energy futures

> energy research 🏛️ UOW
A secure and sustainable supply of energy is a fundamental requirement for any prosperous society. However, an ever-increasing world population and escalating per capita use of energy has led to a new imperative - one which requires that energy supply systems operate within the ecological limits of the planet.

Recently it has become clear that the current reliance on conventional sources of energy is not sustainable in the long term and has the potential to lead to significant environmental impacts through pollution and climate change. There is a clear need to find new ways to generate, distribute, store and utilise energy in all sectors of society. This is one of the greatest challenges that society has ever faced.

Meeting this global challenge requires research and innovation on a wide range of energy technologies. Partnerships between Universities, commercial entities and government will be important in bringing new technologies into being and into widespread use.

In recognition of the importance of these new challenges, the University of Wollongong (UOW) has established an Energy Futures Network. This network spans the Faculties of Engineering, Science, Commerce and Informatics and allows UOW to build multi-disciplinary research teams to address energy-related issues.

UOW’s capabilities in Energy Futures fall into four broad research themes:

> Energy Conversion and Storage;
> Energy Production and Delivery;
> Power Quality; and
> Atmospheric Chemistry.

I hope that you will take the time to read this brochure and consider the University of Wollongong as a potential research provider and partner for your organisation.

Prof Margaret Shell
Deputy Vice-Chancellor (Research)
University of Wollongong
Energy Conversions and Storage

**Intelligent Polymer Research Institute (IPRI)**

The Intelligent Polymer Research Institute (IPRI) is focused on the development of novel electromaterials such as inherently conducting polymers (ICPs) or carbon nanotubes to act as the sensing and actuating elements as well as the energy conversion and storage centres within intelligent material systems. In so doing, IPRI has developed an array of unique polymer structures as well as processing and device fabrication protocols based on fibrespinning, electrosprining and inkjet printing.

Some of IPRI’s technologies have applications to energy development, for example:

- the use of novel light harvesting polymers in polymeric photovoltaic devices;
- the production of polymers for hydrogen generation;
- the development of batteries and supercapacitors based on photovoltaic fabrics; and
- the development of self-powered, mobile sensing systems for solution and air monitoring.

**Research Project: Light-Driven Chemistry with Nanostructured Conducting Polymers**

This IPRI project seeks to understand and exploit the rich photochemistry of electrically conducting polymers. Light stimulated electron transfer events will be employed in a wide range of exciting applications. The ability to produce solutions, films and especially nanoparticles of photo-catalysts should result in new light driven processes of industrial/environmental significance. This project will provide a platform for the design of the next generation of plastic solar cells and light driven catalysts for energy conversion.

**Research Project: Supported Molecular Catalysts for Methanol Oxidation and Other Reactions**

Knowledge arising from these fundamental studies has the potential to place Australia at the forefront of this important area of materials science and catalysis. IPRI expects to make discoveries that will be useful not only in the area of catalysts for the direct methanol fuel cell, but also in environmental decomposition and the whole field of bio-teenic supported electrocatalysts.

**Energy Conversion and Storage: ARC Centre of Excellence for Electromaterial Science (ACES)**

IPRI is the lead partner and ISEM is a supporting partner in the Australian Research Council’s (ARC) Centre of Excellence for Electromaterials Science (ACES). Other partners include Monash University’s Ionic Liquids group, St Vincent’s Health in Melbourne and the Bionic Ear Institute.

ACES aims to develop the nano-science and nano-technology related to the movement of electric charge within and between materials. ACES has four key research programs, two of which are directly relevant to Energy Futures:

1. **Energy Conversion** - including solar energy conversion, electrochemical conversion and nanostructured electrocatalyst materials; and
2. **Energy Storage** - all solid-state thin film lithium ion microbatteries, advanced metal batteries and organic batteries.

**Energy Conversions and Storage: Research Theme**

Key challenges to securing a sustainable energy future for the planet are the development of new ways to convert energy from one form to another and to store energy cost effectively, and with minimal environmental impact. UOW is a world leader in key aspects of this field.

Fundamentally new and exciting energy conversion technologies are being developed at UOW. These range from development of revolutionary photovoltaic materials to convert sunlight to electricity, to the invention of new catalyst materials for fuel cells to convert the chemical energy in hydrogen or methanol to electricity.

Superconductors are new materials that have virtually no electrical resistance. They have the potential to not only eliminate significant energy losses throughout electrical power generation and transmission systems but also to provide a means of storing electrical energy cheaply and in concentrated form. However, to date these materials must be held at very low temperatures to maintain their superconducting properties. UOW’s superconductor research team is a world leader in the commercial development of superconductors that can be used at higher temperatures and manufactured at an industrial scale.

Storage of electrical energy is becoming increasingly important as our society moves away from the combustion of fossil fuels as a means of generating electrical and mechanical energy. One of the challenges in increasing the penetration of renewable energy sources into the energy supply chain is the need to develop both large and small scale electrical storage technologies. Inherent supplies of energy may be harnessed from solar or wind energy, for example. Many new forms of energy storage are under development at UOW, including hydrogen storage technologies and innovations in both conventional and advanced battery systems.
ENERGY CONVERSION AND STORAGE:
INSTITUTE FOR SUPERCONDUCTING AND ELECTRONIC MATERIALS

The Institute for Superconducting and Electronic Materials (ISEM) maintains a world class cooperative research team in superconducting and electronic materials science and technology, and aims to stimulate the technological and commercial development of the Australian industry in this field.

ISEM has research teams investigating:

> Applied Superconductivity: Superconductor technology will play a significant role in a wide range of industries and environments in the twenty-first century. Widespread applications now depend on the cost-effective resolution of fundamental materials and fabrication issues. This group investigates the microstructure of superconducting materials and aims to improve the materials’ performance (e.g., improved flux pinning and critical current density); through, for example, chemical doping. This work will develop new generation superconductors with high performance at low cost;

> Energy Materials: The main interest of this group is to develop innovative technology for next generation energy storage with high energy density, long life cycle and low cost. This group has attracted a number of industries to support its research work, including Sons of Gwalia Ltd, OMG Ltd, LeadPower Battery Co., Ltd, Electric Transit Pty Ltd, DLG Battery Co. Ltd and Australian Battery Technology Ltd; and

> Terahertz Science, Thermionics and Solid State Physics: Semiconductors play a key role in high technology and an understanding of their fundamental properties is essential to their proper application. Spectroscopic and electrical techniques are the most powerful ways of studying these materials. This group is performing experimental studies on both bulk and low dimensional semiconductor structures with and without external perturbation.

RESEARCH PROJECT:
EXPLORATION OF NEW CATALYST MATERIALS FOR HYDROGEN/ AIR FED PROTON EXCHANGE MEMBRANE FUEL CELLS

Fuel cell technology is the most critical technology for the hydrogen economy. Hydrogen/air fed fuel cells can provide pollution-free power sources for vehicles and distributed power generation. A breakthrough in hydrogen fuel cell technology will provide clean and sustainable energy, dramatically improving the environment, while maintaining national security. The success of fuel cell technology will also significantly reduce the dependence on oil. This ISEM research project is expected to establish local expertise, and scientific and industrial know-how on fuel-cell technology. This project is funded by the ARC in collaboration with the LeadPower Battery Co., Ltd.

RESEARCH PROJECT:
CURRENT LIMITING MECHANISMS IN MAGNESIUM DIBORIDE SUPERCONDUCTORS

Numerous important applications have already been identified for MgB₂, wire: power transmission cables, fault current limiters, transformers and magnets for motors and generators, as well as medical applications, magnetic resonance imaging (MRI). The significant increase in current carrying capacity of one order of magnitude expected from the proposed program will enable MgB₂ to replace presently existing low-temperature superconductors (LTS) and expensive high-temperature superconductors (HTS) in numerous important applications. MgB₂ technology, coupled with renewable energy sources, has the potential to provide a long-term solution to the energy crisis and global warming threat.

ISEM is considered a world-leader in MgB₂ superconductivity. Currently, ISEM is commercialising some of its patented breakthrough technology in this field via a licence to USA-based company HyperTech Research Inc.

RESEARCH PROJECT:
HYDROGEN STORAGE MATERIALS FOR ENERGY CONVERSION APPLICATIONS

For a clean environment, the ideal synthetic fuel is hydrogen because it is highly abundant and its oxidation product (water) is environmentally benign. However, the effective storage of hydrogen remains a scientific challenge. This ISEM project aims to develop innovative materials with high hydrogen storage capacity and long cycle life, including new composite hydrides, catalysed metal hydrides and various nanotubes. The expected outcome is the achievement of high and reversible hydrogen storage capacity to meet all the demands required for energy conversion applications, in particular, for hydrogen storage/fuel-cell vehicular applications.

RESEARCH PROJECT:
DEVELOPMENT OF HYBRID ELECTROCHEMICAL ENERGY STORAGE AND CONVERSION SYSTEMS

Electrochemical energy is regarded as an alternative green energy/power source. The breakthrough technologies developed in this ISEM project will realise the great potential of widespread usage of electric vehicles and hybrid electric vehicles, inducing dramatic improvements to the world’s environment. They will also help to reduce global dependence on the current oil-driven economy, and increase national energy security and energy independence. The project will establish indigenous expertise and scientific know-how on electrochemical energy storage and conversion technology. The competitive results from this research will provide an incentive to the Australian automobile and energy industries.

CONSULTING/TECHNICAL ADVICE:
PROF SHI DOU (DIRECTOR)
Phone: +61 2 4221 4558
Email: shid@uow.edu.au
www.uow.edu.au/eng/research/ISEM

CONSULTING/TECHNICAL ADVICE:
DR ANDRZEJ CALKA
Phone: +61 2 4221 4945
Email: acalka@uow.edu.au
www.uow.edu.au/eng/research/emi

ENERGY CONVERSION AND STORAGE:
SPECIAL MATERIALS: APPLIED RESEARCH AND TECHNOLOGY GROUP

The Special Materials Applied Research and Technology Group (SMART) undertakes research on the synthesis, processing and characterisation of advanced materials. SMART researchers have strong international research connections and collaborate extensively with international experts.

RESEARCH PROJECT:
MECHANICAL SYNTHESIS AND REHYDROGENATION OF COMPLEX HYDRIDES AND NANOCOMPOSITES IN HYDROGEN BALL MILLS

This SMART project aims to directly synthesise novel hydrides, hydride mixtures and nanocomposites in specialised “hydrogen ball mills” under molecular hydrogen gas and hydrogen plasma. The resultant novel nanomaterials will have application in hydrogen storage systems. This project is an international collaboration involving the Department of Natural Resources Canada, the University of Waterloo; the Russian Academy of Sciences, Hy-Energy LLC (USA) and the University of Wollongong. The project has obtained prestigious support from the International Partnership for the Hydrogen Economy.
World energy demand is projected to rise dramatically in the coming years. It is therefore vital that new ways of generating and delivering energy, that are both economically and environmentally sustainable, are developed.

Greenhouse gas emissions from the Energy Production and Transport sectors represent over 68% of Australia’s total emissions and have increased by 43% and 23%, respectively, between 1990 and 2004. Renewable energy sources will therefore play a key role in reducing greenhouse emissions and UOW is currently involved in research into several of the most promising options including wind, ocean wave and biomass energy generation systems.

Development and maintenance of the infrastructure for both existing and future energy generation/delivery systems relies on development of new materials and ongoing innovation in manufacturing techniques. UOW has significant expertise in the field of advanced materials research and manufacturing, particularly in applications such as welding and joining which are of great benefit to the energy industry.

UOW is also actively involved in developments in the large-scale use of hydrogen, which is acknowledged as the most likely long-term replacement for carbon-based fossil fuels in delivery and storage of energy for transport and stationary electricity generation systems.

**RESEARCH PROJECT:**
**NEW GENERATION GAS TRANSMISSION PIPELINE STEELS**

WeldED Materials Group is undertaking research to investigate the weldability of a new family of pipeline steels in collaboration with local industry. Successful introduction of these new steels will open up opportunities for market growth and export potential in areas of fundamental importance to Australia’s energy infrastructure. Implementation of this newly developed technology would, for the first time, create export market opportunities for Australian linepipe manufacturers. Further, it is anticipated that the reformulated alloys will provide greater confidence in the integrity and cost-effectiveness of gas transmission pipelines for future hydrogen delivery needs.

**RESEARCH PROJECT:**
**ENVIRONMENTAL EFFECTS ON STRUCTURAL ALLOYS IN ENERGY APPLICATIONS**

The WeldED Materials Group has a long history of research into the structural integrity of engineering alloys in energy applications, including creep of alloy steels in power generation, high temperature wear and oxidation effects, and microstructure/property relationships in weld metals and heat-affected zones. In particular, the WeldED Materials Group has been involved in the study of weld-related hydrogen embrittlement, and is now focusing more effort on the fundamentals of hydrogen transportation in structural steels. It is anticipated that this work will make a major contribution to our understanding of the mechanisms of plastification and embrittlement that are known to be associated with hydrogen in steel, and help to provide practical guidelines for ensuring the safety and integrity of hydrogen delivery infrastructure.

**RESEARCH PROJECT:**
**A TECHNOLOGY ROADMAP FOR AUSTRALIA’S HYDROGEN DELIVERY INFRASTRUCTURE**

The WeldED Materials Group is leading a CSIRO Flagship Project to develop a Technology Roadmap for Australia’s Hydrogen Delivery Infrastructure. The objective of the project is to develop a technology roadmap for Australia’s future hydrogen distribution infrastructure that outlines the technical and economical aspects of various delivery modes, and associated operational considerations (including safety, maintenance and structural integrity requirements).
A number of projects are underway in the field of Renewable Energy Systems. Staff from groups including the Engineering Manufacturing Research Strength and the Sustainable Water and Energy Research Group (SWERG) are exploring advanced technologies in renewable energy production systems, particularly in the fields of Wave, Wind and Bio Energy.

Ocean Wave Energy is a vast resource of renewable energy which has not been tapped to date. One of the most promising types of energy conversion device is the Oscillating Water Column (OWC) system which is being researched at the University of Wollongong. OWC research at UOW involves experimental and computational modelling of the air turbines used to convert the pneumatic energy generated within the OWC to mechanical/electrical energy. Mathematical modelling of the hydrodynamics of the ocean waves using advanced numerical methods is also carried out by researchers from the School of Mathematics and Applied Statistics, Faculty of Informatics.

Wind Energy is currently the most cost-effective of all the decentralised renewable energy systems. However, relatively little research has been carried out on small scale wind turbines (less than 50KW) which have enormous potential for use by remote and peri-urban communities. The research team at UOW are investigating the performance of small scale vertical and horizontal axis wind turbines for on and off grid applications, through experimental field testing and theoretical modelling.

Bio-energy systems utilise natural processes, such as photosynthesis, to capture solar energy and convert this to greenhouse neutral fuels including: ethanol, bio-diesel, bio-methane and hydrogen. Researchers are currently developing new technologies that can be applied at small and large scale to reduce greenhouse emissions in a number of sectors.

**RESEARCH PROJECT:**

**OCEAN WAVE ENERGY CONVERSION SYSTEMS**
The Wave Energy Research team is carrying out experimental and theoretical work on the development of Oscillating Water Column (OWC) systems and is a close collaboration with one of the world’s leading Ocean Wave Energy companies, Enertech Australia Pty, which has built a 0.5MW demonstration plant located in the ocean of Wollongong.

The main research activities include:
- Numerical modelling and CFD studies are being used to optimise the design, performance and control of air turbines driven by OWCS.
- Investigation of the aerodynamic/hydrodynamic coupling between the air turbine and the OWC chamber to optimise overall plant efficiency. Experimental scale models are used to make practical measurements.
- Fundamental hydrodynamic studies of ocean waves using numerical methods specifically the Dual Reciprocity Boundary Element Method. The aim is to determine the optimal hydrodynamic configuration of the OWC and associated components such as reflector sails, sea-floor topography (bathymetry) and presence of breakwalls etc.

**RESEARCH PROJECT:**

**NEW GENERATION SMALL SCALE WIND TURBINES**
A new generation of small scale wind turbines is being field tested and analysed experimentally. Numerical performance analysis includes blade element analysis and CFD methodologies. Field testing of the wind turbines is being carried out on commercial wind turbines suitable for Remote Area Power Supplies (RAPS) with full data acquisition instrumentation at a coastal site in Wollongong.

Theoretical modelling of the optimal configuration of windstar RAPS systems is being carried out, particularly, with a view to electrification of small communities throughout developing countries. A prototype novel vertical axis machine is also undergoing further development.

**CONSULTING/TECHNICAL ADVICE:**

**A/PROF PAUL COOPER**
Phone: +61 2 4221 3355
Email: pcooper@uow.edu.au
www.uow.edu.au/eng/research/manufacturing

**RESEARCH PROJECT:**

**GENERATION OF BIOHYDROGEN FROM DAIRY MANURE**
Bio-hydrogenation can be produced by two processes; by photosynthetic micro-organisms and by fermentative micro-organisms. In the latter process, hydrogen is produced during hydrolysis of organic matter and acidification by bio-degradation.

Anaerobic bacteria play an important role in this process. In this project, a suitable anaerobic bacteria will be isolated from cow dung. Hydrogen gas will be produced in an anaerobic bioreactor using this specialised bacteria. The effect of waste composition and suitable environmental conditions are then studied to optimise the production of hydrogen. Once SWERG is successful in producing hydrogen from the fermentative micro-organisms, it will undertake research using photosynthetic micro-organisms.

**RESEARCH PROJECT:**

**DEVELOPMENT OF BIOGAS (METHANE) FROM AGRICULTURAL WASTE**
Continued growth and consolidation of the livestock industry, such as the dairy industry, generates large quantities of wastes that have long been identified as a major contributor to diffuse source pollution in Australia. Anaerobic digestion (AD) is an efficient, small footprint, cost effective and sustainable technology that has the potential not only to minimise the environmental impacts but also to maximise resource recovery, especially the generation of useful renewable bio-fuel (methane) and wastewater reuse. In order to be able to design and operate efficient anaerobic digestion systems, appropriate mathematical models need to be developed to observe and analyse the anaerobic process dynamics and accordingly optimise anaerobic digestion applications. SWERG is developing suitable biocatalysts to digest agricultural waste to produce methane gas that can be used as an energy source for various dairy farming activities. In addition, SWERG is developing mathematical models to optimise the system configurations and simulate gas production rates.

**CONSULTING/TECHNICAL ADVICE:**

**A/PROFESSOR (SIVA) M SIVAKUMAR**
Phone: +61 2 4221 3055
Email: siva@uow.edu.au
www.uow.edu.au/eng/research/swerg
Power Quality: Integral Energy Power Quality & Reliability Centre

The focus of the Integral Energy Power Quality & Reliability Centre (IEPQRC) is to work in conjunction with industry to improve the quality and reliability of electricity supply for the benefit of all consumers. IEPQRC’s expertise is made available to industry and to power utilities to provide expert advice and consulting in areas such as power quality monitoring and reporting, power quality investigations and problem solving and interpretation of standards. IEPQRC also runs regular continuing education courses in the area of power quality as well as other specialised courses from time to time.

The strength of IEPQRC comes from its wide ranging expertise in both the power system and customer load area, its strong contacts with industry, and its knowledge of international research efforts. IEPQRC is equipped with an instrumentation and development laboratory as well as a range of commercial and in-house developed computer software.

IEPQRC has specific expertise and experience in the following areas:
- Power Quality - standards, instrumentation, monitoring, analysis, reporting, improvement;
- Harmonics - modelling, analysis, mitigation, instrumentation;
- Voltage Fluctuations and Flicker - modelling, analysis, measurement;
- Voltage Sag - modelling and analysis;
- Transients - modelling and analysis; and
- Conducted electromagnetic interference measurement.

Research Project: Modelling of Wind Turbines
IEPQRC uses simulation software (PSCAD/EMTDC). It is used to examine the operation and control of doubly-fed induction generators and how they interact with the electricity grid.

Research Project: Data Exchange with Industry
IEPQRC is particularly interested in obtaining design data from wind turbine and generator manufacturers so that accurate modelling can be performed. In return, results from any work performed would be made available to the supplier of the data.

Research Project: Renewable Energy and Distributed Generation Standards
Standards for renewable energy and distributed generation require regular review and improvement. A recent investigation examined the general applicability of the IEC standard 61400-21 for wind turbines. IEPQRC staff have an association with several national and international standards bodies. As standards become available, they will be examined and tested for their applicability and usefulness.

Research Project: Detecting Harmonic Sources
When harmonic voltages exceed maximum acceptable limits, customers are not entirely responsible for their level of disturbing current. Situations can arise in which customers who are normally compliant find that their current exceeds what has been specified in a connection agreement. Practicable methods need to be developed that will allow a clear demonstration as to which customer, if any, is exceeding their allowance. Methods being investigated by IEPQRC include harmonic power and reactive power flow and observing the natural daily variation of harmonics voltage and current levels. Various analysis and simulation tools are being investigated for their suitability for this project.

Research Project: Voltage Unbalance in Untransposed Interconnected Sub-Transmission Networks
Voltage unbalance in power systems can cause damage to customer loads such as three phase induction motors. While most of the voltage unbalance in distribution systems arises as a result of unbalanced loads, in sub-transmission systems this is not the case. Also, the unbalance voltage limits are much more stringent. This IEPQRC project looks at an interconnected system with a view to identifying and ranking the contributors to voltage unbalance at various nodes. The preliminary investigations show that the untransposed lines are a major contributor to the voltage unbalance. This IEPQRC project also looks at variable cost effective voltage unbalance mitigation techniques.

Research Project: Impact of Renewable Energy Generators on the Electricity Grid
Power electronics technology is often used to interface renewable energy sources to the electricity network. This inevitably results in harmonic currents flowing into the network and distorting the mains voltage. An initial study by IEPQRC has looked at the impact of residential type photovoltaic generators on the low and medium voltage distribution systems. This work will be expanded to allow for a variety of network construction and will be extended to include other renewable energy sources.

Research Project: Propagation of Voltage Fluctuations and Flicker through Transmission and Distribution Systems
This IEPQRC project deals with how voltage fluctuations and flicker, due to large network loads such as arc furnaces and wind farms, move through the electricity network and are attenuated. This involves theoretical investigations supported by field measurements.

Consulting/Technical Advice:
Dr Vic Smith
Phone: +61 2 4221 4737
Fax: +61 2 4221 3236
Email: iepqc@elec.uow.edu.au
www.elec.uow.edu.au/iepqrc
Sustainable energy supply system. This, in turn, is necessary for a rational approach to the design of the world’s future and climate change.

Understanding the chemistry of the atmosphere and how it is affected by anthropogenic and natural greenhouse emissions is a crucial component of modelling global warming and climate change. This, in turn, is necessary for a rational approach to the design of the world’s future and sustainable energy supply system.

ATMOSPHERIC CHEMISTRY

Planet Earth has a diameter of about 12,700 kilometres, yet the atmosphere that we and our biosphere rely upon is effectively only a few tens of kilometres thick.

In recent research, ACRG has begun to investigate the use of high resolution FTIR spectroscopy for isotopic analyses of gases that are otherwise very difficult to analyse. These include measurements of isotopes such as $^{13}$CO$_2$ and $^{13}$CH$_4$, which are marked by $^{13}$C in mass spectrometric measurements. ACRG’s current focus is on $^{15}$N$_2$O and CH$_4$. In other studies ACRG has used low resolution FTIR spectroscopy to determine $^{13}$C/$^{12}$C ratios in air samples as a considerably cheaper and more convenient alternative to isotope ratio mass spectrometry.

RESEARCH THEME:
ATMOSPHERIC CHEMISTRY

RESEARCH PROJECT:
NOVEL, COST-EFFECTIVE METHODS FOR MEASURING METHANE EMISSIONS FROM GRAZING LIVESTOCK

Agriculture is second only to energy generation as a source of greenhouse gas emissions in Australia. Methane from cattle and sheep constitute 60% of these agricultural emissions. Their abatement is a win-win goal for the agricultural industry, reducing greenhouse emissions while increasing feed efficiency. This ACRG project will develop a novel, cost- and labour-efficient method for on-farm measurements of the emissions of methane from free-grazing cattle and sheep in their undisturbed environment. The method will be used to assess the dependance of methane emissions on factors such as diet and the efficacy of proposed methods for abatement of methane emissions, as well as providing improved data to the National Greenhouse Gas Inventory.

RESEARCH PROJECT:
INNOVATIVE MEASUREMENT AND MODELLING OF GREENHOUSE FLUXES AT REGIONAL SCALES ACROSS AUSTRALIA

Carbon dioxide accounts for around 60% of the enhanced greenhouse effect. This project aims to markedly improve knowledge of the exchange of carbon, mostly as CO$_2$, between atmospheric, ocean and land-based reservoirs in the Australian region. This will be achieved through a suite of measurements using innovative technologies: satellite and ground based remote sensing as well as in situ measurements at Darwin and on the Ghan railway from Darwin to Adelaide. ACRG will use the measurements to constrain inverse models of the carbon cycle and significantly reduce uncertainties in regional carbon source estimates. These estimates will in turn be compared to the Australian National Greenhouse Gas Inventory for comparison and verification.

RESEARCH PROJECT:
BIOMASS BURNING EMISSIONS: AN INNOVATIVE TECHNIQUE FOR ASSESSING GLOBAL CLIMATE IMPACTS

This ACRG project investigates the impacts of biomass burning on climate and environmental change leading to better predictive powers and more informed political and economic responses to issues such as Australian compliance with international protocols dealing with global climate change (Kyoto). Further, it will help the development of Australian expertise in global chemical transport modelling not currently addressed by other Australian research programs.

CONSULTING/TECHNICAL ADVICE:

PROF DAVID GRIFFITH
Phone: +61 2 4221 3515
Email: david_griffith@uow.edu.au
www.uow.edu.au/science/research/acrg
ENERGY FUTURES@UOW

UOW research can deliver many improvements to
> Quality of Life;
> Environment;
> Health; and
> Commerce.

as well as providing significant returns for investors.

CONTACT DETAILS

GENERAL TECHNICAL ENQUIRIES:

A/Prof Paul Cooper
Convener - UOW Energy Futures Network
Email: pcooper@uow.edu.au
Phone: +61 2 4221 3355
www.uow.edu.au/eng/research/manufacturing

GENERAL INVESTMENT ENQUIRIES:

Dr Troy Coyle
Executive Officer - Commercial Research Development
Email: tcoyle@uow.edu.au
Phone: +61 2 4221 4420
www.uow.edu.au/research