

Grand challenges, bold solutions

Bringing together the best minds and technology to make
our world more sustainable, secure and resilient



About US

The Institute for Future Environments (IFE) is a multidisciplinary research institute at Queensland University of Technology (QUT) in Brisbane, Australia. Hundreds of QUT researchers and students from across the fields of science, engineering, law, business, education and the creative industries collaborate at the IFE on large-scale research and development projects. Our mission is to generate knowledge, technology and practices that make our world more sustainable, secure and resilient.

The future of the planet

Grand challenges

Several grand challenges confront humanity in the 21st century, from feeding the world's booming population to managing scarce natural resources and reducing our carbon footprint. How we respond to these challenges will shape the future of the planet.

Converging environments

We live within a web of environments that are rapidly evolving and converging:

- the natural environment – life, land and water
- the built environment – infrastructure, buildings and technology
- the virtual environment – networks, models and data.

Bridging these environments are the global systems that support human life and wellbeing, such as our food, energy, transport and communication systems. The IFE's vision is to comprehensively understand these interacting environments and systems, so that future populations can sustainably live within and adapt to the planet's constraints.

The future of research

Converging disciplines

The planet and its problems do not divide neatly into traditional academic categories, so researchers must go beyond conventional ways of thinking and working. The IFE is at the forefront of a shift to interdisciplinary integration and collaboration. We bring together experts from a diverse range of fields – from microbiology and robotics to information security and property law.

Powerful technology

You need more than the right people to do quality research and development – you need the right tools. The IFE has first-class facilities for modelling complex systems, monitoring the environment, analysing the properties of solids, liquids and gases, and testing pilot equipment and processes.

Productive partnerships

Only by working with industry, government and the community can researchers help steer the world onto a sustainable path. The IFE collaborates with leading national and international organisations on the practical applications of our research.

Research themes



Future Energy Systems and Clean Technologies

REDUCING OUR CARBON FOOTPRINT | RECYCLING AND REUSING OUR ENERGY RESOURCES

IFE researchers are exploring how we can transform our power grids from centralised grids into more efficient networked grids using:

- high levels of local generation
- new energy technologies, including solar photovoltaics and biofuels
- energy control and storage systems that support renewable technologies
- equipment monitoring to manage peak demand and reduce network costs.

The clean technologies we are currently investigating include:

- power generation and solar fuels from concentrated solar thermal systems
- new plasma-generation methods that consume waste products
- treatment of water fit for purpose at low energy cost.

Sustainable Tropical and Subtropical Production

PRODUCING NUTRITIOUS, RESILIENT FOODS FOR A RAPIDLY GROWING GLOBAL POPULATION

IFE researchers are studying a range of tropical crops, including pulses, sugarcane, banana and other fruits, and the pests related to these crops. We are also studying tropical livestock, including fish, crustaceans and other farmed species.

Our current research work includes:

- genetically manipulating specific crops and livestock to improve nutritional value, increase disease resistance and improve stress tolerance
- developing advanced techniques to diagnose and control diseases

- restricting exotic pest entry and managing pests (e.g. tropical fruit flies and invasive weeds)
- developing diverse products from particular crops, and thereby boosting the economic sustainability of certain industries.

Geosystems and Resources

IDENTIFYING AND SUSTAINABLY USING OUR NATURAL RESOURCES

The planet's resources, including surface and ground waters, oceans and reef systems, fossil fuels and ores, formed over many million years, and they are finite. IFE researchers are developing better methods to identify, evaluate and visualise natural resources, so they can be used more efficiently and sustainably.

One of our major focus areas is groundwater systems. We can model and evaluate subsurface data on the chemistry, quality, connectivity, depth and location of groundwater associated with Queensland's sedimentary basins – including the Great Artesian Basin – to assess how resource extraction affects groundwater use or resupply.

Healthy Ecosystems and Environmental Monitoring

MONITORING AND DOCUMENTING THE HEALTH OF OUR PLANET

To protect the planet's ecosystems, we need to know how human activity and the climate influence the carbon, nutrient and water cycles, and how ecosystems operate at field, landscape and regional scales. IFE researchers are monitoring soils, waters and atmospheres to assess the impact of changes in climate on plants, animals, air, water and ecosystems.

We acquire and analyse large volumes of environmental data using innovative technologies and methods, such as acoustic and video sensors, trace gas and particulate analysis at nano-scale, unmanned aerial vehicles and autonomous robots, and GIS and simulation modelling.

Intelligent Environments

DESIGNING AND DEPLOYING INTELLIGENT SYSTEMS AND MACHINES THAT SUPPORT SUSTAINABLE LIVING

Intelligent systems and machines are responsive to their environments and learn from experience. Using virtual models and scenarios, IFE researchers are studying:

- the application of intelligent systems and machines to a wide range of human endeavours and environments, such as airports, transport networks and corporations
- the use of networked robots and machines to monitor oceans, coastlines and infrastructure
- vulnerability, coping capacities and adaptation responses of humans and systems
- the convergence of the natural and built environments.

Mathematics, Computation, Simulation and e-Research

USING MATHS, MODELS AND COMPUTERS TO SOLVE REAL-WORLD PROBLEMS

Many practical problems arising from complex systems and decisions can be solved through mathematical or computational analysis. IFE researchers are working on solutions to various real-world problems relating to:

- global changes in demographics and climate
- resource management and environmental impacts
- changes in the service industries (particularly health, finance and information)
- efficient planning and management of the built environment
- the capture, analysis and delivery of large sets of data.

Secure and Resilient Infrastructure

DESIGNING AND CONSTRUCTING SECURE INFRASTRUCTURE | PROTECTING INFRASTRUCTURE FROM FAILURE AND DECAY

IFE researchers model and analyse physical, social and virtual infrastructure systems in order to optimise their performance and security. We study how infrastructure systems respond to disturbances—such as natural disasters and terrorist and criminal attacks—and how they can be made more secure and resilient through better design, construction and management.

The infrastructure systems we are currently studying include:

- utilities, transport systems and urban communities
- businesses and their processes
- buildings in tropical and subtropical environments
- information and communication networks, including the World Wide Web.

Facilities

SCIENCE AND ENGINEERING CENTRE | THE CUBE | CENTRAL ANALYTICAL RESEARCH FACILITY | SAMFORD ECOLOGICAL RESEARCH FACILITY | MACKAY RENEWABLE BIOCOMMODITIES PILOT PLANT | BANYO PILOT PLANT PRECINCT



Science and Engineering Centre



The IFE is based at QUT's Gardens Point campus in the Science and Engineering Centre, a pioneering research, education and community hub and a model of sustainable building design. The Science and Engineering Centre's flexible rooms and spaces promote interdisciplinary discussion and collaboration and interactive teaching and learning. The centre also showcases the world of science, technology, engineering and maths to school students and the general public.

Samford Ecological Research Facility

The Samford Ecological Research Facility (SERF), a 51-hectare property in the Samford Valley, is a base for research and education programs related to the impact of urban development on ecosystems. SERF is part of the Terrestrial Ecosystems Research Network (TERN), a nationwide Australian Government program of systematic, automated monitoring of ecosystems. The SERF property was generously bequeathed to QUT by renowned Queensland entomologist Dr Elizabeth Nesta Marks.



The Cube



The Science and Engineering Centre houses high-end computers and screens for modelling, visualising and interpreting complex systems. The core of this capability is The Cube, one of the world's largest digital labs and learning spaces. With more than 40 interactive screens, The Cube is an inspiring zone of scientific exploration for the academic community, school students and the general public.

Mackay Renewable Biocommodities Pilot Plant

The Mackay Pilot Plant, which is linked to an operating sugar mill, converts biomass into renewable transport fuels, green chemicals and other bioproducts. In collaboration with industry partners, we develop new industrial processes and commercial products using a wide range of biomass feedstocks, including sugarcane bagasse and trash from the sugar mill.



Central Analytical Research Facility



The Central Analytical Research Facility (CARF), also housed in the Science and Engineering Centre, contains state-of-the-art instruments for analysing the physical, chemical and biological properties of solids, liquids and gases. CARF includes laboratories dedicated to electron microscopy, light microscopy, X-ray analysis, analytical chemistry, particle analysis, physical and mechanical properties, environmental analysis, proteomics and genomics.

Banyo Pilot Plant Precinct

The Banyo Pilot Plant Precinct is a general-purpose research and development facility. The broad areas of research conducted at Banyo are mechanical and manufacturing engineering; power and energy engineering, including power generation; water and wastewater engineering, including stormwater evaluation; environmental, ecological and earth materials processing, including whole organism treatment; biofuels and biocommodity production; and tropical and subtropical aquaculture.



Research snapshots



PROFESSOR PETER GRACE AND HIS RESEARCH TEAM USE AUTOMATED GREENHOUSE GAS MONITORING SYSTEMS AT FARMS IN AUSTRALIA, CHILE, INDIA, BRAZIL AND THE US TO EVALUATE THE IMPACT OF AGRICULTURE ON GLOBAL EMISSIONS.

THE DATA COLLECTED BY THE CHAMBERS IS INTEGRATED INTO A WEB-BASED DATABASE AND MADE AVAILABLE TO INDUSTRY AND THE RESEARCH COMMUNITY.

Greenhouse gas monitoring



Biofuels DISTINGUISHED PROFESSOR JAMES DALE (PICTURED) AND HIS COLLEAGUES ARE DEVELOPING AND TESTING NEW BIOFUEL PRODUCTION TECHNOLOGY AND PROCESSES AT THE MACKAY RENEWABLE BIOCOMMODITIES PILOT PLANT, WHICH IS HOSTED BY MACKAY SUGAR LTD.

SUGARCANE WASTE CONVERTED INTO BIOETHANOL HAS THE POTENTIAL TO REPLACE UP TO 35 PER CENT OF QUEENSLAND'S UNLEADED PETROL SUPPLIES.



Superfoods

PROFESSOR SAGADEVAN MUNDREE AND HIS COLLEAGUES ARE USING BIOTECHNOLOGY TO DEVELOP NEW VARIETIES OF CHICKPEAS AND OTHER TROPICAL PULSES THAT ARE MORE DROUGHT-TOLERANT AND DISEASE-RESISTANT.

THEIR PROJECT, FUNDED BY THE QUEENSLAND GOVERNMENT, SHOULD ENABLE FARMS ON MARGINAL LAND TO EXPAND INTO THE PRODUCTION OF CHICKPEAS AND OTHER TROPICAL PULSES.



Farming robots

PROFESSOR PETER CORKE AND HIS COLLEAGUES ARE DEVELOPING LIGHTWEIGHT AGRICULTURAL ROBOTS, EQUIPPED WITH CAMERAS, THAT CAN WORK IN TEAMS TO COVER LARGE AREAS, WHILE CAUSING LESS SOIL DAMAGE AND APPLYING HERBICIDE MORE INTELLIGENTLY THAN CURRENT FARMING MACHINES.

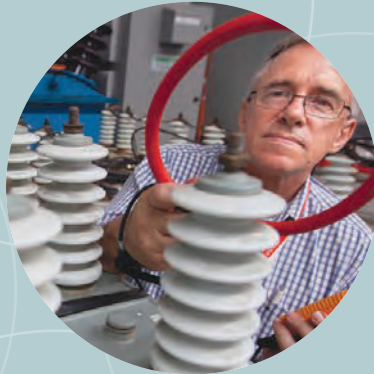
THE PROJECT, FUNDED BY THE AUSTRALIAN RESEARCH COUNCIL, IS A COLLABORATION WITH THE UNIVERSITY OF SYDNEY AND QUEENSLAND FARMER ANDREW BATE.



Cyber security

PROFESSOR COLIN BOYD AND DR DOUGLAS STEBILA ARE DEVELOPING NEW THEORETICAL MODELS AND REAL-WORLD SYSTEMS OF ONLINE SECURITY, TO BETTER PROTECT INDIVIDUALS, BUSINESSES AND GOVERNMENTS FROM ALL KINDS OF SECURITY BREACHES—FROM IDENTITY THEFT TO CYBER-TERRORISM.

THEIR RESEARCH IS FOCUSED PARTICULARLY ON INTERNET AUTHENTICATION PROTOCOLS, WHICH ARE THE PROCESSES BY WHICH USERS LOGIN TO WEBSITES AND VERIFY THEY ARE USING THE RIGHT WEBSITE.



SOME OF THE WORLD'S LATEST INNOVATIONS IN ENERGY-SAVING TECHNOLOGY ARE BEING TESTED BY QUT RESEARCHERS AS PART OF THE GUIDED INNOVATION ALLIANCE, A RESEARCH COLLABORATION BETWEEN QUT, ERGON ENERGY, SMARTGRID PARTNERS AND BROOKFIELD FINANCIAL.

AT THE BANYO PILOT PLANT, ADJUNCT PROFESSOR RICHARD TAYLOR IS TESTING A US-DEVELOPED VOLTAGE REGULATOR THAT COULD SIGNIFICANTLY IMPROVE THE EFFICIENCY OF AUSTRALIA'S POWER GRIDS.

Energy efficiency



PROFESSORS SHARON CHRISTENSEN AND BILL DUNCAN ARE DEVELOPING A NEW LEGAL FRAMEWORK FOR DEFINING CARBON RIGHTS WITHIN THE LEGAL SYSTEM. AUSTRALIA IS CREATING NEW TYPES OF ASSETS AND PROPERTY RIGHTS THAT DON'T FIT NEATLY INTO OUR EXISTING PROPERTY LAW REGIMES.

THIS PROJECT, A COLLABORATION WITH MONASH UNIVERSITY, WILL DEVELOP PRINCIPLES TO GUIDE AUSTRALIAN LEGISLATORS, REGULATORS AND INDUSTRY IN CLEARLY AND CONSISTENTLY DEFINING CARBON PROPERTY RIGHTS.

Carbon property law

There are many ways you or your organisation can work with or support the IFE. Our projects range from short-term consultancy work to long-term collaborations with industry, government, community and peak body partners. We link with other universities and help to train the next generation of researchers.

Here are a few of the ways you can help us make our world more sustainable, secure and resilient:

Industry, Government and Nonprofit Organisations

- Partner with us on a research project.
- Use our facilities to test new products and processes.
- Commission us to do consultancy work or provide advice.
- Sponsor a scholarship or prize for a research student or an early-career researcher.
- Donate funds or equipment for targeted research.
- Invest in the commercialisation of QUT intellectual property.

Researchers and Students

- Collaborate with us on a research project.
- Use our facilities or services.

Individuals

- Visit The Cube or attend an IFE event.
- Make a donation or include a gift in your will.

For more information about any of these possibilities, please visit our website or contact us.

Contact

LOCATION

Level 6, P Block
QUT Gardens Point campus
2 George Street
Brisbane QLD 4000

ENQUIRIES

Email ife@qut.edu.au
Web www.qut.edu.au/ife
Phone +61 7 3138 9500
Mail GPO Box 2434, Brisbane QLD 4001
Fax +61 7 3138 4438

QUT acknowledges the financial support of the Australian and Queensland Governments and Atlantic Philanthropies in the establishment of the Institute for Future Environments and the Science and Engineering Centre.