland.

“This collaborative research is being undertaken with the expectation that Australia's already substantial CO_2 storage potential can be increased, particularly focusing on those areas where there is limited storage capacity identified at the present time,” Dr Cook says.

The research targets National Research Priorities one and three – a sustainable Australia and frontier technologies to transform industry.

More information: 02 6200 3362

Golden gums

Gum trees and mulga may point the way to Australia’s next mineral strikes, in a scientific breakthrough with promising implications for the nation’s $12 billion gold and base metals industries.

Scientists in the CRC for Landscape Evolution and Mineral Exploration (LEME) have shown that certain native Australian trees provide giveaway clues to mineral deposits hidden beneath the mantle of transported sediment (called regolith) that carpets two thirds of the continent.

For nearly a century of modern exploration the chief challenge has been the difficulty of finding surface traces of buried deposits, says CRC LEME CEO Dr Dennis Gee.

Chemical analysis of soil and water combined with other techniques have helped unearth $3 billion in new gold finds over the past decade – but these geochemical methods only work reliably where the weathered rock is not obscured by transported regolith.

In some areas in inland Australia there is up to 20 metres of “hardpan” – a dry, concrete-like layer close to the surface. In these areas explorers have very little to go on, to help them pinpoint possible new deposits.

This dry layer forms a physical barrier which prevents metal traces from buried mineral deposits being brought close to the surface as dissolved ions in groundwater.

Now CRC LEME teams led by Dr Ravi Anand of CSIRO and Dr Steve Hill of Adelaide University have found that native vegetation, which has very deep tap roots designed to reach water far underground, can do some of the prospecting for us.

“Certain plants, notably the thirsty mulga, act as hydraulic pumps, bringing up the metal-rich water from deep down to nourish their leaves and branches,” Dr Anand explains.

“Dissolved metals enter the roots, rise through the vascular tissues, enter the fruits, twigs, bark and leaves, and then build up in specific products in the tree. ” In several areas north of Kalgoorlie, Dr Anand has detected very high levels of zinc in products of the mulga tree.

In a related study, a LEME doctoral researcher, Karen Hulme at Adelaide University, has confirmed surprisingly high levels of lead and zinc in certain parts of river red gums, in central outback Australia.

While the research is still in its early stages, the LEME team is confident that, with the help of the trees, they will soon have a practical new way for penetrating the regolith and picking up the telltale signatures of hidden metal ore deposits.

In the process they are adding a new word to the Australian dictionary – biominex, or biological mineral exploration.

“For the first time we have hope of a technique that reads surface geochemical signatures of mineralisation concealed under 20 metres of transported regolith (eg hardpan), where no other technique works,” Dr Anand says.

The research addresses National Research Priority Three – frontier technologies for transforming Australian industry.

More information: 08 6436 8672

Salt into steel

Ironmaking is offering a new way for Australia to tackle three of its greatest environmental challenges – salinity, renewable energy and greenhouse emissions.

In an imaginative solution that combines environmental protection with heavy industry, researchers from two Cooperative Research Centres (CRCs) are investigating the use of charcoal from oil mallee trees for making iron and steel.

The trees will be grown in belts in agricultural areas to control dryland salinity by lowering groundwater tables, and reducing greenhouse gases by absorbing CO2. They will also produce valuable oils, timber, charcoal and activated carbon, under a project developed by partners in the CRC for Plant-Based Management of Dryland Salinity (CRC Salinity).

The use of charcoal from the mallee timber as a reductant for making iron and steel is being tested by the CRC for Sustainable Resource Processing (CSRP).

The CSRP chief executive Mr Stevan Green says that new research indicates mallee charcoal could be a viable replacement for coke (made from coal) in a bath iron-smelting process.

It has the advantages of being a renewable source of energy in which the next crop of trees absorbs much of the CO2 that is emitted when the charcoal is burnt, reducing the greenhouse impact.

Studies by CSRP show that if 20 per cent of the coke used to make iron is replaced with charcoal, then non-renewable energy use falls by 13 per cent, as does the overall global warming potential.

If coke is totally replaced by charcoal, non-renewable energy consumption and greenhouse potential both drop by at least 60 per cent.

"We've found that using char produced from trees instead of coke to fuel iron ore sintering has the potential to significantly improve productivity and environmental performance," says Mr Green.

"It’s interesting, when you think about it. For more than 3000 years the world relied on charcoal as fuel for smelting, resulting in widespread deforestation. Coal only came in as blast furnace fuel during the 18th century. It's interesting that, three centuries on, we are again looking at charcoal – this time for environmental reasons," he says.

One drawback is that charcoal is not quite so efficient at reducing iron as coke, but recent work by CSIRO into the physics of the reaction gives promise that this obstacle can be overcome through fine-tuning the conditions under which fuel is injected into the slag bath.

The use of mallee charcoal for ironmaking emerged from a decade of research into the commercial development of mallee as a farm tree crop.

“Mallees are naturally prodigious water users with deep roots, and there’s every reason to think they will be effective in lowering water tables and helping to control dryland salinity,” says John Bartle, of the WA Department of Conservation and Land Management (CALM).

“One of the challenges in making woody crops like mallee relevant to salinity control is to have markets of sufficient size and profitability. The industry is hopeful that the $10 million, one fifth-scale pilot plant developed by Western Power at Narrogin for processing whole mallee feedstocks into eucalyptus oil, activated carbon and electricity will show that large markets for these products can be tapped.”

If this trial proves successful full-scale plants will need 100,000 tonnes of feedstock from 10,000 ha of mallees planted in strategic strips across wheatbelt farms to support it, Mr Bartle says. There is potential to build 9-12 full scale processing plants in the WA wheatbelt, while more could be considered in salt-affected areas of the Eastern States.

“The development of mallee and other woody crops is limited by the comparatively small markets for activated carbon. The preliminary step in manufacture of activated carbon is charcoal. That’s why we decided to look at ironmaking using charcoal.

“If the project proves a success, Australian iron will take on a new, green image, helping in the fight against salinity and greenhouse, and taking the nation another step on the road to renewable energy.”

Mr Bartle said that the push to diversify woody crop types and products has now been taken up by the Florasearch Project run by CRC Salinity. It is screening native trees across southern Australia to determine their potential for producing wood, industrial products, bioenergy and fodder while helping to combat salinity and greenhouse.

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

More information: 08 6436 8734

Big digger

Australian researchers have achieved a technological breakthrough capable of lifting mine productivity up to10 per cent in the nation’s $60 billion minerals and energy sector.

New monitoring technology developed by CRCMining and industry partner P&H MinePro Services promises to revolutionise the performance of two of the industry’s workhorses – the electric shovel and the large haul truck.

The new technology helps to sharply reduce the damage, downtime and economic loss caused by the overloading of shovels and trucks.

“Unlike aircraft pilots, who have a wide array of instruments, electric shovel operators work in an information-poor environment and receive hardly any feedback on their performance,” explains CRCMining chief executive officer professor Mike Hood. “Yet the equipment is often worth as much or more than an aircraft.”

The mining industry traditionally rewards operators with high pay for moving the most material they can in a shift. Without good feedback, this can lead to overloading of equipment.

“Mining trucks are often overloaded beyond their recommended capacity and this results in breakdowns and higher maintenance costs, which in turn penalise a mine’s production rates,” Prof. Hood says.

“It is another important step towards automation in our mines, which will significantly reduce hazards by removing workers from dangerous environments. By reducing the scope for equipment failure, this technology will also enhance safety.”

The shovel monitor, being marketed by P&H MinePro Services is designed to improve the performance of both machine and operator. It provides direct, real-time intuitive feedback to the operator on how the machine is working and highlights areas for improvement. The information is displayed to the operator on easy-to-read graphic touch-screens.

The system extracts information about how the shovel is operating by processing data from a number of channels associated with the electrical drive system. Using smart maths developed by the CRCMining team, it works out the weight of material in the bucket after each dig pass. It then warns the operator if they are attempting to overload a truck.

By providing overall performance information, the shovel monitor also helps mining companies to better understand how their equipment is operating and how to get the best out of it while avoiding breakdowns.

The new system has been trialed at Goonyella in Queensland’s Bowen Basin, at mines in the Hunter Valley, the Morenci Mine in USA, in partnership with mining giants BHP-Billiton Mitsubishi Alliance (BMA), Rio Tinto and Phelps Dodge and at Bracalba Quarry, close to Brisbane.

“The shovel monitor technology is the first step in a long-term research plan intended to ensure the Australian mining industry remains competitive. This can

only be achieved through the continued development of technologies that reduce the costs of operation," Prof Hood explains.

More information:
Professor Mike Hood, CRCMining 07 3365 5641

Spectrolaser success

Researchers from the CRC for Clean Power from Lignite (CRC CPL) have designed and commercialised a new, super-powerful tool for analysing the atomic elements in virtually any material, quickly and cheaply.

The Spectrolaser's commercial development through high-tech company Laser Analysis Technologies Pty Ltd recalls the huge global success of atomic absorption spectroscopy, discovered in Australia in 1952. That analysis technique is today used in hospitals and labs throughout the world.

"The Spectrolaser can determine the elemental makeup all kinds of materials. It produces a bright spark – or plasma – at the surface of the target substance and the composition of the light emitted is analysed by a unique spectrometer and detection system," explains CRC CPL chief executive Dr Peter Jackson.

"Every element gives off a characteristic spectral emission, enabling you to tell quickly and easily what elements comprise the material you are analysing."

The Spectrolaser is a high tech offspring of the coal industry. The idea grew out of the CRC's research into coal gasification and the instrument was initially designed to perform rapid analyses of coal quality, to help power stations operate more efficiently.

Coal varies in moisture, organic components, and trace elements. Some coals burn better than others, some cause greater corrosion of furnaces, others deposit more ash and char. If operators understand the composition of the coal before it is fed into a furnace, then combustion conditions can be tweaked to improve burning efficiency and reduce fouling.

However the Spectrolaser can also be used to analyse minerals, building materials, metals and alloys, pharmaceuticals, manufactured products and to carry out environmental monitoring.

"Like atomic absorption, laser spectrometry has an enormous range of potential uses in industry, healthcare and the environment," Dr Jackson says.

“Another great advantage is that the instrument can be built using off-the-shelf components and is therefore relatively low-cost,” he adds.

“Most of the value has been added in the smart software that operates the system, and in creating a library of characteristic emission signatures to automate element identification.”

To find the right partner to get to market the CRC team conducted a careful search and identified Automated Fusion Technology Pty Ltd (AFT), a Melbourne-based firm with a 10-year track record for quality instrumentation.

The intellectual property of the CRC in the Laser Plasma Spectrometer—including two patents, software source codes, circuit board designs, schematics, and available know-how—was exclusively licensed to the joint venture, Laser Analysis Technologies Pty Ltd in 2002. Two years later, Automated Fusion Technology Pty Ltd merged with a number of other companies to form XRF Scientific Ltd, and LAT subsequently became part of the merged XRFS Group.

“The Spectrolaser continues a 50-year tradition in Australia as a discoverer, developer and exporter of precision scientific instrumentation.

“Today this industry is earns almost a billion dollars a year from exports, and underpins the quality of a great many of our other export products and commodities.

“There is strong overseas interest in the Spectrolaser, and we are optimistic it will build on this great Australian tradition for making quality scientific instruments.”

Dr Jackson says the research addresses National Research Priority three – frontier technologies for building and transforming industry.

More information: 03 8542 0801

Agriculture & Rural-based Manufacturing

Better beer

In a program which promises to boost the nation's billion dollar barley exports by up to a third, a team at the Molecular Plant Breeding Cooperative Research Centre (MPBCRC) is busy turning cattle feed into top quality beer-making ingredients.

The secret lies in the stress, says University of Adelaide doctoral researcher Elysia Vassos. Feed barley, used mainly to nourish livestock, copes well with the stresses of drought, frost and disease prevalent in the Australian environment. But it doesn't make good beer.

Malting barley, on the other hand, makes beautiful beer – but is harder to grow and gets stressed more easily, leading to lower yields. she says

To beat the problem, the MPBCRC team decided to take a different tack to the usual approach. Instead of trying to bolster the established malting barleys, they are using molecular marker technology to turn hardy, feed barleys into elite malt performers.

Molecular markers are a rapid way of checking whether new, experimental kinds of barley – crossbred in the traditional way – have the genetic make-up to be superior malt producers.

Developed over more than a decade, they point to regions on the barley plant's chromosomes that indicate if it has – or hasn't - the required malting abilities.

The goal is to develop new barleys which are resilient, high yielding and rich in malt, to service a booming export market as consumers throughout China and SE Asia toast their rising affluence with a growing intake of the amber fluid.

"Research over the past 10 years has provided major advances in our understanding of the genetic control of malting quality, allowing breeders to select for improved quality using DNA based molecular markers," says Elysia.

"Our work began in 2001 using the feed barley variety Keel and three international sources of elite genes for superior malting quality. The

lines developed in this initial phase have matched the performance of Keel in low rainfall environments, and performed significantly better in higher yielding environments.

“Our selected lines are being evaluated at 14 sites in southern Australia this year and we are combining the malting quality genes from the Japanese, Canadian, and European sources within the Keel genetic background by conventional plant breeding. The new crosses are being evaluated both in the field and for quality in the lab.”

Ms Vassos says that the process has involved the use of up to 9,000 molecular marker assays in the past year – equivalent to what would normally be used in an entire crop breeding program. This illustrates the power of the new biotechnology to home in on the genes of choice and speed up the breeding process by quick selection of the top performing lines.

MPBCRC barley program leader Dr Jason Eglinton says the work, which is supported by ABB Grain Ltd, will make a real difference to the barley industry’s export prospects.

“Feed barley normally yields about 10 per cent more than malting barley, and malting barley normally fetches an extra $30-40 a tonne. By combining the higher yield of feed barley with the higher value of malting, the scope is there to boost industry returns by as much as 30 per cent,” he explains.

Underpinning the promise is a booming market for malting barley in China, whose east coast breweries are struggling to keep up with demand for beer as newly-affluent Chinese workers increase their consumption.

With similarly strong demand for beer in countries such as South Korea and the Philippines, the future for Australia’s malting barley exports looks bright, he adds. Australia currently grows around 7 million tonnes of barley a year on 3.5 million hectares, mainly in southern Australia. Barley exports earned $1.4 billion in 2004/05.

More information: 03 9479 3750

E-Sheep

The 21st century Aussie sheep will decide for itself when to change paddocks, when to get weighed, and when to go off to market. And making its own decisions will make it a happier, healthier sheep.

According to the Australian Sheep Industry CRC and NSW DPI Project Officer Bill Murray, electronic flock management is better for the sheep, more efficient for the grazier and ultimately better for the consumer, in the form of more tender meat.

“The concept of e-sheep is only just beginning to realise its potential,” says Mr Murray, who is working with flocks and graziers in the Western Division of New South Wales to develop a unique Australian grazing system for the 21st Century.

“Starting with the basic application of electronic tagging and weighing, e-sheep management can extend to many aspects of sheep production,” he says.

“As a sheep goes about its daily business, information such bodyweight can be gathered and sheep can be moved between paddocks. Marketing decisions can be made without the need to muster animals and put them through undue stress.”

Each sheep is equipped with an inexpensive and unobtrusive ear tag, says Mr Murray. The tag contains a transponder so the grazier can keep track of every individual sheep in the flock.

“We can keep tabs on a single sheep from the time it is a little lamb to the time that it becomes lamb chops,” says Mr Murray. “However the main advantage is in sheep handling, because the transponder allows the sheep to make its own decisions, without being hassled by people or dogs.”

Electronically operated gates and weighing platforms are placed so that the sheep must pass through the gates, and over the weighing platform, when they are moving about the paddock. The gates are usually placed where the sheep go to drink.”

This allows the sheep to decide when to drink, or when to seek shade or shelter with minimal interference.

“The transponder activates the gate and the sheep is weighed and recorded as it passes through,” says Mr Murray. “The sheep very

quickly become accustomed to the gates and the grazier can download information about the flock which is accurate in real time."

"If there are discrepancies, or if the numbers of sheep passing through are not what they should be, the grazier is alerted to go out and check the flock", he says.

"The drafting criteria are quite flexible," says Mr Murray. "If a grazier wants to select, for example, all the pregnant ewes, or all the wethers that are over a certain weight and ready for market, he has only to set the system to the desired parameters," he says. "The sheep do the rest, with the gates directing them into the correct yards or paddocks."

Mr Murray says that new applications for the basic system that are on the way include disease control and the automatic dispensing of medicine, the control of lice and devices currently under development to detect the level of parasitism that would direct an affected sheep through a side gate for treatment.

"At present the system can weigh the animals, record numbers and direct different groups by weight or other characteristics such as sire-groups, into different areas," he says. "This enables the grazier to set up 'custom feeding' within a flock, ensuring that lighter sheep get better fed."

"The e-sheep system has real potential for prime lamb production: lamb feedlots can draft animals out of the flock as soon as they are ready for market," he says. "The reduced stress in handling of animals is an important animal welfare benefit, as well as improving the meat quality and probably growth rates."

Mr Murray says that a grazing property can now be set up for e-sheep management for "the cost of a second-hand ute" – about fifteen thousand dollars for a system of ear-tags, gates and yards, with the appropriate software installed in the grazier's PC or laptop.

Included in the cost are solar panels and mechanisms to operate gates and weighing machines.

"Anyone who can use a standard PC can handle the e-sheep software," he says. "The e-sheep concept will be commercialised, and the companies that are marketing the product are responsible for installing the software and providing a help-desk service. It's also quite flexible, as elements of the system can be set up to match the individual farmer's particular circumstances and requirements.

“There are also people in state departments of agriculture and the Sheep CRC who are available to help in setting up and using these systems.”

Mr Murray says that the initial costs of setting up an e-sheep property are quickly recovered as efficiencies lower day-to-day management costs.

“In arid areas in particular, sensors at watering points feeding information in to the system can save significant monitoring costs – as much as four dollars per sheep per year – as well as the savings accrued by the e-sheep ‘self-managing’ their own food and water requirements,” he says.

The electronic ear-tags, at approximately two to two dollars sixty each, can be recovered and re-used many times, says Mr Murray.

This project supports Australia’s National Research Priority No. 3, Frontier Technologies for Building and Transforming Australia.

More information: 02 6773 3597

Cyber-vineyards

A combination of clever software and world best-practice vineyard know-how are giving Australia’s $3 billion wine industry a fresh global edge.

PAM AusVit is a software package that has been adopted by some of Australia and New Zealand’s largest winemaking businesses, as well as attracting considerable interest in major wine producing countries such as California, Chile and South Africa.

PAM AusVit contains tools for improving grape quality, reducing crop losses, predicting disease outbreaks and minimising chemical use in the vineyard.

According to Roger Wiese of the West Australian software development company Fairport Technologies, it was a marriage made in heaven, when the Cooperative Research Centre for Viticulture (CRCV) formed a joint venture with Fairport to get the AusVit package into the hands of Australian grape growers and wine makers.

“CRCV was doing world-leading work on their AusVit software program,” says Roger. “This was particularly concerned with water use efficiency, pests and diseases, grape quality, spray application, wine quality and soil and canopy management, and incorporated very sophisticated modelling and prediction programs.”

Among its newest features is a database of nearly four hundred chemicals used in grape growing, plus the rules for their use in all the main customer markets.

“Every winery has different chemical-use requirements, as their various products go to different export and domestic markets,” says Bridget Ransome of the CRCV. “Australian grape growers have to keep track of herbicides, fungicides, pesticides, and fertilisers.

“Growers not only have to know their chemicals, they also have to have a good knowledge of the rules and regulations which govern the use of each chemical, in Australia and in overseas markets,” she says. “Each grower is required to keep a detailed ‘spray diary’ which is handed to the winery with every consignment of grapes.

“PAM AusVit brings all of this together in one streamlined package, common to the grower, the wineries, and the researchers,” says Bridget. “The database contains safety schedules for products, application information, permit use details, and guides the user in selecting the correct chemical for pest targets.

“Other elements of the PAM AusVit package are essential tools for improving grape quality, reducing crop losses, predicting potential disease outbreaks, and minimising chemical use,” she says.

Bridget says that the AusVit Chemical Database can be used in conjunction with the Agrochemicals list published by the Australian Wine Research Institute, but contains more detail and more extensive listings.

“Fairport’s PAM Ultracrop program is really a very smart computerised diary, which any farmer with a computer and working in horticulture can use,” he says. “We’d tried to incorporate every slightest piece of data which might advantage the farmer.

“The CRCV research brought modelling to the mix,” he says. “When PAM Ultracrop and the AusVit programs were melded to produce PAM AusVit, we felt we could offer a practical tool to the Australian wine industry which would put us well into the lead in the field of global innovation and ‘best practice’”.

According to Roger, PAM AusVit has applications which cover the whole of the winemaking industry including prediction of yield, cost per vine, staffing requirements, water and fertiliser costs and needs, precision farming and mapping.

“What the CRCV added to the product was the modelling and prediction capability which they had developed,” he says. “This includes the vitally important areas of disease, and water usage and water stress. The CRCV modelling programs include very strong predictive capabilities that are vitally important to the industry.

“As well as this we now have access to CRCV’s AusVit Chemical Database, uniquely important to an industry which depends heavily on a pest free environment, but which cannot afford the least trace of chemical residues in its product,” he says.

The CRCV AusVit project supports Australia’s National Research Priority No.3 – frontier technologies for transforming industry.

More information: 08 8303 9663

Cold rice

Researchers have made an important breakthrough in identifying why cold snaps during flowering cause huge reductions in rice yield.

In Australia, cold snaps after the Australia Day weekend cost rice growers millions of dollars, when the male parts of the rice plant become sterile. This is a problem in all temperate rice growing areas of the world.

Rice is very sensitive to cold during flowering, but strains of rice discovered on the Tibetan plateau could hold the key to breeding cold-tolerant rice in Australia, Japan and other parts of the world where cold snaps are a problem.

Rice feeds more than half the world’s population, but yields have been levelling off, and some 400 million people in rice-growing areas of Asia, Africa and South America are facing chronic hunger. In Australia, cold is the main yield limiting factor for rice. By better understanding and addressing cold-tolerance it is hoped reliable rice yields, even during cold snaps, will be achieved.

"Rice growers dread a cold snap just as the pollen is setting," says CSIRO's Dr Rudy Dolferus, a molecular biologist with the Cooperative Research Centre for Sustainable Rice Production. "Rice is originally a tropical plant, and it doesn't have an inbuilt resistance to cold. To a rice plant, anything under 18°C feels chilly.

"Australia has the highest yield per hectare in the world when the weather permits," says Dr Dolferus. "We get nine tonnes or more per hectare, compared with three tonnes in most of Asia. But we can also lose up to forty to sixty per cent of our crop when there is a cold snap. The pollen doesn't set, the flowers are not fertilised, and the rice farmer ends up with a paddock full of hay."

So far breeding cold-tolerant rice has been difficult because nobody understood exactly what was happening in the rice when a cold snap occurred. Dr Dolferus says that his team has been investigating the precise molecular mechanism which causes failure to produce pollen in rice plants.

"At the genetic level, we have found that it's all about sugar," says Dr Dolferus. "A cold snap only causes harm when it happens at the exact time when the rice plant is about to produce pollen. We found that cold interrupts the supply of vital sugars to the pollen, and pollen development ceases. We identified the sugar transport genes that are switched off by cold, and discovered that the switching off of these genes is done by a plant hormone which increases under cold conditions.

"If the pollen grains get no sugar, they die, and - as rice is self-fertilising - this means that no rice grains are formed a few weeks later, just when the farmer is hoping for a harvestable crop," he says.

Dr Dolferus says rice growers have learned to expect a cold snap every three or four years. Unusually, there were cold snaps in both 2004 and 2005, when the situation was complicated by the continuing drought. Rice farmers normally use large quantities of water to act as a buffer against cold.

“If a farmer suspects that a cold snap is imminent, deep water is used so that the panicles (the grain bearing part of the stem) are under water and so protected from sudden cold,” he says. “However this is not an option when there are stringent water restrictions in place.

“Increased cold-tolerance in rice would mean that farmers could save on water use,” he says. “With cold-tolerant rice they could either use less water or grow more rice with the same water.

“Along with the search for cold-resistant rice, we are looking for drought resistance as well,” he says.

Dr Dolferus says that impending climate change has given a new urgency to the search for cold- and drought-tolerant rice, as predictions for rice growing areas suggest that weather ‘events’, including cold snaps, may become more frequent, more severe, and happen in a context of less available water.

Dr Dolferus says that an international search by rice CRC researchers has discovered a rice cultivar which is impervious to cold, growing on the Tibetan plateau in Southern China. The problem with this rice however is that it has a very poor quality grain.

“Australian rice breeders have developed a very high reputation for the quality of their grain,” he says. “Around 85 per cent of the rice grown in Australia is exported, earning some $650m annually, and our grain is much prized in overseas countries. Growers would be very reluctant to lose any of their reputation for quality. The progress we made in understanding the cold problem will greatly facilitate the breeding of cold-tolerant Australian rice cultivars.”

Researchers with the Rice CRC are cross breeding Australian cultivars with the Tibetan rice to try and develop a strain which has the strengths of each. If it is possible, a new cold tolerant variety would still be some years away.

Dr Dolferus says that Australian scientists are working closely with their counterparts in Japan, and South American countries like Uruguay. Australian rice growers will benefit from this international collaboration.

The cold-tolerant rice project supports Australia’s National Research Priorities No.1, an Environmentally Sustainable Australia, and No.3 Frontier Technologies for Building and Transforming Australian Industries.

More information: 02 6951 2713

Rooting out rot

Scientists from the Cooperative Research Centre for Tropical Plant Protection have developed a rapid identikit that will enable growers to detect and identify the common cause of root-rot, *Phytophthora*.

The deadly disease *Phytophthora* is estimated to cost 10% in lost revenue for the nursery industry each year and another $300 million in losses across Australia's farming sector.

Environmentalists are also concerned by *Phytophthora*'s attack on Australia's forests, with Jarrah dieback devastating forests in Western Australia and Tasmania. A recent outbreak of sudden oak death in the United States has also been blamed on the *Phytophthora* pathogen.

Phytophthora represents a family of more than sixty plant pathogens that can be spread by water, soil and the plants themselves.

The new *Phytophthora* -IDENTIKIT™ uses DNA technology to detect *Phytophthora* in soil, water or plant samples, and delivers an identification within a day, compared to a week or more using traditional laboratory methods.

According to Dr André Drenth from the Cooperative Research Centre for Tropical Plant Protection, *Phytophthora* cannot be eradicated, making management strategies of vital importance – a process that begins with detection.

"Detection and identification is essential. But up until now, this may take weeks in a laboratory," Dr Drenth says. "By the time *Phytophthora* is identified using traditional methods, the infection might have spread far and wide.

"For a mining company needing to move soil from a mine site, for example, the cost of these kind of delays can be enormous," he says.

The ease with which the disease spreads is also a cause of concern, according to Dr Drenth.

"*Phytophthora* is very easily spread by the movement of water, by human activities, and by the movement of plants themselves," he says. "Sprinkler systems, irrigation and the use of dam water which catches run-off from infected areas are particularly liable to spread the organism."

For home gardeners, *Phytophthora* infection would likely be characterised by an area in the garden where only the toughest of plants can survive, and is almost certainly transferred from nursery-bought plants with the disease.

Australia's nursery industry currently has no mandatory accreditation scheme for ensuring plants sold are *Phytophthora*-free.

"It's important that the nursery industry consider adopting a system of accreditation, and that professional and amateur plant growers ensure that they only obtain their plants from accredited *Phytophthora*-free sources," says Dr Drenth.

The *Phytophthora* -IDENTIKIT™ has been licensed by the CRC for Tropical Plant Protection to an Australian firm, C-Qentec Diagnostics Pty Ltd for sale to laboratories around the world.

The research addresses three of Australia's national research priorities – a sustainable Australian, a healthy Australia, and frontier technologies to transform industry.

More information: 07 3896 9345

Disease predictor

A major Australian advance in disease prediction is giving health authorities worldwide increased power to predict the impact of an outbreak of an epidemic like avian flu or SARS on the population – and take early action.

Dr Evan Sergeant, an epidemiologist working in the Australian Biosecurity Cooperative Research Centre for Emerging Infections Disease, designed and developed the Pooled Prevalence Calculator and has made it available nationally and worldwide through the internet.

Initially developed for predicting outbreaks of disease in livestock, the Calculator can now be used to predict infectious outbreaks in any population, human or animal. The first successful use of the method was to determine the level of infectious plant and animal diseases being carried by 'pools' or groups of insects.

Traditional methods for surveying for disease in a population of animals or humans take time and involve huge costs. By physically 'pooling' samples into a single sample or pool, and then testing this for the disease, the cost of the sampling operation can be reduced by as much as 90 per cent – a major advantage when dealing with a serious outbreak.

“It’s a great resource for medical researchers and public health authorities who are doing disease surveillance and are trying to establish what percentage of the population may be infected with a disease such as AIDS or hepatitis,” says Dr Sergeant.

“An important function of the Calculator is that it can be used to determine rates of infection, compared to rates of exposure to possible causes.”

Dr Sergeant says that the Calculator includes tools which enable a researcher to design the most effective survey for a particular disease.

“The idea of using pooled samples is not new, but the very complicated mathematics meant that it has practically never been used,” he says. ”What I was able to do was to design a number of methods for using pooled samples and make it easy for the user to feed in data and collect their results.”

Dr Sergeant says that the continuing program of surveillance of fruit bats in Queensland to monitor the occurrence of the Hendra virus, which has been known to ‘jump’ species from bats to horses and human beings, has until now required the testing of thousands of individual bats at a cost of some $30.00 per animal. This cost can be reduced to between $3-6 by pooling the samples, without any loss of accuracy.

Other important diseases now are being monitored for their potential to break into human populations include Menangle virus in bats and Nipah virus in pigs.

Each disease has its own optimum pool size and number, says Dr Sergeant, but this is allowed for in the design of the Calculator.

“The Calculator includes options for working out the best pool size, and the number of pools, to get the most accurate result,” he says. “Modern diagnostic tests are extremely sensitive, and the Calculator takes account of the size of the pool and the reliability of the tests.

“There’s a built-in ability in the mathematical process which can incorporate existing or prior knowledge of likely prevalence and earlier test performance,” he says.

The results of any survey can be classified according to the ‘confidence intervals’, that is, the probable degree of error. According to Dr Sergeant, public health authorities need to know the possible

percentage error when predicting disease outbreaks and developing contingency plans.

“The on-line Pooled Prevalence Calculator includes options for calculating the required pool size, and the number of pools that need to be tested, in order to achieve the desired level of confidence,” he says.

The on-line Calculator includes a comprehensive User Guide, a glossary, and some examples of how to use it based on the Hendra virus in fruit bats. A simulator enables a health officials and researchers to check the accuracy of results obtained.

The research addresses National Research Priority two, a Healthy Australia.

More information: 07-3346 8861
http://www.ausvet.com.au/pprev/

Tropical wins

A powerful new scientific weapon against anthracnose – the soft brown rot that spoils avocadoes – is delivering $40 million in benefits to the nation’s avocado industry, as well as higher quality fruit to consumers.

The return on the avocado research is just a part of $150 million in benefits being delivered to the Australia’s tropical farming industries from ten research projects, according to a new economic analysis.

In fact, every dollar spent on these tropical agriculture research projects returned eleven dollars in industry and wider benefits, says Professor John Irwin, Chief Executive of the Cooperative Research Centre for Tropical Plant Protection.

The finding was made by economic research group Agtrans Research in a benefit-cost analysis of 10 CRC TPP research projects from 1992 to 2004.

“Bananas, avocados, sunflowers, cotton, lucerne, sugarcane, wheat – these are just some of an impressive list of crops where research has paid huge dividends,” says Professor Irwin.

“Avocados are a prime example. Researchers from the CRC have identified a powerful new weapon against anthracnose disease for the

avocado industry and it is already delivering substantial benefits to growers and consumers.

“By using certain Guatemalan rootstocks for avocado tree graftings, growers can halve the incidence of anthracnose disease and enjoy an eighty per cent decrease in the severity of infection,” he says.

Professor Irwin says that the practical horticultural benefits of the study are based on sophisticated scientific research.

“Anthracnose is a fungal disease which affects tropical fruits such as avocados, mangoes and lychees, and results in significant loss of fruit in the marketplace,” he says. “Our research has shown that resistance to the disease is associated with naturally occurring anti-fungal properties.

“We have also found a link between excessive nitrogen fertiliser use, low fruit calcium levels, and anthracnose severity,” he says.

The avocado industry has adopted the CRC research outcomes and made major changes to its management practices. Virtually all ‘Hass’ avocados – the most common commercial cultivar - are now grown on Guatemalan rootstock, compared to less than half before the study.

The direct benefit to the avocado industry is estimated at over forty million dollars.

The CRC is also investigating the potential of the Guatemalan rootstock to resist another devastating disease of avocados, the root-destroying pathogen, *Phytophthora*.

Professor Irwin says that ten representative CRC research projects were analysed by Agtrans Research, with avocado disease resistance being one of the highly successful results shown by the survey.

“Avocados and new lucerne varieties were the two biggest, at over forty million dollars benefit each, but the total value of benefits for the ten investments is almost one hundred and fifty million dollars, at a cost of just over thirteen million dollars.

“This gives an aggregate benefit of CRC research of more than 11 to 1,” says Professor Irwin. “It’s clear that the overall program has and will deliver important outcomes to the whole tropical fruit, horticulture and agriculture sector.”

Two diseases of bananas, black Sigatoka and tropical race 4 Panama, which entered Australia recently have also been identified, quarantined and eradicated, using sophisticated diagnostic tools developed by the CRC.

“These are typical of the diseases which occur in many of our neighbouring countries,” says Professor Irwin. “They pose an immense risk to Australia’s growers, and so it is vital that we identify and eradicate them as soon as they are detected.”

CRC for Tropical Plant Protection research supports Australia’s National Research Priorities No.1, an Environmentally Sustainable Australia, No.3, Frontier Technologies for Building and Transforming Australian Industries, and No.4, Safeguarding Australia.

More information: 07 3365 4776

Environment

Predicting bushfires

Australian scientists are developing reliable tools for predicting fire behaviour which may save lives and help to limit damage.

Fire researchers in the Bushfire Cooperative Research Centre are working on data from extensive experimental burns in Western Australia, New South Wales, and in New Zealand.

“Our aim is a simple and practical manual which can be used by fire managers and fire fighters on the ground, as well as researchers in the laboratory,” says Mr Jim Gould of CSIRO’s Bushfire Behaviour and Management Group, a partner in the Bushfire CRC.

Mr Gould says that the recent joint Australian-New Zealand experiments investigated fire behaviour on steep slopes in different wind conditions.

“Many of the dangerous and sometimes tragic ‘burnovers’ which have occurred in recent years have involved steep slopes when there has been a sudden change in weather behaviour,” says Mr Gould.

“Heath and shrub vegetation types make up a very large proportion of the remaining natural vegetation in the most heavily populated parts of Australia and New Zealand,” he says. “They make up a major component of the urban interfaces surrounding Sydney, Perth, and many bushland urban and rural developments in both countries.

“Our experimental fires have been designed to yield the maximum amount of useful data, especially with regard to the effects of slopes and gullies in scrub and heathland,” says Mr Gould.

“An important part of recent experimental projects such as the 110 experimental burns conducted as part of Project Vesta in Western Australia, and Operation Tumbarumba in NSW, has been to validate existing guides and sets of tables.

“Project Vesta in particular demonstrated that the McArthur Forest Fire meter, familiar to generations of fire fighters, may seriously understate the predicted rate of spread of forest fires under dry summer conditions,” says Mr Gould. Project Vesta has confirmed that the potential intensity and rate of spread of fires in dry eucalypt forest is directly related to the time since last fire. The intensity and difficulty of suppression of fires will increase for at least 15 years after fire

because of changes taking place in fuel characteristics of the litter, shrub and bark fuels.

“Any prediction of natural systems depends on good data,” says Mr Gould. “Weather prediction has significantly improved in the last decade through the increasing availability of better models and better data input. Bushfire prediction is following the same path, by getting an enhanced understanding of the variables which affect bushfire behaviour.”

Mr Gould says that in the three major experimental projects, researchers used a “… physical rather than a biological approach”.

“We look at the forest or shrubs from a structural point of view. We describe the environment in terms of the physical components: the height, the amount of fuels, the amount of dead material, rather than species composition,” he says. “Using those parameters, the resulting model is quite transportable from one part of Australia to another.

“As well as that, we add the moisture content or deficit, wind behaviour, and land-forms,” he says.

Mr Gould says that the end-product of the current research will take several forms, ranging from a technical report, to computer programs, to a set of tables small enough to fit in a fire-fighter’s pocket.

“This sort of work is never finished,” says Mr Gould, “but the data gathered over the past few years is enough for us to formulate a report and design practical tools that will help fire managers and fire fighters in the bush.

“The first products will be available to the bushfire agencies by next season, to be tried out in the field,” he says. “Our primary aim is to increase the safety of our fire fighters and our community.”

The research addresses National Research Priorities one and four – a sustainable Australia and safeguarding Australia.

More information: 03 9412 9602

Desert lifesavers

Health-giving foods and life-saving medications may soon be among the gifts of Australia’s Indigenous people to the rest of the Australian nation. At the same time, they will help to keep alive the world’s oldest living culture, preserving its knowledge and wisdom for future generations.

Desert Indigenous communities are working with researchers from four universities through the Desert Knowledge CRC to preserve age-old knowledge and understanding about the healing and health-giving properties of Australia's desert plants.

"The primary aim is to help transfer traditional knowledge to future generations of Indigenous people, but it is also empowering them in a quite extraordinary way to take their place in Australian society," explains Professor Louis Evans, who leads the Desert Knowledge project.

"It is showing everyone that traditional knowledge and modern scientific knowledge are equally valuable, and can work in harmony."

The "Plants for People" program is being led by senior Indigenous men and women who are using it to teach the children about their desert plant heritage. In particular, Mr John Briscoe, from the Titjikala Community, is playing a pivotal role in the project.

The Indigenous participants are also helping the scientists explore desert plants for possible new medicines to treat conditions such as heart disease, diabetes and cancer. However the rules of the project ensure that ownership of the plant knowledge remains with the Indigenous community, and that they will benefit from any scientific advances that may flow from it.

"We're studying plants regarded by the desert people as very efficacious for certain diseases, and trying to discover the compounds which make them effective as medicines," Prof. Evans explains. "If we do find plants which contain promising compounds for pharmaceuticals, then the royalties will flow back to the desert community which identified the plants for us."

"There is also great potential to incorporate health-giving desert plants or seeds in the Australian and Indigenous diet, in foods that will protect us against the chronic diseases of modern society."

"First and foremost it is about helping to preserve the culture and traditions of the desert people – but it is also about enabling desert communities to develop in new ways, and create new opportunities for themselves.

"And it is about offering all Australians the benefits of desert knowledge."

Prof. Evans says all researchers involved in the project sign a confidentiality agreement which ensures that knowledge provided to them by Indigenous people is not published or used without permission of the knowledge holders. There is also a research ethics agreement between the community and the Desert Knowledge scientists.

For two years the DK-CRC team has worked with the Titjikala community in central Australia to identify and study the plants of the region, and store the information about them in a special database as the Tapatjatjaka Plants. Plant names are recorded in at least four languages – Pitjantjatjara, Luritja, Arrente and English – so local people can use of the database. Specimens are stored in the Alice Springs Herbarium.

Indigenous elders, children and scientists go on collecting expeditions into the desert, learning from the elders about native plants and their traditional uses, and bringing back samples to be made into traditional medicines, catalogued and studied for potential use in western medicines.

The community has discussed possible activities associated with the plants, including wild harvest, seed collection, the breeding and small-scale cultivation of domesticated strains of the plants, their use for revegetating degraded or mining areas, and their marketing. There is general agreement the plants will help bring jobs and new enterprises to isolated indigenous communities.

“The Indigenous elders are truly a part of the scientific research team, they retain complete control of their traditional knowledge – and they are teaching it to a younger generation, who are keen to understand and perpetuate the wisdom,” Prof. Evans says. “It is turning out to be a wonderful collaboration.”

Desert Knowledge CRC CEO Dr Mark Stafford Smith says the Tapatjatjaka Community Government Council is in the process of signing off as an associate research partner – a first for an indigenous community – and discussions are proceeding.

The project is also likely to produce the first indigenous PhD in the field of transferring traditional plant knowledge to future generations and developing Indigenous plant based enterprises, Western Australian researcher, Kado Muir.

“The important thing to bear in mind is that the research is driven by community concerns and interest, not just scientific ones. We are very privileged to have them as our partners,” he says.

Dr Stafford-Smith says the project serves three of Australia’s national research priorities – health, environmental sustainability and new industries.

More information: 08 8950 7122

Pollution preventer

Potentially hazardous pollution is escaping into Australia's waterways from the nation's ubiquitous septic tank systems. Thousands of homes and hundreds of shire councils will soon be directly affected by improved rural building and design standards which will reflect new and world-beating research into the paths of sewage – while a young scientist in Queensland has been up to her elbows in it.

"Limited science behind system design has been built in to the Australian and New Zealand Standards," says Cara Beal of the Coastal Cooperative Research Centre and the University of Queensland. "In the past we've given a lot of thought to the design of septic tanks, but surprisingly little to the next element in the system, the absorption trench."

Ms Beal spent three years excavating and investigating trenches attached to working septic tanks, and her conclusions were disturbing. Contaminated water - which should escape downwards into the soil - is in fact seeping sideways out of absorption trenches to a far greater extent than thought.

"Effluent is assumed to mainly travel down into the soil through the floor of the trench," she says. "However, in certain conditions, effluent is moving quite quickly outwards to potentially pollute groundwater."

In most rural parts of Australia, household wastewater is processed through a septic tank. But, according to Ms Beal, few people are even aware of the covered trench where wastewater filters into the soil.

"The soil is an excellent medium for filtering dirty water," says Ms Beal. "However it can only function as a filter when the dirty water flows through at a slow and constant rate.

"When an absorption trench is functioning correctly, the nutrients and germs in the wastewater are mostly trapped by a zone of bacteria which lines the trench floor.

"This 'biomat' is the key to minimising effluent polluting the groundwater," she says. "We are now understanding that design and permeability of the biomat is at least as important as soil type itself."

Current Australian and New Zealand design standards for trenches are based on the soil properties of any given site, says Ms Beal, but her research has shown that this is inadequate.

"Irrespective of the soil type, the long-term vertical flow through a trench will be governed by the biomat, not by the soil," she says.

Ms Beal says that she combined state-of-the-art two-dimensional computer modelling of hydrologic flows with hands-on digging into real trenches and installing sensors, as well as a series of practical laboratory experiments to investigate flow rates of effluent through different soil types.

She was able to show that whenever a standard trench receives a heavy flow of effluent, the water takes the path of least resistance and escapes through the sides of the trench. Trench design and planning also takes into account the number of users of the system.

On average in Australia, each user puts about two hundred litres of contaminated water into the system every day. According to Ms Beal, the ‘overflow’ of effluent through trench walls is far more common than was supposed, and needs to be addressed by improved trench design.

Her combination of field work and computer simulation to show the flow paths of effluent is a world first, with important consequences for municipal planning and risk assessment.

“Councils want to know how many septic tanks and trenches are sustainable in a given area. For the first time, we can now give them some hard data on the performance of tanks and trenches.”

“The most important outcome of my work is that it will be incorporated into Australian and New Zealand municipal standards, which are issued to all councils and consultancies,” she says. “This means that it will mean a real improvement for communities and individuals.”

Ms Beal won the CRCA ‘Young Water Scientist of the Year’ award in 2005. Her project supports Australia’s National Research Priority No. 1, an Environmentally Sustainable Australia.

More information: 07 3362 9373

Salt-tolerant wheat

A world-wide search for a salt-resistance in wild relatives of wheat may have ended – in West Australia’s Wheatbelt, where the search began.

"A common weed called sea barley grass, which is a distant relative of farmed wheats, may be the solution to improving wheat production on our salty soils,” says Tim Colmer of the Cooperative Research Centre for the Plant-Based Management of Dryland Salinity.

According to Dr Colmer, at least ten per cent of the WA Wheatbelt has become saline, with up to forty per cent threatened in the future. Salinity is also a problem in the cropping zones of our other states. It is imperative, he says, that these millions of hectares be kept in production, but traditional Australian wheat varieties cannot tolerate high soil salinity.

Wheat is Australia's most important farm crop, with exports worth around $4 billion a year, and WA is the main export state.

Dr Colmer says that a successful cross-breeding program will not just benefit grain farmers by providing them with a viable crop. Combined with high water use, perennial plants, salt- and waterlogging-tolerant crop species will help provide the economic incentive to tackle the problem of salinity.

"Sea barley grass *(Hordeum marinum)* is one of the few plants that grows quite happily in ground almost as salty as seawater," says Dr Colmer. "In fact for many years it has been seen as an indicator of salinity".

"Now we discovered that usingcytogenetic techniques we can produce a fertile cross between sea barley grass and wheat," he says. "Rafiq Islam at Adelaide University is very skilled at making these wide hybridizations, and the CRC has enabled us to collaborate on this important work". "The research team has identified the genetic source of salt and waterlogging tolerance in sea barley grass, and then determined which accessions can be crossed with wheat."

Dr Colmer says that the resultant cross has a slightly smaller grain than wheat, and also a lower grain quality, so the crop will probably be harvested as a feed grain rather than as bread or noodle wheat – the normal uses of grain from the wheat. Future generations of the crossed grain may show improvement in grain size and quality.

Dr Colmer says that the search for a suitable species to cross with wheat took Australian researchers around the world. "Initially, we trialled more than thirty species," says Dr Colmer, "before finding that our familiar sea barley grass is the most suitable for our purposes."

"By developing a form of agriculture, which mimics the native ecosystem, we will be moving towards restoring the natural balance between rainfall, plant water use, and plant growth and productivity."

This research may also be applied to restore productivity to waterlogged and saline soils around the world; other countries with large areas of soil salinity are notably India, Pakistan, and southern Africa.

“Dryland salinity is a direct result of the clearing of our native vegetation for agriculture,” says Dr Colmer. “It was first recognised in the late nineteenth century by railway engineers looking for clean water sources in the outback. Early settlers had cleared the land and put in place farming systems which were quite unsuited to our soil types and rainfall patterns, so groundwater started to rise, bringing with it salt hidden in the soil.”

The south-west of Australia is recognised as one of 25 global biodiversity hotspots where 450 species of unique plants are threatened by dryland salinity. Finding solutions to the salinity problem is therefore not only important for Agriculture, but also for our remaining natural ecosystems.

This research project is funded by the Grains Research and Development Corporation, with participants from CSIRO and the Universities of Adelaide and Western Australia. It supports Australia’s National Research Priority No. 1, an Environmentally Sustainable Australia.

More information: 08 6488 8553

Protecting dugongs

Dugongs are shy creatures which spend their lives peacefully grazing the meadows of seagrass along the northern coasts of Australia, but according to James Sheppard of CRC Reef and James Cook University, they can and do travel vast distances at quite high speeds.

Australian waters contain the world’s largest population of dugongs, which are believed to be under threat from human activities along the coastline. The dugong research project has revealed important new aspects of dugong behaviour, which will need to be taken into account in the planning of fishing, netting and conservation zones along Australia’s coastlines.

“Dugongs are quite fussy eaters,” says Mr Sheppard. “When I started studying them, I shared the popular view that they were rather passive creatures which seldom moved far from the bays and estuaries where they live.

“I soon discovered how far and fast they can travel, how clever they are at finding the best seagrass meadows – and how much they may owe to their mothers,” he says.

Mr Sheppard says that using the latest GPS tracking technology, he and his team have been able to build up a detailed picture of the behaviour of a group of some two dozen dugongs from Hervey Bay in Queensland.

“We have carefully captured each of 22 dugongs and strapped a GPS satellite tag to the animal’s tail,” says Mr Sheppard. “The dugong simply trails the tag through the water behind it, and when it comes up for a breath of air, the tag also surfaces and transmits data to a receiving satellite. This gives us fine-scale data about the animal’s movements, twenty four hours a day.”

The GPS tags are ultimately recovered by the researchers so that they can be re-used. They leave no trace on the dugongs. Mr Sheppard says that when he started the dugong tracking project, he shared the common view that dugong herds were largely stationary, feeding at familiar seagrass meadows.

“I soon discovered that the herd could be divided into two behaviour types,” he says. “There are the homebodies, who seem content to stay around and graze in the familiar meadow.

“But there are also the hoons,” he says. “These animals will suddenly leave the herd and travel hundreds of kilometres to fresh fields of seagrass.

“What is clear is that they are moving purposefully to a remembered goal. This suggests that they have strongly developed spatial memories,” he says.

The research team believes that the reason that not all dugongs in a herd undertake these long voyages is that the knowledge of where to go is passed from mother to offspring, and not every member of the herd is even aware of the distant possibilities. This behaviour has also been observed in Florida manatees, a close relative of the dugong.

Having both homebodies and hoons in a dugong population makes sense from an ecological point of view, because the seagrass meadows upon which dugongs depend are so patchy and unpredictable. Dugongs are therefore hedging their bets by staying put when the grazing is good and travelling to distant ‘remembered’ fresh meadows when the food quality drops.

“This is graphically illustrated when, for example, a cyclone wipes out a seagrass meadow,” says Mr Sheppard. “Some members of the herd will immediately move to another feeding site. Others will actually by-pass a good seagrass meadow as if they are unaware of its existence. Others again will try to tough it out at the damaged meadow and – in some cases – even starve rather than move away.”

Mr Sheppard says that Australia’s unique and vulnerable dugongs are increasingly threatened by human activities along the coastline, such as netting, boat-strike, and illegal hunting. The degradation of seagrass meadows on which the dugongs depend is also a problem.

“The increasing urbanisation of the coastline may be posing a real threat to the seagrass,” he says. “Runoff and urban pollution are changing the nature of coastal ecosystems, while we are recognising that seagrass itself is a major resource. It’s essential not just for dugongs, but for the breeding of many species of fish and prawns,” he says.

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

More information: 07 4729 8450

Healthier city streams

Streams and waterways in Australia’s city areas are ecologically degraded, scientists say - but the answer to the problem is within reach.

“The primary reason for the poor condition of urban streams is the impact of stormwater,” says stream ecologist Dr Chris Walsh of the Cooperative Research Centre for Freshwater Ecology and Monash University. “It is delivered to most streams by drainage networks which haven’t changed in design for a century and a half.

“We continue to build this sort of stormwater drain in our cities, even though much less damaging systems have been developed and even installed in some new developments,” he says.

“Conventional drains deliver stormwater directly to the stream every time it rains, but our research has shown that this regular flush of stormwater is harmful to the stream. It causes physical disturbance to the animals and plants, as well as bringing down a cocktail of city pollutants. Most importantly, the creatures that live in streams are adapted to very occasional flooding, and are unable to cope with frequent flushes of water,” he says.

Dr Walsh says that, depending on local conditions, effective water-sensitive urban design can ensure that all the runoff from small rainstorms or showers, and the contaminants it carries, is retained in the catchment. This design means that water does not flow into pipes or over the ground until a substantial amount of rain has fallen. It mimics the situation in grassy or forested catchments, where water is held in the ground and fed into the streams over a period of time.

Dr Walsh and his team have studied streams in Melbourne, Canberra and Brisbane. “Urban and suburban streams are in much poorer condition than they need be,” he says. “A healthy stream contains an amazing diversity of

plant and animal life. An unspoilt rural stream is a very efficient filter, which retains and processes the nutrients that enter it from the catchment.

“Our urban streams on the other hand have hardly any of the sensitive animals and plants that live in rural streams, and they function more as a drain, exporting masses of pollutants and nutrients to rivers, estuaries and coastal waters downstream,” he says.

Stormwater and catchment managers, especially in North America, have advocated the so-called ‘ten per cent rule’ when planning new housing projects, and this rule can give quite misleading results, he says.

The ‘ten per cent rule’ suggests that if just ten per cent of the surface area of a catchment is made of hard or impervious materials, the waterways of the catchment will become severely degraded.

Dr Walsh says that water-sensitive urban design has to take account of stormwater and the conservation of water, and the ‘ten per cent rule’ does not give adequate guidance.

“Not all hard surfaces are equal,” says Dr Walsh. “Where stormwater is taken by concrete gutters and pipes directly into the waterway, just a few per cent of the catchment covered by impervious surface can lead to serious degradation of the stream.

“Conversely, we think it likely that typical urban developments with 30% impervious surfaces or more could still support healthy streams if they were built with new drainage technology, ” he says.

Dr Walsh says that a ‘treatment train’ is needed to maintain urban and suburban water quality, and that planners of the future will need to incorporate the concept into new urban projects.

“The notion of a train is apt, because it is modular, and can be adapted to the particular needs of a given development,” says Dr Walsh.

“Typically, water falling on a suburban catchment might first be captured in rainwater tanks and used for domestic purposes; if tanks overflow, the running water passes through some form of a water garden; from there, by way of street drainage that might include ‘swales’ or grassy hollows (rather than concrete drains) or biofiltration systems or small wetlands before draining to a stream.”

“Wetlands are often constructed at the bottom of urban catchments to treat stormwater,” says Dr Walsh. “They can be quite efficient at storing and processing loads of pollutants, which can protect downstream estuaries

and coastal waters. But to protect urban streams, stormwater management needs to be applied at small scales throughout the catchment."

The best advice for a planner or developer, says Dr Walsh, is to mimic the natural water cycle in a catchment.

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

More information: 02 6201 5168

Reducing roadkill

Dead animals on Australian highways are so common that most drivers don't give them a second glance - but roads which cut through bush pose a major threat to the animals which live there.

Dr Miriam Goosem of the Cooperative Research Centre for Rainforest Ecology says that roads departments and shire councils are becoming far more aware of the problem.

"With increasing traffic and regular highway upgrades, roads have become a real problem for canopy- and ground-dwelling animals," says Dr Goosem. "In some cases, such as the endangered Cassowary and the rare Lumholtz's Tree-kangaroo, road deaths are so frequent that they are a real threat to species survival.

"For example, along 2km of highway through rainforest, I found 4,000 animals killed over a 3 year period when checking weekly. This does not include the animals that disappeared between surveys."

While road kills are an obvious and tragic result of the fragmentation of habitat by roads, other consequences may be less obvious but equally serious.

Roads, pipelines, electric power-line easements and other artificial clearings in bushland can create impossible problems for bush dwellers when they are scared of crossing the open area, she says.

"A viable population needs genetic diversity," says Dr Goosem. "An area of forest or bush sliced in two by a road or other clearing can create two distinct and non-viable populations of a once-thriving animal.

“An overpass or an underpass may be the solution to the problem, and if it is included in the planning for road making or road maintenance it becomes a minor engineering project,” she says.

Dr Goosem says that while ‘fauna underpasses’ are not a new idea, with new research they are an idea whose time has come. On the other hand, ‘fauna overpasses’ in the form of rope bridges that possums can walk across are very new.

One criticism of the provision of animal underpasses was that they would become ‘predators’ lunch-boxes’, as cats and foxes would quickly learn to take up station where there was regular prey traffic.

“This can easily be prevented by providing cover for animals which use the underpass right up to the entrance and exit,” she says. “In the underpass itself, we have learned to provide ‘furniture’ to protect the passing creatures: the tunnel is floored with local soil, there are rocks and logs to provide shelter for small animals, and ropes and branches allow tree-living animals to escape from ground level.”

Traffic through the underpasses has been monitored by the researchers using sophisticated sensors, automatic cameras and simple brushed sand floors to record animal footprints.

The researchers found that in forest country, pest species such as foxes and cats (and even cane toads) are more inclined to use road clearings for their own travel, and less likely to penetrate the denser bush.

Many canopy-dwelling species seldom if ever descend to the ground, and for them Rainforest CRC researcher Nigel Weston and National Parks ranger Rupert Russell provided overpasses in the form of rope bridges above busy roads.

“Initially we trialled hanging tunnels made of rope. We found that several rare species of possum quickly learned to use them but preferred walking along the top of the structure, so we changed to a much simpler and cheaper form of rope ladder,” says Dr Goosem.

Dr Goosem says that there is encouraging community and official acceptance for achieving the best environmental outcome, and increasing understanding of the effects of man-made structures on animal population dynamics.

This research has been included in a manual of environmental best practice produced by the Rainforest CRC and the Queensland Department of Main Roads. Overpasses and underpasses have been included in many road upgrades in eastern Australia, according to Dr Goosem, and the requirement for

natural habitat adjacent to underpass entrances is now emphasised throughout Australia.

“Globally, we lead the world in rainforest road ecology and mitigation of road impacts for rainforest fauna,” says Dr Goosem. “This project is not just good science, but it adds significantly to the skills base of Australian road engineers, many of whom are involved in large overseas projects.”

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

More information: 07 4042 1246

Medical Science & Technology

Tooth saviour

Australian scientists have discovered a highly effective new weapon in the fight against tooth decay and mouth disease.

Researchers from the Cooperative Research Centre for Oral Health Science (CRC OHS) have filed patents for ‘Kappacin’, a peptide derived from casein, a protein in cows’ milk.

Kappacin has a deadly effect on the mouth bacteria which form dental plaque.

“There’s a vast unexplored territory inside every human mouth,” says CRC OHS microbiologist Dr Stuart Dashper.

“Novel research technologies have given us a whole new view of what’s happening in the oral cavity.

“Until quite recently we were limited by which bacteria we could grow as a culture in the laboratory. We know now that not only do cultured bacteria behave differently to those living ‘in the wild’ but there are very many species which cannot be cultured at all.

“One important discovery is that bacteria living in or on the body can be up to five hundred times more resistant to anti-microbial agents than a pure strain of the bacteria in a laboratory flask.”

Recent research has demonstrated that oral bacteria form dense colonies of ‘biofilm’ which is anchored on the teeth.

“Like seaweed on the rocks, biofilm is more than just the sum of all the individual cells which make it up,” says Dr Dashper. “There’s evidence that groups of cells or individuals even from different species behave in a multicellular way and communicate with one another.

“This may have profound consequences for oral health and the prevention of decay.”

Dr Dashper says that more than six hundred species of bacteria inhabit and interact in the human mouth. The behaviour of mouth bacteria is influenced and altered by the behaviour of the host human.

“We eat too much, we eat too often, and we eat too much sugar,” he says. “This means that we are providing an ideal environment for bacterial biofilms, and consequently, decay.”

The new antimicrobial agent Kappacin is particularly effective against one of the microbes most responsible for tooth decay, *Streptococcus mutans*.

Most remedies and mouthwashes on the market are less effective, according to Dr Dashper, and can also cause serious and unwanted side effects including an unacceptable taste, burning pain in the mouth, and staining of the teeth.

Kappacin does not cause these effects.

“A great virtue of Kappacin, from Australia’s point of view, is that it is made from whey, a by-product of the cheese industry,” says Dr Dashper. “The industry has a problem disposing of vast amounts of whey, so it is an ideal source for a commercial oral hygiene product with a potentially huge market world-wide.”

Dr Dashper says that nearly half of Australian children aged 12 show signs of tooth decay. By age seventeen this has risen to three quarters of the population, with an even higher percentage by age thirty. The cost to Australia for dental services is estimated at $2.6 billion annually.

Use of the antimicrobial agent need not be limited to human oral hygiene, says Dr Dashper.

“At this stage we have filed patents on kappacin and we are currently developing it as a human medication, but there is a vast potential in veterinary use, and we are also investigating the possibility of using the antimicrobial peptide as a food preservative,” he says.

The CRC for Oral Health Science research project supports Australia’s National Research Priorities Two – Promoting and Maintaining Good Health, and Three – Frontier Technologies for Transforming Industry.

More information: 03 9341 0287

Wobbegong diagnosis

The spotted wobbegong may one day save Australian lives and reduce suffering – thanks to its remarkable immune system.

Wobbegongs and other sharks have some of the oldest adaptive immune systems in nature. Australian scientists have developed a unique ‘library’ of the

antibodies produced by shark immune systems for use in detecting and diagnosing a wide range of human diseases and poisons.

“Diagnostic tests have relied in the past on antibodies derived mainly from mice,” says Dr Stewart Nuttall of the Cooperative Research Centre for Diagnostics and CSIRO. “However we’ve now established that sharks have a unique class of antibodies which are ideal for disease diagnosis.”

These shark antibodies are known as IgNARs (for ImmunoGlobulin New Antigen Receptor).

“We extracted small blood samples from sharks, which were then transferred to the laboratory. By using bacteria in the laboratory as small protein ‘factories’ we were able to produce enough antibody to enable us to determine its structure.”

No sharks were killed as part of this research.

The shark antibodies have now been produced entirely in the laboratory, to create highly stable new reagents.

Antibodies can be selected to detect a very wide range of targets including chemical pollutants as well as toxins and pathogens, says Dr Nuttall. These shark antibodies may play a role as the front-end reagents for detecting toxins, pathogens, and potential biological warfare agents.

Dr Nuttall says that IgNARs are extremely stable and resistant to harsh treatments that denature other antibodies, such as high temperature and chemical treatments.

“This makes them ideal for practical use in the field,” he says. “They can be used in portable diagnostic or bio-assay devices in harsh surroundings such as deserts or tropical environments.”

According to Dr Nuttall, scientists have been aware for a long time that the immune system of sharks is unusual.

“Sharks have been around for a very long time,” says Dr Nuttall. “Obviously, they’re doing something right. They have a highly effective immune system.

“It’s important to understand the evolution of the immune system to know how nature has solved the problem of fighting off infectious diseases,” he says. “We can then use this knowledge in smart design of the next generation of diagnostics and therapeutics.”

The CRC for Diagnostics at CSIRO Parkville in Melbourne has now developed libraries of millions of different antibodies, selected to target specific disease-causing microbes or poisons.

Dr Nuttall says that the Melbourne laboratory has applied for international patents for the shark-based diagnostic reagents. The patent application was filed on 2 June 2005.

This project supports Australia's National Research Priority No. 2, Promoting and Maintaining Good Health, and No. 4, Safeguarding Australia.

More information: 03 9662 7324

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Appendix B: Contact Details of CRCA CRCs (18/01/06)

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Appendix B: Contact Details of CRCA CRCs (18/01/06)

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Sector: Medical Science and Technology

CRC for Aboriginal Health
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CRC for Cochlear Implant and Hearing Aid Innovation
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CRC for Oral Health Science
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