SDG 7 Affordable and Clean Energy

Overview

UQ plays a pivotal role in advancing SDG 7 through its commitment to clean energy research, sustainable operations, and community engagement.

UQ's state-of-the-art solar research infrastructure and material experts enable exciting new discoveries about photovoltaic advancements and carbon emissions reduction, helping to create change while reducing the University's own emissions. This research excellence is reflected in breakthroughs across next-generation battery technologies, advanced catalysts and mineral security dimensions of energy procurement. During 2025, UQ expanded its global and domestic impact through independent energy transition tracking projects, offering policymakers independent expert check-ups to identify supply chain bottlenecks and accelerate renewable energy deployment. Operationally, UQ also provides electric vehicle charging stations and integrates energy-efficient design principles into all new buildings and renovations, guided by its Design Standards.

In 2025, UQ's community outreach involved supporting energy transitions and workforce capabilities across regional Queensland and internationally. Educational initiatives, such as public technical workshops, empower individuals and evolving industrial workforces with knowledge about clean energy practices. Collaborative long-term networks like the ARC Centre of Excellence for Green Electrochemical Transformation of Carbon Dioxide further demonstrate UQ's leadership in shaping green manufacturing frameworks and practical carbon utilisation technology.

Progress made in 2025 towards SDG 7 is reported here with reference to the following domains and enablers from UQ's Strategic Plan 2022-2025:

- learning and student experience
- research and innovation
- enriching our communities
- our global profile
- securing our future.

Related SDGs

- SDG 1 No poverty
- SDG 8 Decent work and economic growth
- SDG 9 Industry, innovation and infrastructure
- SDG 11 Sustainable communities
- SDG 13 Climate action.

Learning and student experience

UQ strives to deliver a suite of programs and courses that align with SDG 7 through curricula that focus on energy efficiency, renewable energy and energy use and management.

Curriculum

UQ offers several courses within its undergraduate programs that equip students with the skills to understand the energy sector and contribute towards the development of renewable energy. These include:

- as part of the Bachelor of Engineering (Honours):
  - Hydro and Marine Power Renewable Energy Systems (CIVL6112): this course enables students to gain fundamental knowledge of the multi-faceted approach of fluid powered energy generation and provides them with the ability to assess these systems based on their technical, regulatory and efficiency requirements as well as their interactions with the natural and built environment.
  - Thermodynamics: Energy and the Environment (ENGG1500): this course provides basic concepts in thermodynamics and forms of energy at the heart of many engineering processes and many of the important technical and environmental problems that engineers tackle.
  - Electrical Energy Conversion & Utilisation (ELEC3310): this is a fundamental course in electrical power engineering, covering electrical energy conversion components of power systems as well as recent developments in electric power engineering such as renewables and distributed generation.
- as part of the Bachelor of Environmental Management (Honours):
  - Carbon & Energy Management (ENVM1522): this course is structured around 12 important understandings of carbon and energy management, including the links between carbon energy and sustainable electricity supply systems as well as key principles and terms, and issues of scale in sustainable electricity supply system design.

UQ also provides a suite of postgraduate programs in sustainable energy designed to equip students with the knowledge and skills to lead the global transition to low-carbon energy systems. These include:

- Graduate Certificate in Sustainable Energy and Graduate Diploma in Sustainable Energy: these provide students with a deeper understanding of energy systems, responsible business practice and ways to address the threat of rising global temperatures and broader climate change impacts.
- Master of Sustainable Energy: this is designed to address complex problems across a range of disciplines and equip graduates to progress to leadership and management positions in the sector, including understanding the complex nature of energy generation, distribution and supply, the crucial roles of finance, technology and regulation for energy project management, and business development and the critical importance of social licence for assessing the energy landscape.

- Sustainable Energy Field of Study in the Master of Entrepreneurship and Innovation: this program enables students to practically apply theory with options to conduct sustainability analyses of real-life organisations, assess and present solutions to the energy challenges of an Australian community and to strategically analyse organisations in energy industries and systems.

Research and innovation

UQ advances SDG 7 through interdisciplinary and innovative research initiatives aimed at expanding access to clean, reliable and affordable energy for a sustainable, net-zero future. These span technological development, policy support and community engagement, with benefits for both local and global energy challenges. Through these projects, UQ fosters collaboration with industry, government and international partners to accelerate the transition to renewable energy and improve energy efficiency.

How we achieved this

- The UQ-led 'Renewable Grid Integration' project, running from June 2025 to April 2027, establishes a collaborative initiative funded by Australia Renewable Energy Agency (ARENA) and industry partners. With a total investment of A$877k, this project aims to accelerate the integration of hybrid renewable energy systems into Australia's National Electricity Market. The project expands UQ's advanced Hardware-in-the-Loop (HIL) testing platform, enabling real-time simulation of solar, wind and battery systems before deployment. By identifying stability and control issues during design rather than commissioning, the platform reduces technical risks, project delays and connection costs for renewable energy developments. This addresses a major barrier to the deployment of hybrid renewable energy plants and supports a faster transition to a low-carbon electricity system. Delivered in partnership with the key industry partners, including EPEC Group, Powerlink, Australian Energy Market Operator Ltd and SMA Australia Pty Ltd, the project is expected to streamline grid connection approvals, improve grid reliability and accelerate the uptake of renewable energy across Australia, delivering significant benefits for clean energy infrastructure and climate action.
- In 2025, Professor John Zhu from UQ's School of Chemical Engineering had been awarded a prestigious A$4 million Australian Research Council (ARC) Industry Laureate Fellowship to pioneer next-generation proton-conductive solid oxide electrolysis cells (P-SOECs). As one of only 8 fellowships awarded nationally, this research tackles commercialisation barriers by developing highly efficient, durable technologies that produce clean hydrogen using renewable energy. In close collaboration with prominent sector partners Direct Energy Holdings Pty Ltd and Hydrogen Solutions Ltd, the project bridges advanced academic research with commercial scaling to position Australian industry as a global leader in green hydrogen production. This strategic, industry-driven innovation provides a critical, scalable technological roadmap required to accelerate the global transition toward reliable and accessible clean energy systems.
- In 2025, researchers at AIBN achieved a world-record certified efficiency of 16.65 per cent for a lead-free perovskite solar cell, marking a significant advance in safer and more sustainable solar energy technologies. By replacing lead with non-toxic tin, the

technology offers a more environmentally responsible pathway to low-cost solar power. To support commercial translation, AIBN researcher Dr Peng Chen secured funding through a partnership with Halocell Energy to accelerate the development and manufacture of tin-based perovskite solar panels. UQ researchers have also developed high-performance indoor solar cells that operate efficiently under low-intensity artificial light. Lightweight, flexible and easily integrated into a range of products, the technology could provide a sustainable power source for low-energy electronics used in homes, offices and smart devices and reduce reliance on disposable batteries.

- In June 2025, UQ's Sustainable Infrastructure Research Hub (SIRH) commenced work on a multi-year collaborative research project 'Trade and Circular Economy Opportunities for Port Infrastructure'. The project seeks to explore future-proofing strategies for alternative fuels integrated with circular economy principles to transition traditional bulk commodity ports, such as the Port of Mackay, into low-carbon energy hubs. In parallel with iMOVE and North Queensland Bulk Ports Corporation (NQBP), the multidisciplinary team is undertaking research to deliver evidence-based frameworks that strengthen port resilience and improve forecasting for supply chains moving toward a net-zero emission future. The project draws on a diverse international academic network, including Universidad de los Andes in Colombia and Kühne Logistics University in Germany, leveraging global expertise in sustainable ports and transport systems. Their aim is to balance trade facilitation with environmental stewardship, bringing innovative, closed-loop supply chain models to industry and policymakers.

UQ Energy Transition Network

The UQ Energy Transition Network was established by UQ as a multidisciplinary initiative that brings together and coordinates expertise across engineering, science, health, social sciences, economics and policy to address the complex challenges of global energy and resource transitions. Through the Network, UQ is better placed to provide expert advice to the broader community on energy transition strategy, policy and future priorities, specifically to:

- understand and respond to Community, Industry and Government expectations effectively
- support decarbonisation and resilience of the Australian economy
- become the 'trusted voice' for communities, industry and governments based on robust data, analysis and communication
- deliver innovation to create commercial opportunities
- provide visibility of UQ capabilities to stakeholders from their perspectives, such as alignment with UN SDGs

The Network's research spans several focus areas, including transition pathways, people and communities, policy and markets, resources, technologies, and systems and supply to deliver actionable outcomes within Australia and across the Asia-Pacific region, as well as to inform UQ's own operations.

Key 2025 activities demonstrating policy influence, supporting capability and capacity building include:

- engagement with the Queensland government through Members of Parliament, Public Servants and Government Owned Corporations to ensure that UQ energy research is visible to these stakeholders and feedback incorporated into policy development, with notable examples including participation in the Parliamentary Committee process for planning legislation changes, input to the Queensland Government's Energy Roadmap at the invitation of the Energy Minister and briefings to Opposition Members
- engagement with industry through individual companies and NGOs such as the Queensland Farmers Federation, Queensland Renewable Energy Council and the Smart Energy Council established dialogue on key issues
- collaboration with the UQ Gas & Energy Transition Centre to support Coexistence Queensland to improve energy knowledge in regional areas, where avoiding social licence barriers through improved education is a key objective
- active international representation of UQ through:
  - participation in the UN ESCAP Committee on Energy meeting in Thailand from 3 to 5 September 2025
  - delivery of keynote presentations in South Korea and Taiwan
  - support for the Australian Minister for Climate Change and Energy, Chris Bowen MP, in India
  - participation in seminars and meetings within the UQ-IITD Academy program to support students and academic staff
- convening research workshops on energy system insurance and disaster resilience to address topics of increasing importance and urgency across the Region.

UQ Gas & Energy Transition Research Centre (UQGET)

The UQGET operates as an independent, multidisciplinary research hub dedicated to addressing the complex challenges of the energy transition across Australia and the Asia-Pacific. While remaining technology-neutral, the Centre leverages over a decade of specialised expertise to examine the precise role of gas and related infrastructure in a net-zero future. Centre drives targeted science and policy outcomes across 4 research themes: Communities & Coexistence, Environment, Decarbonisation and Energy Security. In 2025, the Centre led several high-impact projects, strategic conferences and policy-informing studies:

- strategic national planning influence: in March 2025, Centre Director Professor David Close formally submitted an independent expert evaluation on the Australian Energy Market Operator's (AEMO) draft 2025 Inputs, Assumptions and Scenarios Report (IASR). The submission challenged the baseline assumption that 'new gas production becomes available when required', arguing it is not well founded on the Integrated System Plan timescale. It detailed urgent gas supply risks, highlighted infrastructure constraints in pipeline transport and storage, and noted that failing to model East Coast gas export dynamics could leave the electricity grid vulnerable to winter shortfalls.

- advanced methane emission frameworks: in September 2025, the Centre presented evidence indicating that standard protocols likely overestimate methane emissions from Coal Seam Gas (CSG) water extraction. Concurrently, a study published in Science of the Total Environment used a portable Quantum Gas LiDAR system to monitor an abandoned coal exploration borehole in the Surat Basin. The measurement revealed a localised annual release of 235 tonnes of methane, highlighting the necessity of assessing and sealing high-emitting legacy boreholes among the estimated 130,000 sites across Queensland to improve regional emissions accounting precision.
- inaugural NEMDEV 2025 Conference: the Centre hosted the premier National Electricity Market Development Conference (NEMDEV 2025) in October 2025. The forum brought together Australia's top energy regulators, wholesale market practitioners and academic experts to challenge and refine the policy assumptions, regulatory conditions and models driving grid updates, helping create a shared vision for Australia's energy future.
- major industry dissemination: research covering hydrogeology, groundwater modelling and community coexistence frameworks was highlighted at the 2025 Australian Energy Producers (AEP) Conference & Exhibition. This technical showcase allowed Centre researchers to interface with major operators, effectively translating academic findings into immediate industrial applications and regulatory guidelines.

These 2025 milestones are backed by advanced data analytics, enabling UQ to shape national policies, derisk commercial investments and train the future energy workforce.

Net Zero Australia (NZAu)

NZAu is a groundbreaking, collaborative research partnership between UQ, the University of Melbourne, Princeton University and international management consultancy Nous Group. Established in 2021, the project provides rigorous, technology-neutral and evidence-driven modelling to illustrate the scale, cost, pace and impacts of Australia's domestic and export energy transition. Backed by extensive industry and philanthropic support, NZAu translates detailed decarbonisation pathways into a practical, non-political actions framework to help governments, businesses and communities accelerate toward net-zero emissions while respecting social and environmental needs. 2025 highlights include:

- introduced Phase 2 modelling to evaluate real-time national decarbonisation progress across diverse performance indicators
- provided independent data clarity revealing that Australia’s 2050 target risks being delayed by a decade due to lagging utility-scale solar, onshore wind and carbon capture infrastructure
- modelled and verified positive acceleration trends in domestic rooftop solar deployment, household energy storage capacity and electricity transmission infrastructure upgrades
- developed localised policy support recommendations to address compounding annual growth targets required for industrial electrification and massive agricultural land abatement.

ARC Centre of Excellence for Green Electrochemical Transformation of Carbon Dioxide (GETCO2)

Led by UQ, GETCO2 progressed significantly in 2025 following its official 2024 launch. Moving from foundational setup to full operational scale, GETCO2 advanced research across its core themes and its 3 established flagship programs targeting multicarbon compounds, organonitrogen compounds and value-added co-products. Major highlights from 2025 include:

- deepened global ties in February by sending a delegation to Japan's Research Center for Advanced Science and Technology (RCAST) at the University of Tokyo for a 3-day workshop. This visit yielded concrete outcomes, including agreements to exchange catalyst and electrode samples for parallel testing in CO2 electrolysis, plans to utilise RCAST's expertise in Life Cycle Assessment and bioengineering, and frameworks to develop an Australia-Japan supply chain linking renewable energy with carbon utilisation.
- hosted its landmark 2025 GETCO2 National Conference in Sydney Harbour National Park in November, gathering over 110 world-leading researchers, industry partners, and advisors. The event featured the grand finale of the inaugural GETCO2 Hackathon, where 5 teams from 7 member universities, supported by industry mentors, tackled the challenge of 'turning CO2-to-X'. Team CO_2nverters won the title for their innovative electrolyser concept designed to provide farmers with affordable, safe formic acid, while Team CelluStack earned the runner-up spot with their modular, recyclable electrolyser design.
- expanded early-career development by participating in the newly launched ARC Centres of Excellence Mentoring Program via the Mentorloop Mentoring Program alongside 13 other national research centres.

Sustainable Minerals Institute (SMI)

The SMI at UQ has combined research excellence, education and collaboration to advance sustainability in the minerals and resources sector. As the world's largest co-located minerals and resources interdisciplinary research institute, SMI unites 7 specialist centres spanning geology, mineral processing, environmental management, health and safety, organisational effectiveness, social responsibility and mineral security. This unique structure adopts a multidisciplinary approach to deliver sustainable resource development, enable integrated, practical solutions to complex challenges and educate future industry and community leaders.

In 2025, SMI launched several new initiatives and advanced many of its pioneering projects to support critical mineral security and drive the lobal transition to sustainable energy systems, including:

- commencing work on the A$1.2 million Australian Research Council Future Fellowship 'Assessing the mineral security dimensions of multi-dimensional poverty' by Professor Daniel Franks. The project seeks to explore how the availability, access, stability and utilisation of minerals impact the prevalence and intensity of poverty. In parallel with the award, SMI announced the establishment of a new research centre, the Global Centre for Mineral Security, with Professor Franks serving as its inaugural Director. The

Centre's multidisciplinary team is undertaking research, education, technical assistance and capacity building with international partners including the United Nations, World Bank, OECD, Australian Department of Foreign Affairs and Trade and IKEA. The team comprises diverse skill sets and experience, having worked as international development practitioners and researchers for a wide range of development institutions, industry and government in more than 54 countries. Their aim is to bring evidence to policymakers, innovation to partners and new tools to realise sustainable development.

- adding new chapters and 3D models of mineral deposits, maps and other key data to the Mineral Deposit Atlas in February to assist in the search for critical mineral opportunities. Developed by the SMI in collaboration with industry partners and the Geological Survey of Queensland, the project combines historical and new data to detail the history, chemical composition and 3D layout of major deposit systems. Placing this information in the public domain as a precompetitive dataset helps companies target their exploration, identify new types of deposits and discover alternative opportunities like critical minerals within existing explored deposits.
- identifying 11 critical and strategic metals, including copper, cobalt, silver and antimony, retained within the waste of metalliferous and coal mine sites across New South Wales in July. This research unlocks a secondary source of raw materials that are essential components for clean energy technologies and infrastructure, driving the circular economy while directly supporting the global transition to affordable and sustainable energy systems.
- publishing new research in September revealed that sand and gravel constitute over 70 per cent of clean energy's mineral demand. Moving beyond the traditional focus on lithium, copper and rare earths, this pioneering study highlights the massive, often overlooked volume of construction materials like sand and aggregates needed for the concrete that goes into the foundations of wind turbines, solar panels and the walls of hydroelectric dams. The findings from the Global Centre for Mineral Security demonstrate that the renewable energy transition depends on a much broader set of minerals than commonly recognised, providing critical insights for managing environmental impacts and ensuring true mineral security.
- publishing a paper in November investigated indium host minerals to find economic ways to extract it and better understand its environmental impact, as mining waste could be a key source of indium for Australia's future home-grown solar panel manufacturing industry. Indium is an element prized in solar panels because it conducts electricity and is transparent, but it is currently imported. The research focuses on finding and extracting critical minerals from mine wastes to highlight the circular economy aspect of extracting and reprocessing waste materials, offering a pathway to support an independent supply chain for Australia and manufacture solar products using green energy.

Enriching our communities

In 2025, UQ's research and outreach activities worked to benefit Queensland communities across academia, industry, government and civil society. Energy transition and decarbonisation initiatives, input into future planning and research and development, and

training opportunities all contributed to improving environmental sustainability while maintaining productive economic and social outcomes for Queensland and Australia.

How we achieved this

- In 2025, UQ partnered with VINCI Energies to inspire and support a new generation of women in engineering by focusing on building skills, confidence and careers in electrical infrastructure, while actively collaborating with ten dedicated program partners, including Ergon Energy, Energex, the Australian Power Institute, Origin Energy and Powerlink Queensland to deliver targeted support and professional mentoring to high schools in regional Queensland, doubling the intake of women entering engineering fields at UQ from 200 in 2014 to around 400 commencing in 2025.
- From 4 to 7 March 2025, the Minerals Industry Safety and Health Centre at UQ's SMI delivered this UQ-developed 4-day G3 G-MIRM Risk Management Systems short course, with subsequent sessions rolled out later. Developed to support the resource sector ahead of the incoming *Resources Safety and Health Legislation Amendment Act 2024*, the training equips industry managers with evidence-based tools to identify Material Unwanted Events and implement critical control management frameworks. Endorsed by the Queensland Government, the course bridges training gaps by utilising 20 years of applied research to help companies analyse risk controls, prevent fatal accidents and adapt to evolving state safety mandates.
- On 25 and 26 June 2025, the Power, Energy and Control Engineering discipline at UQ's School of Electrical Engineering and Computer Science (EECS) held a 2-day face-to-face Renewable Energy Integration: CPD course. Aimed at engineers and professionals from both electrical and non-electrical backgrounds working on power systems, the course facilitated dialogue and knowledge sharing to better understand renewable energy technologies and their integration in terms of renewable generator modelling, control techniques, frequency, and voltage regulation aligning with grid codes. Participants were taught theoretical background information and provided with hands-on experience through industry-standard simulation platforms and experimental test benches to understand renewable energy integration.

Our global profile

UQ is striving to advance SDG 7 by leveraging the University's development expertise to support capacity building beyond Australia. The University achieves this through collaboration and knowledge-sharing to help solve energy challenges, and through guidance on improved access, efficiency and cleaner production.

How we achieved this

- On 13 January 2025, UQ and the Technical University of Munich kicked off a collaborative project that aims to develop an overarching, efficient and automated process control for integrated light-driven microalgae production and downstream processes to produce sustainable products ranging from high-value biopharmaceuticals to renewable fuels, focusing on the deployment of automation protocols to design next-generation, high-efficiency solar biotechnology systems that seamlessly integrate media supply, bioreactor operation, cell separation and product refinement.

- On 15 September 2025, researchers from UQ's SMI delivered the course 'Developing Carbon Conscious Mining in Mongolia', funded by the Australian Government's Department of Foreign Affairs and Trade (DFAT) and supported by UQ's International Development unit, empowering 22 participants, including from the Mongolian National Mining Association (MNMA), its member companies and stakeholders to understand key concepts of climate change and actions required, applying global sustainability insights to local challenges. This was the first short course delivered in Mongolia combining both online and in-person learning approaches and marking a significant step toward greener mining practices in the country. Through a blend of learning approaches, the course brought together mining professionals including members of the MNMA to explore how mining can align with global climate goals. Participants gained practical knowledge on carbon markets, sustainable mining and carbon credit calculation methods.
- Held from 29 September to 3 October 2025 and hosted by the Technical University of Denmark (DTU), UQ was a major contributor as one of the four founding members and long-term co-organisers of the Global Bioeconomy Alliance (GBA) alongside DTU, Technical University of Munich and São Paulo State University. This annual event brought together more than 200 representatives from research institutions, industry and government agencies across Europe, Australia, Latin America and beyond. The conference featured 3 sessions exploring key questions: 'How can the world's leading bioeconomy nations collaborate across borders?', 'How do we build a common European approach and scale solutions globally?' and the industry perspective 'What challenges does the sector face when scaling biosolutions?', with a central consensus emerging that biosolutions play a central role in the future economy and Europe needs to accelerate efforts to bring these solutions to market.

Securing our future

UQ is a large energy consumer. Electricity accounts for 95.3 per cent of its overall energy consumption and represents 98.2 per cent of its overall Scope 1 and 2 emissions. Energy is the University's second biggest operating expense. UQ is adopting a comprehensive approach to enhancing energy efficiency and reducing energy consumption across new construction projects, existing buildings and all refurbishment and upgrades.

Energy efficient building

UQ is committed to enhancing energy efficiency through a range of strategic initiatives. UQ's Design Standards mandate the selection of high-efficiency equipment such as chillers and cooling towers and the implementation of chiller management systems to optimise the performance of centralised plants. These requirements apply to all new constructions, refurbishments and system upgrades.

The standards also promote advanced design strategies, including Demand Controlled Ventilation (DCV) in teaching spaces with high outside air requirements, and the use of efficient heat recovery systems such as heat exchangers and run-around coils. The preference for heating is for heat pumps and heat recovery systems rather than electric duct heaters, due to their superior efficiency.

To minimise environmental impact, UQ specifies the use of low Global Warming Potential (GWP) and low Ozone Depletion Potential (ODP) refrigerants such as hydrofluoroolefins (HFOs). Water conservation is also a priority, with cooling tower operations monitored to maintain higher cycles of concentration (CoC), reducing water usage.

UQ runs an active asset replacement program, upgrading end of life chillers and cooling towers with more efficient models. Additionally, energy audits are conducted across various buildings to identify and implement efficiency improvements. These efforts are supported by advanced metering and building management systems (BMS) to ensure optimal control and performance.

UQ is currently delivering an LED lighting upgrade program to replace legacy fittings with new high efficiency LED fittings with smart controls. This program will continue to expand across all UQ sites. Through fitting replacement and new controls systems, energy savings of up to 50 per cent are expected for lighting loads across UQ.

The targets and requirements articulated in the UQ Design Standards have been derived from several different sustainability initiatives, rating programs and the National Construction Code (NCC) standards. Sustainability initiatives are embedded holistically into all projects through good design practice.

Reducing energy consumption and wastage

UQ is committed to reducing its energy consumption through several ongoing projects and initiatives including rooftop solar photovoltaic asset modernisation. Additionally, UQ is reducing carbon emissions by:

- improving efficient use of energy
- enabling extensive and comprehensive metering with detailed, live energy data
- reporting detailed energy utilisation through the National Greenhouse and Energy Reporting (NGER)
- implementing targeted energy reduction initiatives.

Warwick solar farm

Warwick solar farm opened in 2020 and has since played a significant role in UQ's renewable energy journey. As UQ's largest solar facility, the solar farm makes a substantial contribution to the University's renewable electricity generation and supports progress towards its sustainability objectives. In addition to its operational benefits, the facility provides valuable opportunities for research, teaching and student engagement, supporting innovation and learning in renewable energy technologies and sustainable energy systems.