SETsquared Scale-Up University Expertise Connected to the Sustainable Innovation Sector

University of Bath

Bath is first UK university to sign 'green chemistry' commitment

- Institute for Advanced Automotive Propulsion Systems – IAAPS
- Institute for Sustainable Energy and the Environment
- Centre for Integrated Bioprocessing Research (CIBR)
- Centre for Sustainable & Circular Technologies – CSCT
- Water Innovation & Research Centre – WIRC
- Advanced Design & Manufacturing Centre - ADM@Bath
- BRE Centre in Innovative Construction Materials - BRE CICM
- Centre for Energy & the Design of Environments – EDEn
- Centre for Sustainable Power Distribution – CSPD
- Sustainable Energy Research Team
- Centre for Natural Resource Extraction, Sustainability and Social Justice
- Sustainable Living
- Centre for Business, Organisations and Society – CBOS
- iCAST - Centre for Sustainable and Circular Technologies : Centre for Sustainable and Circular Technologies (csct.ac.uk)

University of Bristol

The University of Bristol is leading in its research to protect the environment and find better ways of living. Our research expertise is truly multidisciplinary, we create impact in both practical applications and public policy contributions. All faculties at the University participate in research to tackle the global challenge of Sustainability.

Highlights include:

- The development of the Diamond Battery a technology taking nuclear waste and turning it into electricity.
- Wind Blade Research Hub Adaptive structures present a novel solution for wind energy production.
- Bristol part of new £10 million National Green Research centre to spur a greener global financial system.
- The Composites University Technology Centre supported by Rolls Royce to advance composite materials technology. Advanced composite materials are critical to reducing weight, energy consumption and CO2 generation for transport applications

The Cabot Institute is a University of Bristol research institute. It brings together world-class expertise, developing truly multidisciplinary research programmes to tackle the challenges of uncertain environmental change. We deliver the evidence base and solutions to tackle the challenges of food security, water, low carbon energy, city futures, environmental change, and natural hazards and disaster risk

Director Prof. Guy Howard Manager Sophie Ross-Smith

University Partners – The Partnerships team and relationship managers across Bristol engage regularly with key partners including Rolls Royce, Airbus, Met Office, EdF Energy, Rothamsted, AgustaWestland Helicopters, GE Aviation, and Vestas.

We have mapped Bristol expertise to the themed areas below, please note due to the multidisciplinary nature of research at Bristol there will be a lot of cross between themes and research groups.

- **Novel Food Production**

  Bristol Veterinary School – Global Food Security research theme Our research addresses major challenges to sustainable intensification of livestock production, including epidemiology, infectious disease, nutrition and management, 'One Health', parasitology, veterinary public health, animal behaviour and animal welfare.

  Research groups Animal Behaviour and Welfare; Infection, Inflammations and Immunotherapy, Antimicrobial Resistance

  School of Biological Studies Bristol Centre for Agricultural Innovation

  School of Physics Global demand for food is rising with a demand on cereal. The pressure for efficiency of crop production will increase; Bristol Centre for Functional Nanomaterials applies its expertise to address this through advanced surface science methods to plants and seeds, enabling a profound understanding of their surfaces.

  Research Themes - Precision Agriculture, Plant-Insect Interactions, Crop Protection, Ecology & Sustainable Agriculture, Crop Genomics, Plant-Environmental Interactions & Translating Fundamental Research to Crops. Prof Gary Foster, head of group.

  Affiliated groups – Rothamsted Research, Fenswood Farm, Centre for Innovation Excellence in Livestock

- **Circular high value manufacturing**

  Department of Mechanical Engineering Our research is of an international standard and covers the full range of mechanical engineering topics, for example, advanced materials for aero-engines and energy studies in power stations.

  Research groups Dynamics and Control, Solid Dynamics, Fluid and Aerodynamics, Engineering Systems and Design, Robotics, Ultrasonics and Non-destructive Testing

  Department of Aerospace Engineering The Department benefits from the concentration of aerospace industry in the south-west of England, The Department has also seen burgeoning links with the renewable energy industry.

  Research Centres Bristol Composites Institute Advanced composite materials are critical to reducing weight, energy consumption and CO2 generation for transport applications. They also enable novel and multi-functional structural designs. They are formed by combining two or more materials to create an advanced material with significantly improved properties. Composites also enable novel and multi-functional structural designs. The Composites

University Technology Centre supported by Rolls Royce to advance composite materials technology.

School of Management Group we employ a set of research methods including theoretical, analytical, empirical, and behavioural models, and apply to a range of areas such as circular economy, industrial sustainability, low carbon manufacturing, responsible innovation, and sustainable supply chain management.

Research Group Sustainable Production, Inclusivity, Consumption and Economy (SPICE), Operations and Management Science, Innovation & Healthcare

- **Carbon Capture and Storage**

  School of Chemistry Associated research groups: Atmospheric Chemistry Research Group The ACRG is a multidisciplinary group, but our research activities typically fall into one of three over-arching fields - climate change, stratospheric ozone depletion and air quality.

  School of Physics Physics is also pivotal to shaping the technologies of the future and our research spans a wide range of disciplines. Low Carbon fusions, Bristol is researching novel ways to reduce the UK's greenhouse gas emissions, by advancing tritium technology for fusion power station. Diamond Batteries

  Associated research centres Interface Analysis Centre, South West Nuclear Hub

- **Net Zero Energy Systems and Fuels**

  Faculty of Engineering Our leading academics are addressing many of society's grand challenges in transport, the built environment, energy and advance healthcare.

  Research groups Electrical Energy Management Group; Fluid and Aerodynamics, Bristol Composites Institute, Solid Mechanics, Dynamics and Control, Ultrasonics and Non-destructive testing (UNDT), Water and Environmental Engineering, BLADE research hub

  School of Chemistry we are pioneering the innovations that are essential to a sustainable future, from liberating soil nutrients to make agriculture more efficient to pioneering low carbon solar, biofuel and nuclear energy.

  Research themes - Synthesis and catalysis, Chemical and synthetic biology, Computational chemistry, theory and dynamics, Functional molecules and materials, Bristol Electrochemistry Group

  Earth Sciences – Our research ambitions are towards the sustainable extraction of critical metals, carbon capture and sequestration, resilient energy infrastructure and water and soil resources.

  Research groups - Geochemistry, Geophysics, Palaeobiology, Petrology, Marine and Terrestrial Environments, and Volcanology.

- **School of Geographical Sciences**

  Research groups - The Bristol Research Initiative for the Dynamic Global Environment (BRIDGE)

- **Net Zero Buildings**

  Civil Engineering Our multi-disciplinary research addresses the global need for long-term, sustainable performance in existing and new infrastructure systems.

  Research groups - Earthquake and Geotechnical Engineering, Water and Environment, Dynamics and Control, Engineering Systems and Design, Advanced Composites Centre for Innovation and Science (ACCIS)

  Computer Sciences Internationally-leading research in intelligent systems, digital media, foundations, personal systems, and architecture and design.

- **Net Zero Finance**

  Cabot Institute - The long-term transition to a net-zero and resilient future requires trillions of dollars of investment and an unprecedented shift in the global financial system. Our experts are looking at ways to achieve this

  Associate groups – National Green Finance centre

Cardiff University

Cardiff strengths in Sustainable Innovation

- **Carbon Capture and Storage**

  This is covered by a work package in the FLEXIS project.
  WP 11 Carbon Sequestration in Coal and Soil | Flexis
  WP 4 CCS-Integrated Power and Alternative Fuels | Flexis

- **Net Zero Energy Systems and Fuels**

  This is covered by another work package in FLEXIS delivered by the CIREGS research centre (ENGIN):
  WP 1 Integrated Energy Supply Systems | Flexis
  Centre for Integrated Renewable Energy Generation and Supply - Research - Cardiff University

- **Cross modal transport technologies**

  Decarbonisation of Transport Network+ led by Professor Liana Cipcigan (ENGIN)
  GW4 Net Zero
  Accelerating to Net Zero: Further, Faster, Fairer - GW4

Groups & Research Centres

- **Novel Food Production**
  Research Centre for Sustainable Urban and Regional Food (SURF)
  https://www.cardiff.ac.uk/research/explore/research-units/research-centre-for-sustainable-urban-and-regional-food-surf
  Professor Roberta Sonnino (GEOPL)

- **Circular high value manufacturing**
  Centre for Advanced Manufacturing Systems at Cardiff (CAMSAC)
  https://www.cardiff.ac.uk/camsac
  Professor Rossi Setchi (ENGIN)
  Professor Mohamed Naim (CARBS)
  CAMSAC is an interdisciplinary research centre set up to build directly on Cardiff's existing strong reputation for internationally leading manufacturing related research.

- **Net Zero Energy Systems and Fuels**
  UK Energy Research Centre (UKERC)
  https://ukerc.ac.uk/
  Professor Jianzhong Wu (ENGIN) – Co-Director
  SMART Grids and **Multi-Vector Energy Systems**: Technologies and solutions for integrated electricity/gas/heating/cooling/hydro-gen energy supply for a reliable, affordable and zero carbon future. Leading multi-energy research in the Supergen Hub on Energy Networks and the UK Energy Research Centre. Working with Welsh Government to develop a novel Provite Virtual Wire solution for the renewable connection in Wales under the Smart Living Programme. Academic partner for the National Grid led project South Wales Zero2050 project, https://zero2050.co.uk/, to speed up the rate of progress towards achieving government targets of net zero by 2050 in South Wales.

- **Energy Systems Research Institute**
  https://www.cardiff.ac.uk/energy-systems-research-institute
  Professor Phil Jones (ARCHI)
  Professor Phil Bowen (ENGIN)
  The Energy Systems Research Institute tackles the global challenges that lie ahead in generating, distributing and utilising energy. Research is focused in four areas:
    - Built Environment – Professor Phil Jones and Professor Yacine Rezgui
    - Sciences – CCS and Petroleum Geology – Dr Tiago Alves
    - Earth High Voltage Research – Professor Manu Haddad
    - Renewable Energy – Professor Nick Jenkins

- **Net Zero Buildings**
  Dr Jo Patterson (ARCHI)
  https://www.cardiff.ac.uk/people/view/1254531-patterson-jo
  Senior Research Fellow at the Welsh School of Architecture with main research interests in implementation of low carbon technologies at different scales, urban scale sustainability, retrofitting the existing built environment. Part of the UK wide Consortium EnergyREV researching Smart Local Energy Systems. Technical project manager for WEFO funded LCRI programme including the Solcer house, the Sustainable Building Envelope Centre (SBEC) and 5 low carbon refit houses together with Swansea University, BASF, NSG Pilkington and Tata Steel as part of the LCBE (Low Carbon

Built Environment team) team as part funded by COST Action Smart Energy Regions including funding from Innovate UK and EPSCRC (£2.5m).

University of Exeter

Overview of University of Exeter capabilities
Institute for Environment and Sustainability

The University of Exeter's Environment and Sustainability Institute (ESI) is an interdisciplinary centre leading cutting-edge research into solutions to problems of environmental change. As well as working with 32 world-class academics within the institute and over 200 other academics across the University of Exeter studying the environment and sustainable futures; the ESI also offers access to a network of over 450 businesses, NGOs, policymakers and schools.

In looking for solutions to problems of environmental change, our researchers tackle an extensive range of topics: some solutions are technological, others might relate to land use, and sometimes they depend on a change in human behaviour. Most involve combinations of all three.

The ESI has strong relationships with institutions such as the Met Office and the Environmental Futures & Big Data Impact Lab as well as with other Institutes and Centres of Excellence across the University.

The recently opened **Exeter Centre for Circular Economy (ECCE)** is a new research centre comprising a multi-disciplinary team of economists, engineers, designers, sociologists, management academics and practitioners engaging in projects that develop Circular Economy theory and practice designed to transform our economy, creating regenerative wealth and well-being'.

The **Exeter Energy Hub** brings together over 140 individuals from across all disciplines at the University of Exeter to collectively make sense of and facilitate transformation to sustainable energy systems. The research facilities and equipment span a range of sectors and disciplines and allow us to carry out cutting-edge energy research.

In an era of unprecedented environmental and societal change, the ESI's overarching aim is to provide insight and solutions to meet the challenges this creates in securing a sustainable future.

Centres of Excellence

We work closely with other centres of excellence across the University including:

- European Centre for Environment and Human Health (ECEHH)
- Centre for Ecology and Conservation (CEC)
- Centre for Geography and Environmental Science (CGES)
- Camborne School of Mines (CSM)
- Exeter Centre for Circular Economy
- Global Systems Institute (GSI)
- Institute for Data Science and Artificial Intelligence (IDSAI)
- Wellcome Centre for Cultures and Environments of Health (WCCEH)
- Exeter Marine Hub
- Exeter Energy Hub
- Land, Environment, Economics and Policy Institute (LEEP)

Focus areas:

- **Net Zero Transport Technologies:**
  Centre for Future Clean Mobility
  The Centre specialises in developing new hybrid and electric powertrain technology for cleaner mobility of humans and goods. We have expertise in design, assembly and test of hybrid and electric powertrains, across a range of vehicles and vessels, from passenger ferries, to road-rail vehicles, to all-terrain military vehicles.

- **Net Zero Buildings:**
  Smart Composite Material for Advanced Building Fenestration to Enhance Energy Efficiency
  Dr Asif Tahir; Senior Lecturer, Renewable Energy
  Building Integrated Photovoltaics (BIPV)
  Prof Tapas Mallick; Professor & Chair in Clean Technologies
  Renewable Energy experts from the Environment and Sustainability Institute are developing a pioneering new technique that could accelerate the widespread introduction of net-zero energy buildings through the latest Building Integrated Photovoltaics (BIPV).
  Low carbon building materials - Dr Raffaele Vinai

- **Carbon Capture:**
  SeaCURE technology - Method of capturing carbon from seawater

- **Circular High Value Manufacturing:**
  Exeter Technologies Group (ETG)

- **Renewable Energy:**
  Offshore renewable energy
  Solar energy

- **Net Zero Finance:**
  Exeter Sustainable Finance Centre (ESF)

- **Novel Food Production:**
  Producing insects for food and animal feed

University of Southampton

Sustainability / Net Zero Campaign Summary

Novel Food Production

Plants and Food Security - within the group there are four main areas of research: Plant molecular biology, Agricultural ecology, Crop pests and pollinators and Human nutrition.

Ecology and Evolution - interests cover the interactions of species with their environment - such as the adaptation to changing environments, sustainable use of natural resources including energy, food and water security, and biodiversity conservation

Environmental Change and Sustainability – conduct geospatial analysis and experimentation to understand environmental change, its drivers and solutions, including agricultural production and food security – using whole systems approaches to understand sustainable

futures and trade-offs, and potential transitions and tipping points. Our intended impact is on decision-making concerning environmental management and human development, adaptation and mitigation.

Marine Biology and Ecology – includes in-depth understanding of how ocean ecosystem's function, as the basis for their management given increasing human activities – includes sustainable food, fisheries and aquaculture, extractive industries, nature-based solutions, as well as strengthening the science-policy interface.

The Institute for Life Sciences (IFLS) Living Systems theme includes cell and molecular biology, one of three focus areas is ecology and organismal biology where researchers from biological sciences, geography and ocean and earth sciences are examining current and future issues of global significance such as the adaptation to changing environments, sustainable use of natural resources and biodiversity conservation.

NEXUS Science is an interdisciplinary strategic research group which is spearheading the advancement of understanding how to develop Water, Energy, Food resources sustainably to benefit societies and the environment.

Circular high value manufacturing

Sustainable Electronic Technologies research group address aspects of sustainability which relate to electricity, electronics and communication. Including low power and efficient computing, renewable energy and its management and IoT hardware and resilient electronics. The group is well positioned to tackle emerging scientific and engineering problems utilising extended expertise in nanotechnology and electronics and electrical engineering.

Engineering and Design Manufacturing Centre provides professional engineering design service. In addition to a range of conventional machinery the centre offers specialist CNC equipment, extensive CAD/CAM facilities plus 3D printing and additive manufacturing capabilities.

Engineering Materials – part of the Mechanical Engineering Department, whose research spans many sectors including aerospace, automotive, energy, electronics, electrochemics and healthcare technologies; and includes areas such as future manufacturing and processing and advanced characterisation of structural materials.

Organic Chemistry: Synthesis, Catalysis and Flow – discover, design and make molecules for functions such as medicine, liquid crystals, electronic materials and smart inks etc.; whilst developing sustainable and environmentally 'green' approaches to chemical and materials manufacture that minimise chemical waste, improve product velocity and reduce the need to isolate intermediates. Along with the Centre of Excellence for Continuous Digital Chemical Engineering Science which aims to reduce the environmental footprint of chemicals and materials manufacture and open up new possibilities for industrial product development and scientific research by harnessing the potential of advanced sensor technology, artificial intelligence and computer modelling tools.

CORMSIS, the Centre for Operational Research, Management Sciences and Information Systems, is one of the largest groups of its type in the UK, spanning Mathematical Sciences and Southampton Business School. Research spans optimisation through business analytics and simulation to qualitative research in problem structuring. Including optimising

the scheduling of resources, sustainable supply chain management, and supply chain innovation and the circular economy.

Carbon Capture and Storage

Clean Carbon another of the University's interdisciplinary strategic research groups, Clean carbon explores novel technologies across the full carbon chain; including behavioural and policy change, carbon capture, reduction, consequences of rising carbon atmospheric levels, sequestration and utilisation.

Carbon Management – focuses on Greenhouse Gas emissions and finding practical solutions for the management of these emissions in the public and private sectors; and includes carbon foot printing in cities and urban communities, the waste industry, the transport sector, the corporate sector and the maritime industry.
Geochemsitry – using state-of-the-art facilities the group applies geochemical analysis and modelling to tackle pressing issues like carbon capture from the atmosphere and the sourcing of metals and elements critical for the "green" energy revolution.

Functional Inorganic Materials and Supramolecular Chemistry - synthesis of new materials and functional molecules is vital to drive innovation and technology, and to improve the sustainability of our society through developments in energy and healthcare.

Net Zero Energy Systems and Fuels & Net Zero Buildings

Southampton's Energy and Climate Change Division comprises the Sustainable Energy research group and the Coastal and Climate research group. The Division's work supports the UN Sustainable Development Goals with fundamental and applied research across six research themes: Renewable Energy (wave, tidal, Photovoltaic, wind – micro turbines, onshore and offshore wind), Energy Access, Cities and Infrastructure, Buildings and Communities, Behaviour and Modelling and Climate and Emissions.

The University is also a member of the International Low Carbon City Neighbourhood Building Academic Alliance which aims to support research related to low carbon cities, neighbourhoods and buildings for the purpose of promoting a sustainable society and liveable cities through collaboration and cooperation among members of the Alliance.

The Energy Technology group addresses major scientific and technological challenges in energy efficiency, emerging technologies and sustainability, and are concerned with the social, economic and environmental impact of energy technologies. The group is engaged in fundamental and applied research across thermal energy, cryogenics and superconductivity, electrochemical engineering, solar energy, maritime energy, electromechanical, and energy management and control. Whilst the Engineering Materials Group covers the physical processes and interactive mechanisms in materials that affect the performance of engineering systems including energy systems.

Water and Environmental Engineering – is a multi-disciplinary team across the areas of water engineering (including low head hydropower and environmental fluid dynamics), water and wastewater resource management, eco-hydraulics (assessing the impacts of water and energy infrastructure in aquatic habitats), and bioenergy and organic resource utilisation (including anaerobic digestion, CO2 biomethanisation and microbial fuel cells).

National Centre for Advanced Tribology – tribology is core to future transport and energy-efficient machines, the control of emissions and low-maintenance renewable energy systems, and to biotechnology. The group aims to solve next-generation tribological design issues and enable surface interactions to occur with minimal energy loss and impact on the environment.

Electrical Power Engineering – expertise ranges from nanoelectronics to grid level high voltage engineering and space propulsion. The group are pioneering technologies essential for energy efficient power transmission and renewable power generation.

Net Zero Finance

Centre for Digital Finance – explores the opportunities associated with the rapid growth of technological innovation for the wider economy and society as a whole. Including novel block chain technology and the environmental sustainability and growth of cryptocurrencies.
The Centre for Inclusive and Sustainable Entrepreneurship and Innovation, CISEI, is an interdisciplinary group within our Business School advancing research strands on sustainability, diversity and inclusiveness and translating their outputs to business and societal practices. The Department engages not only with the economic dimensions of innovation, but also with its social dimensions (social enterprise, inclusiveness and quality of life agenda) and its ecological dimensions (the low carbon economy and sustainability transitions).
Centre for Research in Accounting, Accountability and Governance – focuses on the role of accounting in facilitating global development and sustainability. Providing insights to investors, policy makers and businesses. Research interests include social and environmental accounting, including carbon and climate change accounting and finance, as well as accounting for the UN Sustainable Development Goals

Cross modal transport technologies

Transportation Group – research within the group is wide ranging and aimed at helping to secure sustainable transport systems. The group covers both passenger and freight transport, with expertise covering traffic management and control, safety, the environment/sustainability, bus and rail operations, freight/logistics and walking and cycling; with a particular interest in Intelligent Transport Systems.

Centre of Excellence for Re-engineering for Electric Mobility - is accelerating the development of sustainable, interconnected electric transport systems, re-engineering existing infrastructure and vehicles through advances in energy storage technology, the use of digital tribology to optimise components, and the redesign of the human–machine interface.

Autonomous Systems – a University strategic research group combining sensing, computing, communications and platforms, and providing world class facilities and capabilities for autonomous systems technology to develop and maintain a low carbon economy, respond to climate change, conduct earth science research, to coordinate disaster response and numerous other applications whether sub-sea, surface, land, air or space.

The UKRI Trustworthy Autonomous Systems Hub, based at the University, delivers world-leading best practices for the design, regulation and operation of autonomous systems that are socially beneficial.

Maritime Engineering – provides expertise in engineering systems in a maritime environment with a view to improving the integration of design, production and operation, accounting for safety, economic and societal viewpoints. Systems include ships, submarines and submersibles, yachts and offshore structures.

Southampton Marine and Maritime Institute – is an internationally recognised centre of excellence and an interdisciplinary community whose research is structured around four key challenge areas: Trade and Transport, Society and Government, Energy and Resources, Climate and the Environment. Facilities include for example the largest University towing tank in the UK supporting research not just for conventional ship model testing but across the aerospace, energy, and transportation sectors.

Aerodynamics and Flight Mechanics – are engaged in fundamental fluid dynamics, computational aeroacoustics, applied aerodynamics and flight dynamics. With access to super computers and a range of wind tunnels.

Human factors Research Unit – part of the Institute for Sound and Vibration the unit conducts research, provides training and offers advice in matters related to human responses to vibration, including whole body, hand transmitted, and low frequency vibration, including vibration induced by mototr vehicles, trains, boats and aircraft.

The Web Science Institute – research area Digital Futures includes collaboration in SCIFI (Smart City Innovation) including Making Smart Fair – a white paper on building inclusive, fair and sustainable transport for cities of the future.

Demand Led Industrial Innovation

Agents, Interaction and Complexity group undertakes world-leading research into the science and engineering of complex socio-technical, socio-economic and socio-ecological systems, such as engineering resilient and sustainable smart infrastructure, or anticipating and mitigating the impacts of climate change, which involve building and analysing complex systems comprising interacting agents, including people and other organisms, hardware robots and autonomous software agents.

Within our Business School the Product Returns research group works with retailers and manufacturers to explore ways to streamline returns processes, assess the true costs of returns, influencing customer behaviour, making returns more sustainable, using circular economy concepts, and other aspects.

IT Innovation Centre - specialising in the advancement of innovative information technologies and their deployment in industry and commerce. Teams work on secure systems, risk management, cyber security, crisis management, decision support, big data, information discovery, internet of things, social media analysis and social behaviour in complex human machine networks. Expertise is applied across industry sectors as diverse as health, media, e-government, oil and gas exploration, marine systems, education, transport and security.

The Centre for Electronics Frontiers - brings together diverse expertise ranging from materials science and electronic devices to circuits and systems for transforming modern society through technology. It is pioneering solutions for real life problems in nanoelectronics, AI, next generation batteries, biosensors, neuromorphic engineering and oxide spintronics.

Another of our strategic research groups MENSUS tackles challenges related to monitoring of equipment and natural processes across aerospace, energy, transport, healthcare and construction sectors.

University of Surrey

University of Surrey capabilities for the SETsquared Scale-Up Programme's Sustainable Innovation Campaign

Sustainability is one of the University of Surrey's strategic research themes which have been defined to support the ambitious objectives for research excellence and impact. Our sustainability research is aimed at:

- Developing a better understanding of the world's resources
- Understanding environmental phenomena and how they impact on society
- Developing an understanding of the behaviours and attitudes that shape the way people interact with their environment
- The development of technologies, processes and models that seek to improve our ability to live sustainably and well.

We have identified a set of 'foundations', or areas of focus, that encapsulate the sustainability research and activity at the University. These reflect key outcomes or objectives for sustainability areas towards which much of the current research is directed and which are shaping future plans.

1. **Life cycle assessment**

   A systems analysis approach to quantifying and representing environmental impacts of products/services, underpinning carbon, water and environmental foot-printing. Often used by industry and policy makers. We include extended analyses such as:

   - Social life cycle assessment
   - Life cycle costing
   - Life cycle sustainability assessment
   - Supply and value chain analysis etc.

   Centres, groups and departments:

   - The Centre for Environment and Sustainability (CES) is an internationally acclaimed centre of excellence on sustainable development.
   - Geomechanics Research Group covers activities related to the characterisation of granular materials, soil, clays etc and understanding, and modelling, their behaviour under a range of conditions and time scales.

2. **Food, energy, water (and nexus)**

   Research that encompasses diverse aspects of practice and policy for the development and management of these key underpinning provisioning services for sustainability. The Nexus concept considers the interdependencies and interactions between the food, energy and water systems within the context of sustainable development. It reflects an approach to simultaneous,

integrating thinking about these systems that transcends individual, isolated sectoral, policy and disciplinary silos.

Centres, groups and departments:

- Centre for the Evaluation of Complexity Across the Nexus (CECAN)
- Advanced Technology Institute (ATI)
- Energy and Materials
- Materials Research Group
- Centre for Engineering Materials
- Centre for Environment and Sustainability (CES)
- Chemical and Process Engineering
- Environmental Flow (ENFLO) Research Centre
- Sociology
- Systems Biology Research Section

3. **Climate Change Science**

Research on all aspects of the science of climate and especially climate change that impinge on earth systems and their functioning. The application of insights from this to inform policy and responses to climate change.

4. **Sustainable Living and behaviour**

Research that considers the ways in which livelihoods and lifestyles impact on, and respond to, perspectives about living sustainably and well. Includes evaluation of the ways that human and systems behaviour can adjust to support sustainable living.

Centres, groups and departments:

- Centre for Environment and Sustainability (CES)
- Centre for the Evaluation of Complexity Across the Nexus (CECAN)

5. **Industrial ecology and circular economy**

Research on resource conservation and efficiency in industrial and business systems to reduce burdens on the environment. Includes evaluation and modelling of industrial ecosystems, waste management and recycling and business models.

Centres, groups and departments:

- Centre for Engineering Materials
- Chemistry
- Chemical and Process Engineering
- Energy and Materials
- Materials Research Group

6. **Policy and development and governance**

Research on concepts of sustainability e.g. UN sustainable development goals, absolute sustainability and planetary boundaries, corporate social and environmental responsibility that

inform policy, civil society and business models. Includes support for, and analysis of, voluntary and regulatory schemes and policy impact analysis.

Centres, groups and departments:

- 5GIC
- Sociology

7. **Pollution management and mitigation**

Research focused on the harmful effects of anthropogenic emissions to water, land, air and human health. Includes systems analysis of pollution mitigation options and developments.

Centres, groups and departments:

- Chemistry
- Global Centre for Clean Air Research (GCARE)

Urban Living

The Urban Living strategic theme focuses on what it means to live healthy, sustainable, prosperous and connected lives in urban environments (i.e. towns and cities). This recognises the challenges, opportunities and threats associated with a growing tendency for people to live and work in such environments. Our Urban Living research theme has four key pillars (or sub-themes) that recognise areas of research strength at the University, and map to key UN Sustainable Development Goals.

1. **Risk and Resilience**
   This pillar concerns the ability of urban centres to respond to and recover from 'shock' events or disturbances (e.g. flooding, social unrest, etc.), and to adapt and transform in the face of current and future threats and opportunities. In particular, the pillar considers how resilience can be engendered in built and digital infrastructures/networks; and how social resilience and cohesion can be fostered through governance and leadership.

   Centres, groups and departments:

   - The Institute for Communication Systems (ICS) is home of the 5G Innovation Centre (5GIC), one of the largest and most renowned academic research centres in its field in Europe.
   - The Digital World Research Centre (DWRC) carries out new media innovation projects with social and cultural benefit.

2. **Healthy living**
   This pillar concerns the physical and mental health and/or wellbeing impacts associated with living and working in urban environments. In particular, the pillar considers internal and external environmental quality (e.g. air and water quality; lighting/access to daylight, etc.); and provision and access to healthcare services and social support.

   Centres, groups and departments:

   - The Global Centre for Clean Air Research (GCARE)
   - Surrey Living Lab

3. **Access and mobility**
   This pillar concerns aspects associated with accessing urban centres, moving around them and gaining access to their services and products (e.g. road and rail infrastructure, public transport provision, etc.) In particular, the pillar considers advances in low-carbon, shared and/or active transport options (e.g. electric/autonomous vehicles; Mobility as a Service) and affiliate policies and infrastructure (e.g. EV charging technologies).

   Centres, groups and departments:

   - Centre for Automotive Engineering

4. **Sustainable Prosperity**
   This pillar concerns how urban societies can flourish in the face of ecological and resource constraints, e.g. how towns and cities can be sustainably resourced, how sustainable practices can be encouraged, and how inclusive communities can be created. In particular, the pillar considers how production, supply and consumption cycles can be decarbonised among different groups and in different sectors (e.g. hospitality and tourism; domestic housing); and how institutional structures and organisations can be modified to foster equality and opportunity.

   Centres, groups and departments:

   - Centre for the Understanding of Sustainable Prosperity
   - Centre for Sustainability and Wellbeing in the Visitor Economy (SWELL)