AUSTRALIAN TECHNOLOGY NETWORK
OF UNIVERSITIES

UTS

The University of Technology Sydney (UTS) has a bold vision to be a world-leading university of technology.

We are known for our industry focus, practice-based teaching and learning, real world research and location.

With state-of-the-art campuses and facilities, we pride ourselves on preparing students to become global thinkers, leaders and innovators.

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Algae biotechnology

A new global industry sector with mega potential based on microscopic species

- **Decarbonising established industry, while accelerating new start-ups and products**
- **Positioning Australia at the forefront of the new multi-billion-dollar global algae bioeconomy**
- **Valuable practical experience for students helps to develop the future workforce for a new industry sector**

Algae are microscopic organisms that can make virtually any product and there are over 300,000 species found across the planet. The market for algae-based applications in agricultural, industrial and medical biotech in the US alone is worth about $350 billion. UTS's Deep Green Biotech Hub (DGBH), established in 2016 with support from the NSW Government, supports a diverse, resilient and connected algae bioeconomy in Australia. It is the world's first vertically-integrated innovation hub for algae-based products and services and includes Green Light, a globally unique algae biotech accelerator program.

DGBH brings together researchers, SMEs, industry partners, start-ups, students and other stakeholders to launch new businesses and encourage existing companies to adopt algae biotechnologies. Critically, as this new global industry sector rapidly grows, it is also training the next generation of engineers, scientists and specialist technicians for these jobs of the future.

Algae offers enormous potential to provide products and services needed to decarbonise industries, create new industries and support a circular economy. Independent beer brand, Young Henry's, worked with DGBH to capture the benefit of using an algae bio-reactor to offset carbon dioxide emitted during brewing. It is a neat match: while the yeast in the brewing process takes in oxygen and sugar and produces CO2, the microalgae in the reactor takes in CO2 and produces oxygen and a sugar substrate. Algae is up to five times more efficient than trees at absorbing carbon and one 400-litre bag of algae can produce as much oxygen as about a hectare of Australian bush.

In 2019-2020 DGBH supported 93 businesses and assisted the establishment of 19 new start-ups, contributing to a 33% annual increase in Australia's algae-based businesses. Diverse industry partners range from nutritional products maker, Sea Health, to Regional Development Australia and the global giant, GE Healthcare Life Sciences. Students gain valuable experience working directly with industry partners, positioning them strongly for employment when they finish their studies.

Safeguarding seafood

Helping the seafood industry anticipate and avoid marine microbe threats

- **Empowering seafood farmers with diagnostics to manage changing environmental threats**
- **Deep university-industry collaboration informs research that protects Australia's lucrative aquaculture sector**
- **Translating cutting-edge marine science into real-world impacts and commercial value**

Australia's seafood industry is worth around $3 billion annually, with half of this exported. This lucrative industry sector faces evolving threats from rising water temperatures, changes to ocean currents, pollution, salinity levels and biotoxins.

Researchers from the UTS School of Life Sciences Seafood Safety research group are actively engaged with diverse industry partners, from the CSIRO to government primary industry departments, food safety authorities, aquaculture companies and the Sydney Fish Markets. They study the molecular genetics, ecology, phylogenetics and systematics of marine microbes, discovering new ones and determining the toxicology of many others, with real-world implications for seafood safety and industry productivity.

For example, the team has developed new methods of monitoring two dangerous marine biotoxins: saxitoxin and ciguatoxin. Both biotoxins are invisible to the naked eye, odourless, tasteless, and heat-stable, meaning they cannot be destroyed through cooking. They also have the potential to cause fatalities in humans.

The early warning diagnostic test for saxitoxin has already reaped benefits for the seafood industry, providing early detection of two emerging algal bloom events in Tasmania. This gave mussel farmers sufficient time to move production to safer sites, avoiding losses of around $13 million, not to mention the danger to consumer health.

It will improve industry revenue by around $3.03 million per year

The test kit has been commercialised by Australian biotechnology company, Diagnostic Technology, and is now being used by aquaculture farms and shellfish safety regulators.

Ciguatoxin has long been known in tropical environments but in the last five years has become more common in NSW as ocean temperatures rise. Based on the UTS research, the Sydney Fish Market has changed its practices to protect consumers from high risk fish.

In addition, working with partners from the NSW oyster industry, the team has also developed real time salinity and temperature sensors in each estuary of NSW. This information is correlated with other water testing data, such as biotoxins and microbial communities, to develop models that improve harvest management plans. This has reduced the number of closure events and is expected to improve industry revenue by around $3.03 million per annum across all NSW oyster farms.

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Water security

Holistic approaches to water management and drought preparedness

- **Data science informs predictive maintenance to save millions in repair costs**
- **Research enables governments to strike the right balance of infrastructure investment and water supply, meeting community demand**
- **Advancing the local water industry and providing global solutions**

Water security underpins all economic activity and is essential for life in Australia. Responding to drought and ensuring affordable, reliable access to water is an imperative now more than ever.

For more than two decades, The Institute for Sustainable Futures (ISF) at UTS, has partnered with governments and water utilities across Australia to ensure water security in our cities and towns. IFS' point of difference is its holistic approach: integrating both supply- and demand-side management measures, while drawing on a wide range of research disciplines to devise the most efficient, quickest and cheapest solutions to conserve and increase water supplies.

Historically, in response to drought, water agencies would seek to increase supply (build more dams and infrastructure) and reduce demand (through water restrictions). IFS has developed an innovative adaptive planning approach, incorporating both supply and demand planning into urban water management. During the Millennium Drought (1997-2010) this approach allowed the NSW Government to identify the storage level trigger point beyond which new dams were required and gave the government confidence to take a modular approach to constructing desalination capacity. As a result, Sydney averted water shortages but also avoided wasted capital investment on surplus capacity.

In Sydney alone, ISF's research has informed measures that have saved 120 million cubic metres, or 25% of water used each year. This represents cost savings to Australian households, as well as greenhouse gas savings of more than 300,000 tonnes per year for Sydney alone, equivalent to taking 112,000 cars off the road. ISF's expertise is in international demand, including advising governments in California and Brazil.

The complex challenge of water management requires multi-disciplinary solutions. UTS also boasts an award-winning team at the Data Science Institute, whose analysis of more than 10 million pipes with more than 30 global water utility partners show that UTS' predictive models of pipe maintenance have achieved between 5- and 10-times greater accuracy than the industry standard. This could enable Australian water utilities to save $700 million a year on reactive repairs and maintenance.

Infrastructure robotics

A game changer for worker safety and cost-effective maintenance

- **Protecting workers by developing robots that take the risks**
- **Translating research into real commercial value and job creation**
- **Advancing local industry and generating global export potential**

Steel bridges and infrastructure are maintained through abrasive blasting to remove rust and scale, a market estimated to be worth $A1.2 billion globally. However, it is physically demanding and dangerous work, with deadly risks to worker safety from falls and exposure to dust and lead-based particulates.

In 2006 the NSW Roads and Maritime Service and UTS collaborated to design robotic solutions to the Sydney Harbour Bridge's annual A$18 million maintenance bill. Over six years, UTS researchers developed two autonomous grit-blasting robots, purpose-built to perform condition assessments on the steel girder bridge and to grit blast old paint and corrosion in preparation for repainting and repairs. Led by Professor Dikai Lui, the UTS Centre for Autonomous Systems created a new field of infrastructure robotics, which has huge potential to shape the future of global infrastructure maintenance by delivering productivity and safety gains, with cost savings.

In 2013 UTS and the NSW Government established SABRE Autonomous Solutions to commercialise the technology and create production quality systems suited to a range of tasks. The partners, now also including Burwell Technologies, have developed an intelligent climbing robot known as CROC, inspired by the movement of an inchworm. The machine can climb vertical steel walls, avoid obstacles and pivot through confined spaces inside bridges and other steel structures such as ship hulls and oil rigs. Along the way, it can collect and record inspection data and compare it with data from previous visits. The team has also perfected autonomous underwater robots for cleaning and inspection of bridge pylons, replacing a system that required potentially risky manual inspections.

With more than 270,000 steel bridges in the US, Europe and Japan alone and enormous potential in the oil and gas sector, Sabre has attracted investment from Shell's Gamechanger program. It will soon establish a US presence as part of global expansion.