



## Capability Statement

# Cleaner, fairer and more reliable energy

Evidence-based research at the University of Wollongong (UOW) is critical to inform industry and public policy to enable a shift toward efficient and sustainable energy transformation that is fair and just for all.

UOW provides distinctive capabilities through our holistic approach to energy-related research and our expanding engagement with industry, government and regulators in energy domains including electricity, gas and hydrogen.

Large-scale collaboration across the Illawarra is supporting the transition of our regional economy from carbon-intensive industries into new, vibrant economies centred on clean manufacturing and clean energy production.

- Energy research at UOW is energy sector and industry-focused, impacting along the entire energy supply chain, while serving the needs of communities, consumers and regional stakeholders.
- UOW is developing sustainable solutions that embrace new technologies and connect industrial centres with renewable energy.
- Within the UOW Energy Futures Network, our multidisciplinary teams work to advance innovative technologies and policies while also monitoring and studying the behavioural and social effects of technologies, pricing, and energy policies.
- UOW's Energy Futures Skills Centre designs and delivers courses to train and reskill the clean energy and clean manufacturing workforces of the future.
- Declared a Renewable Energy Zone by the NSW Government, the Illawarra plays a central role in Australia's renewable energy future, powering existing and emerging industries, including green hydrogen and green steel production.

There is opportunity to transition existing workforces in these industries toward new jobs in clean energy. Addressing this opportunity, UOW's Energy Futures Skills Centre will design and deliver courses to train and reskill the clean energy and clean manufacturing workforces of the future.

UOW is well placed to provide evidence-based advice to help inform policy and industry investment across NSW and Australia that accommodates the complex interactions between social, economic and technical issues. Research, education and training in clean energy at UOW is supported by extensive technical infrastructure, as well as modelling and simulation capability for complex systems.

UOW has electrical, gas, hydrogen and built environment test and measurement laboratories. The electrical laboratories contain equipment capable of evaluating the performance of products and appliances up to 45 kVA rated power across a range of scenarios and criteria. We have multiple hydrogen pipeline testing machines in our globally competitive laboratory, accompanied by the unique expertise required to successfully maintain and operate the equipment.

### UOW ENERGY FUTURES NETWORK

The UOW Energy Futures Network provides a trusted voice to inform government, utilities, regulators, equipment suppliers and communities with well-defined strategies based on data and evidence. We have brought together a University-wide network of energy researchers who meet regularly to coordinate their activities to create a holistic energy research environment.

Our energy-related research includes renewable energy systems and integration, power systems, sustainability (including building design), power quality and reliability, battery energy storage and management systems, distributed energy generation, microgrids, infrastructure modelling and economics, and R&D leading to a more hydrogen-intensive economy.

Work within the Energy Futures Network is expanding energy transformation locally and nationally and showcases some of the key energy research strengths at UOW, including:

**Decarbonisation of energy networks:** Research addresses the issues of decarbonisation through the advancement of reliable and affordable hydrogen, syngas and biogas supply



chains, accompanied by economic modelling. Researchers have also provided significant progress on the engineering and management of pipelines for carbon capture and storage projects. UOW's long-term collaboration through the Energy Pipelines CRC and now Future Fuels CRC has led to close engagement with all natural gas and other energy suppliers in Australia, along with regulators, industry associations and government agencies. UOW hosts a nationally unique experimental facility for high-pressure gas pipeline research, exploring the potential for existing pipelines to transport hydrogen. The ARC Research Hub for Australian Steel Innovation (Steel Research Hub) is also working to decarbonise the steel industry.

#### **Adjusting power systems and decarbonising buildings:**

The Australian Power Quality and Reliability Centre (APQRC) has pioneered and currently maintains a national database of real-time power quality throughout Australia. Microgrids for zero-energy building communities can be studied within the existing microgrid system at the Sustainable Buildings Research Centre (SBRC). The APQRC works closely with the SBRC on researching the transformation of technologies within the electricity transmission, distribution and utilisation industries. APQRC projects include: renewable energy and microgrid technology application; power system modelling and analysis and advanced control and sensor technology; and development of the Flexgrid facility at the SBRC. The APQRC is working with the Australian Renewable Energy

Agency (ARENA) to better understand how to effectively integrate renewable energy to ensure a safe, reliable and low-cost future electricity supply system. It is also training the engineers that will be required to implement this transition. Together with ARENA and 12 renewable energy partners, UOW is working to help overcome the effects of voltage waveform distortion, known as harmonics, which can impact grids and hold back renewables.

**Consumer behaviour (social impacts):** The Australian Centre for Culture, Environment, Society and Space (ACCESS) draws together skilled researchers and professionals with expertise in human geography, regional development, and sustainability research who are interested in the environmental and social impacts of achieving a clean energy future. Key themes include: mobility justice and sustainable transport modes; energy efficiency, energy poverty and energy justice; sustainable everyday household practices; sustainable consumption; environmental justice; transitions to sustainable industries and employment; and low carbon energy transitions. Major work completed in recent years includes an Office of Environment and Heritage project to identify barriers and enablers for energy efficiency investments among social, community and First Nations housing providers.



### HYDROGEN TECHNOLOGY COMMERCIALISED

UOW has demonstrated the ability to develop and commercialise innovative energy solutions, such as the Hysata hydrogen production technology spun out of the University. The application of the Hysata hydrogen electrolyser technology to industry has the potential to significantly shift the economics of green hydrogen production.

In July 2021, Hysata was launched with \$5 million in seed funding led by IP Group, with support from the Australian Government's Clean Energy Finance Corporation (CEFC). The world-leading electrolyser is based on breakthrough technology developed within UOW's Australian Institute for Innovative Materials (AIIM).

Hysata's process is about 20 per cent more efficient than traditional electrolysis.

In 2022, the Australian Research Council granted funding for UOW to further develop high-efficiency electrochemical cells that use green hydrogen, based on the work used to create the Hysata electrolyser technology. The new project is to develop a cell for extracting pure hydrogen from methane mixtures.

**Economic impacts:** The expertise of UOW's Faculty of Business and Law has been recognised and accessed by international organisations such as the World Bank, the European Commission, the International Centre for Integrated Mountain Development (ICIMOD), the Asian Development Bank Institute (ADBI) and the Economic Research Institute for ASEAN. Achievements include research and publication on energy sustainability and climate change, green technological development and its deployment, the pandemic effect and calibrating COVID-19 impacts, energy insecurity, renewable energy and economic growth, and electricity markets in transition.

### TRAINING THE FUTURE ENERGY WORKFORCE

Further building on the established reputation of UOW as a leader in energy workforce development and education, in 2022 UOW secured funding from the Australian Government to establish an Energy Futures Skills Centre. This initiative will design and deliver courses to train and reskill the clean energy and clean manufacturing workforces of the future.

The centre will have four key components:

- **Energy skills program development.** New courses jointly design by UOW and TAFE NSW to train the energy workforce of the future, as well as transition programs to retrain existing highly skilled people, equipping them with the knowledge and training for careers in the clean energy and clean manufacturing industries.
- **Energy skills program delivery.** Using state-of-the-art clean energy and clean manufacturing teaching laboratories to provide real-world examples of clean energy technology applications.
- **Clean energy business support.** The centre will collaborate with new businesses as they develop their business models in the clean energy and clean manufacturing space, from new technology start-ups through to well established large-scale industries.
- **Community outreach and engagement.** The centre will operate as an energy outreach centre, engaging communities in the development and implementation of an equitable energy future and forging strategic partnerships between UOW, TAFE NSW and industry partners.

The Australian Research Council (ARC) Industrial Transformation Training Centre in Energy Technologies for Future Grids (ARC Future Grids ITTC) at UOW is tackling the immediate challenges to grid decarbonisation. The focus is on developing innovative methodology and technology that will facilitate the widespread integration of renewable resources into electricity grids while maintaining grid stability. It will also help train the next generation of industry leaders and specialists in future grid technologies for renewable energy generation, transmission and distribution, and renewable hydrogen energy storage.

Other areas of specific energy transformation training across UOW includes:

- Facilitated by the Australian Power Quality and Reliability Centre (APQRC), UOW offers one of the most comprehensive and respected undergraduate degree courses in electrical engineering in Australia, along with a number of postgraduate degrees in power engineering.



- The Sustainable Buildings Research Centre (SBRC) offers training for professionals working in the sustainable buildings, energy efficiency, electricity distribution, and renewable energy industries, with a focus on key demand areas including: energy efficiency in the built environment; energy storage and renewable energy technologies; electricity distribution operation and regulations; energy efficiency in electrical systems; and energy efficiency enhancements in industry.

**INDUSTRY COLLABORATION**

UOW has strong engagement with industry and government through the delivery of a large number of commercial research and consulting projects.

Existing partners include:

- Endeavour Energy (Australian Power Quality and Reliability Centre), Jemena, Energy Networks Australia, and the Australian Pipelines & Gas Association (Future Fuels CRC).
- BlueScope Steel (ARC Research Hub for Australian Steel).
- ANSTO, DST Group, and the Cooperative Research Centre for Advanced Automotive Technology (Australian Institute for Innovative Materials).
- UOW is also working closely with the NSW Government, the Future Fuels CRC and Illawarra industry and energy suppliers to develop a vibrant hydrogen industry in the region.

UOW brings our unique and complementary skills and capabilities to the NUW Energy initiative within the NUW Alliance (University of Newcastle, UNSW, UOW and Western Sydney University).

Generator Labs is an initiative of UOW's Innovation and Commercial Research Unit that allows UOW researchers to contribute to complex, multi-stakeholder challenges. In 2022 one such Generator Lab was run for UOW's Energy Futures Network, bringing together innovative technology companies to build on the shared mission of making the Illawarra a hub for clean energy innovation. Participants in this session included BlueScope Steel, working alongside

wind turbine operator Squadron Energy, energy storage startup Green Gravity, UOW's hydrogen electrolyser spinout Hysata, and UOW academics from a wide array of disciplines. These workshops are not only helping to position the Energy Futures Network as an important player in energy policy, but also to seed new collaborative research projects.

**PRIORITY FOCUS AREAS**

**Clean manufacturing:** Much of UOW's work is continually being built upon through our strong partnerships within the manufacturing and defence sectors, especially Australia's largest steel maker BlueScope Steel. UOW proposes to establish a Renewable Energy and Manufacturing Precinct at Port Kembla which will incorporate three key initiatives: The Sustainable Steel Manufacturing Institute, UOW Energy Communities, and Recharge Illawarra Hydrogen.

In May 2022, UOW entered into a partnership with BlueScope Steel and the Future Fuels Cooperative Research Centre to explore potential pathways to decarbonise the steelmaking process at Port Kembla Steelworks. This collaborative project includes research involving site-specific evaluations of all potential emission reduction opportunities at the steelworks, and pilot-scale test work of biochar pneumatic conveying.

**Energy storage and conversion:** This includes high-performance lithium-ion batteries, smart battery management for electric vehicles and developing sodium-ion batteries for large-scale residential and commercial applications as well as mining. UOW's Australian Institute for Innovative Materials (AIIM) has an international reputation for battery development and battery management systems and has world-class battery and charger testing facilities. AIIM is home to two of UOW's flagship research institutes - the Institute for Superconducting and Electronic Materials (ISEM) and the Intelligent Polymer Research Institute (IPRI). A graphene discovery, through a research collaboration between IPRI researchers and private next-gen battery material company Sicona Battery Technologies is fast-tracking the creation of cheaper and more efficient lithium-ion (Li-on) batteries. ISEM has been undertaking electric vehicle research since 2013. A major development for the team was the retrofitting of a standard passenger vehicle to be fully battery-

# Global subject rankings



## TOP 50

**Energy Science and Engineering (20th)**  
**Mechanical Engineering (47th)**

Global Ranking of Academic Subjects (ShanghaiRanking) 2022

**Physical Chemistry**  
**Mechanical Engineering**  
**Materials Science**  
**Energy and Fuels**

US News Best Global Universities Rankings 2022



## TOP 100

**Engineering and Technology**

Times Higher Education World University Rankings by Subject 2022

**Civil and Structural Engineering**  
**Materials Science**

QS World University Rankings by Subject 2022

**Geography**  
**Civil Engineering**  
**Instruments Science and Technology**  
**Materials Science and Engineering**

Global Ranking of Academic Subjects (ShanghaiRanking) 2022



## TOP 150

**Chemistry**  
**Electrical and Electronic Engineering**

QS World University Rankings by Subject 2022

**Engineering**  
**Civil Engineering**

U.S. News Best Global Universities Rankings 2022

powered. Researchers are currently working on a project which will deliver Australia's first battery-powered personnel transporter vehicle for underground mining.

**Hydrogen for transport:** Coregas is working with UOW, Hyzon Motors, Premier Buses and other partners to develop and implement a hydrogen bus and truck transport trial. This would utilise the hydrogen refuelling station to be developed in Port Kembla at the Coregas facility. The Coregas refuelling station could provide 350-bar hydrogen for third-party trucks and buses. The collaboration is also looking at the longer-term opportunity to develop a large-scale public refuelling hub within the Port Kembla industrial complex for 50 to 100 heavy-duty hydrogen trucks. Meantime, Hydrogen Highway refuelling network modelling by UOW's SMART Infrastructure Facility aims to deliver an optimised model for the rollout of the tri-state Hydrogen Highway refuelling stations (trucks and buses), connecting Victoria, NSW and Queensland.

**Demonstrating electrification:** Electrification has been suggested as a necessary path to decarbonise the future. UOW's Sustainable Buildings Research Centre (SBRC) and the award-winning Solar Decathlon houses at the Innovation Campus demonstrate how to electrify appliances and air-conditioning equipment, and optimise energy use with localised generation and storage. Team UOW, combining UOW and TAFE NSW, was named the overall winner of Solar Decathlon China 2013 with its Illawarra Flame house. This success was followed up with a second placing at Solar Decathlon Middle East in 2018 with the team's Desert Rose house.

**UOW WELCOMES THE OPPORTUNITY TO WORK  
WITH GOVERNMENT AND INDUSTRY PARTNERS  
TO DELIVER EXCEPTIONAL OUTCOMES**

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