GW4 ALLIANCE

Accelerating to Net Zero:
Further > Faster > Fairer

GW4 draws together the research excellence of Bath, Bristol, Cardiff and Exeter Universities, with collaborations that connect government, industry, civil society, charities and communities.

We recognise the imperative to respond urgently and comprehensively to the challenges of decarbonisation by working with new and existing regional partnerships to produce, translate and embed research and innovation into policy, society and business.

Our intra-regional synergies, combined with extensive resources of skills, expertise and partnerships, make the GW4 region a natural testbed to explore how the transition to net zero emissions can be a just transition, helping to address social and economic inequalities and ‘level up’ the region and the UK.

The Challenge

The climate emergency and coronavirus (COVID-19) pandemic are two of the most pressing crises facing our planet.

The UK was the first major country to legislate for a net zero target for carbon emissions by 2050. Achieving net zero emissions will require unprecedented research and innovation activity and integration of new and existing solutions into all sectors of society.

Even before COVID-19 highlighted the need to 'build back better', the climate crisis has been the largest enduring global, anthropogenic threat to humanity. Without successful interventions dedicated to supporting transformations towards net-zero emissions, climate change will have a catastrophic effect on society.

Our Vision

As a regional anchor, GW4 will lead the UK and the world in accelerating to net zero emissions.

We will harness our research excellence, regional assets, world-class facilities and partnerships to drive innovation and forge an equitable green recovery from the coronavirus pandemic, putting our region and the UK at the forefront of the global effort to reach net zero carbon emissions. We will co-create a 'whole system' regional net zero testbed working with government, industry, and civil society to understand the challenges and priorities faced by different sectors in our region and identify opportunities to collaborate on innovative solutions.

Increased investment in research and development will allow us to **Accelerate to Net Zero**:

Further

Reaching beyond our region, beyond academia and beyond disciplines - we will collaborate with our communities, government and industry partners to test and deliver interdisciplinary solutions scalable for the whole of the UK and internationally.

Faster

Working together will accelerate opportunities – we will identify where swift, beneficial and long-lasting changes can be made.

Fairer

Equitable – we will develop innovative whole system solutions, with fair approaches through co-creation.

Why GW4?

The GW4 Alliance is uniquely placed to address the net zero challenge, combining the synergistic climate and decarbonisation research excellence of our four research intensive universities: Bath, Bristol, Cardiff and Exeter. Our research strengths and world leading institutes include:

The Cabot Institute for the Environment, based at the University of Bristol, is a diverse community of 600 experts. The Institute's academic community develops cross-sectoral and cross-disciplinary partnerships to deliver the evidence base and solutions necessary to tackle the challenges of food security, water, low carbon energy, city futures, environmental change, and natural hazards and disaster risk. The Institute also runs a unique Master's by Research programme that offers a blend of in-depth research on global environmental challenges, such as net zero, with interdisciplinary cohort building and training.

The Centre for Sustainable and Circular Technologies (CSCT) brings together academic expertise from the University of Bath with international, industrial and stakeholder partners to carry out research, training and outreach in sustainable and circular technologies key to achieving net zero. CSCT applies a whole system approach to their research areas, including clean energy.

The Centre for Climate Change and Social Transformations (CAST) is a £5 million ESRC Centre and a global hub for understanding the systemic and society-wide transformations that are required to address climate change. It researches and develops the social transformations needed to produce a low-carbon and sustainable society. CAST is led by Cardiff University and includes other universities (including the University of Bath) and other organisations dealing with climate change.

The University of Exeter and the Met Office established a new Joint Centre for Excellence in Environmental Intelligence in December 2020. This initiative is designed to harness the power of Environmental Intelligence to find solutions to some of the world's most pressing environmental challenges, including delivering net zero. The Joint Centre will create and support a global community in the application of data science and artificial intelligence to a wide range of environmentally related issues and challenges. It also builds on the University of Exeter's UKRI Centre of Doctoral Training in Environmental Intelligence: Data Science and AI for Sustainable Futures.

Cabot Institute for the Environment
University of Bristol
Many minds, one mission

Centre for **Sustainable & Circular** Technologies

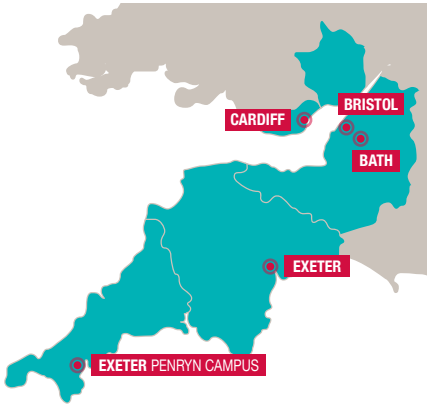
Centre for **Climate Change** and **Social Transformations**

Joint Centre for Excellence in **Environmental Intelligence**

Our Unique Region

As the region with the highest carbon emissions in the UK[1], we face huge challenges but also opportunities to lead the way on emissions reductions.

Our regional diversity[2] provides a unique opportunity to explore and test equitable transitions to net zero to help 'level up' the UK. Our geography covers two national governments, a combined authority, two health systems, includes areas with among the highest and lowest deprivation rates in the UK and rural, urban and city areas.



1. Ivanova et al 2017 Environ. Res. Lett.
2. Facts and figures taken from South West England and South East Wales Science and Innovation Audit

More climate expertise than any other area worldwide.

The UK's first nuclear power station for a generation.

Two national governments and health systems.

Unique combination of city, marine, industrial and rural regions including 1/5 of UK agricultural workforce.

Pioneering sites for biomass, wind, tidal, wave and solar energy testing and generation.

The UK's largest aerospace sector.

Global powerhouse for microelectronics, cyber security and environmental data.

UK Top 5 of most productive digital economy clusters outside London.

> The GW4 region of South West England and South East Wales is becoming the powerhouse for climate and the environment. GW4 has the potential to deliver real change and train the next generation of scientists necessary.
>
> **Dame Julia Slingo, former Chief Scientist at the Met Office**

Our Whole Systems Approach

Delivering a fair and just transition to a net zero society is an unprecedented and complex challenge. It requires harnessing and orchestrating the collective endeavours of all parts of society.

This means developing a framework that brings together our citizens, businesses, Universities, the third sector and government to work collaboratively in directing and accelerating change. It entails a comprehensive, joined-up approach capable of prioritising and aligning the diversity of research, resources and leadership assets we have in the region, and ensuring that these all work together to affect the desired outcome.

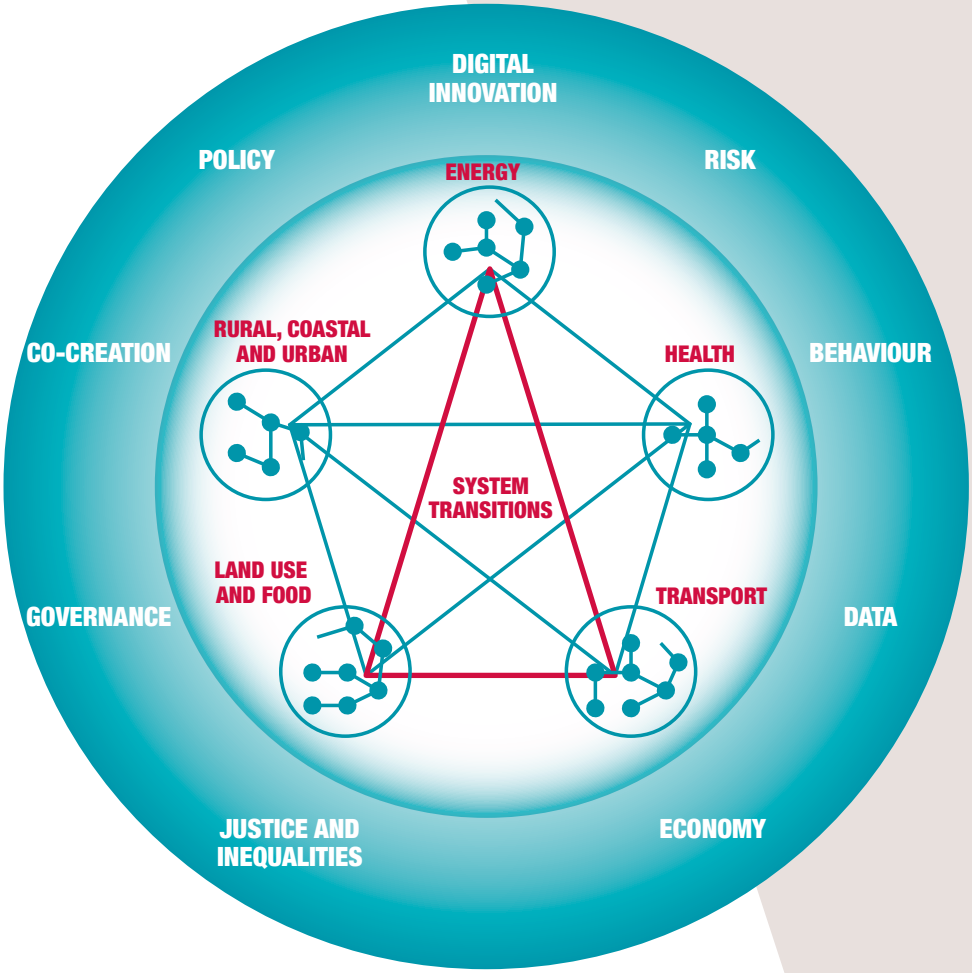
It requires us to recognise that interactions between different sectors, including technical, economic, environmental and social, are frequently complex and messy, and to work out how to intervene without giving rise to unintended adverse consequences that would otherwise undermine and slow down the pace of change.

Bringing people together to collaboratively understand the challenge, to work across disciplines and span sector boundaries, to co-create a mosaic of social and technical solutions that work together, to join up networks and their leadership and to integrate academic know-how comprises our 'whole systems' approach.

We will build on our current work with communities, government and industry partners to develop a shared understanding of the challenges and co-create sustainable, long-term 'whole system' solutions and equitable societal change.

As a regional living lab testbed for **net zero energy, transport, land use and food systems** we will research the interdependencies and opportunities between, and within, these sectors to co-create innovative solutions.

By co-creating a programme of transformational change, our region will become a world-leading proving ground for new techniques, technologies, social enterprises and innovation. Our interdisciplinary, collaborative and holistic approach will enable our region to accelerate to net zero and better enable transition across the UK, and we will share this worldwide so that others can learn and benefit from our approach.



Opportunities

Create regional living lab testbeds for net zero in **energy, transport, land use and food** transitions, with co-creation at every step.

Accelerate adoption of existing or emerging technologies and innovation through policy change and identifying strategies that address social and technical barriers.

Build **skills and capacity** across sectors, investing in the next generation of researchers and delivering the step-change required to build nationwide capacity for transformation and development.

Challenge Areas

By implementing a whole systems approach we will tackle complex challenge areas linked to our themed research areas.

How can society adapt to meet the urgent need for rapid and far-reaching emission reductions?

How can people have safe, energy efficient and affordable homes in areas they wish to live?

How can everyone access a healthy sustainable diet that doesn't cost the earth?

What changes are required around policy making to have positive and long-lasting effects?

How can we support a green recovery, protecting and providing jobs in a circular economy?

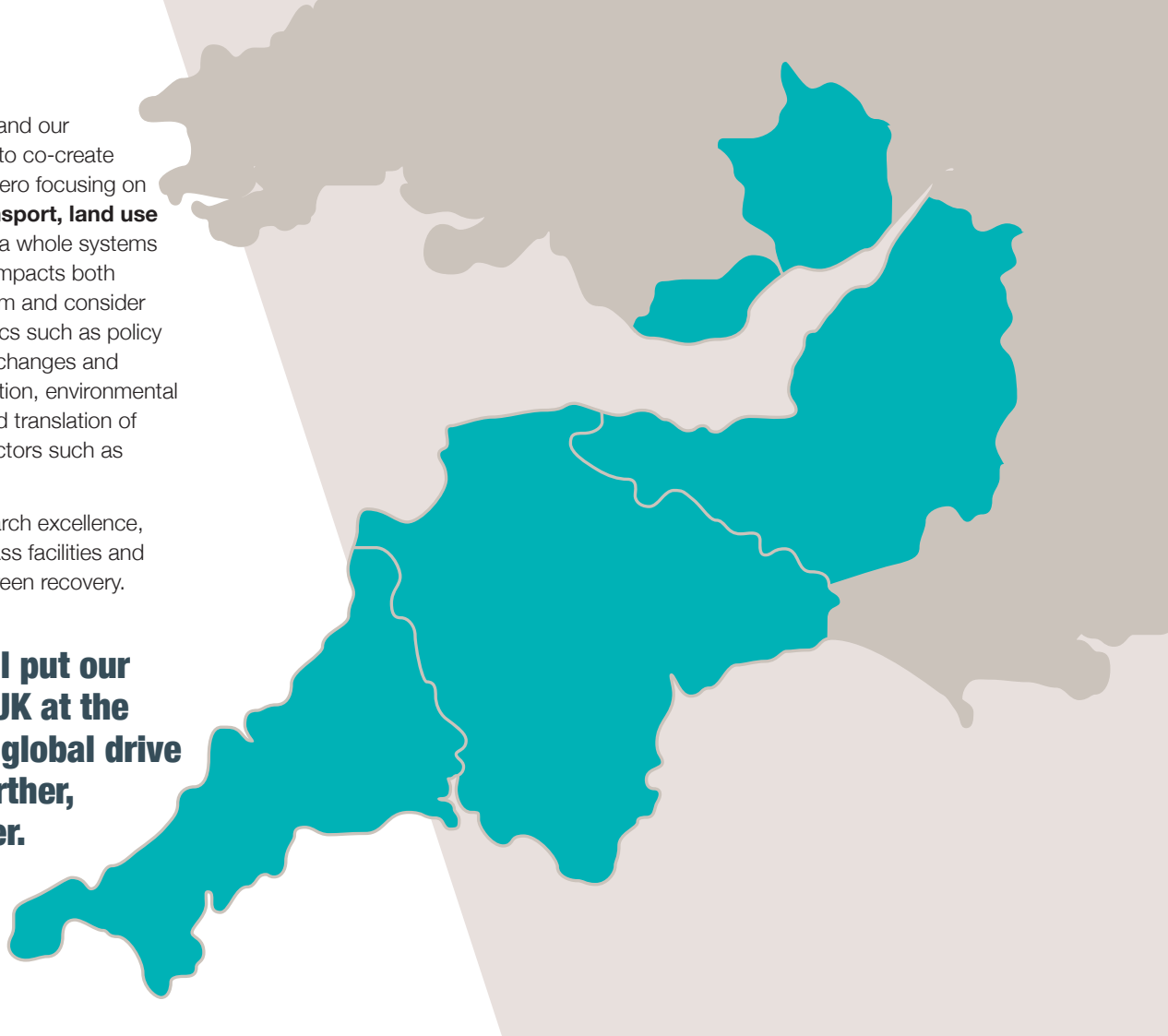
What changes would be needed for society to adopt cleaner transport?

Themes

We will enhance and expand our interdisciplinary research to co-create solutions to achieve net zero focusing on the areas of **energy, transport, land use and food**. We will adopt a whole systems approach looking at the impacts both upstream and downstream and consider and embed other dynamics such as policy implementation, societal changes and behaviours, digital innovation, environmental and economic factors and translation of solutions into different sectors such as industry.

We will harness our research excellence, regional assets, world-class facilities and partnerships to forge a green recovery.

Together we will put our region and the UK at the forefront of the global drive for Net Zero: Further, Faster and Fairer.



Energy

How can people have safe, energy efficient and affordable homes in areas they wish to live?

Achieving a Net Zero energy system means managing demand, making efficiencies, transitioning to new energy carriers and sources and integrating and managing increasingly diverse energy sources.

Across the GW4 Alliance we are conducting research in a comprehensive range of energy sources including geothermal, nuclear, smart energy, solar, tidal, wave and wind. We are also working with partners to create innovative buildings that create more energy than they use, as well as circular economic solutions for sustainable building products.

Low Energy Infrastructure

FLEXIS (Flexible Integrated Energy Systems) is a £24 million research programme in Wales, led by Cardiff University. It provides a demonstrator site to explore low energy infrastructure, power electronics, energy safety, public perceptions of new energy system technologies, hydrogen and fuel cells and environmentally-friendly gas for electrical network insulation.

South West Nuclear Hub

The South West Nuclear Hub, led jointly by the University of Bristol and the University of Oxford, brings together academic, industrial and governmental institutions to engage with the opportunities and challenges facing nuclear energy in the UK and around the world, to help realise the zero-carbon economy of the future.

The Hub is pursuing research, innovation and skills in support of nuclear energy for electricity and other high-value products such as heat and Hydrogen co-create innovative solutions.

Energy

Energy and the Environment

The Institute for Sustainable Energy and the Environment (I-SEE) is a specialist research institute at the University of Bath. It brings together academic, industry and policy experts to present, review and discuss topics of popular interest in the UK and global energy sector. The Institute's research is influencing and helping to shape new ideas for affordable power, heat and transport.

Sustainable Buildings

The Centre for Energy and the Environment (CEE) at the University of Exeter is an interdisciplinary team providing research and consultancy into sustainable buildings, energy and environmental policy and the impacts of climate change on the built environment. The CEE has advised across the energy, buildings, transport, and waste sectors with the commercial sector, public sector and research council partners for over four decades.

Energy Networks

Led by the University of Bristol, all four GW4 universities are involved in the **Supergen Energy Networks (SEN) Hub**, which brings together a diverse energy network community of more than 600 industrial, academic and early career research partners. The SEN Hub's core research programme aims to gain a deeper understanding of the interactions and interdependencies of energy networks investigating the physical multi-vector energy network infrastructure, markets and regulation, policy and society, ICT and data and risk and uncertainty as critical elements to modernise and integrate the infrastructures effectively.

Transport

What changes would be needed for society to adopt cleaner transport?

Our region is home to the UK's largest aerospace sector, with exciting research and innovation programmes in maritime, shipping and rail as well as the electrification and automation of vehicles.

This provides GW4 with unparalleled opportunities to work with the transport sector to develop new sustainable solutions to carbon emissions, while ensuring they work for all sectors of society and are supported by any necessary infrastructure requirements or policy changes.

Institute of Advanced Automotive Propulsion Systems (IAAPS)

Based at the University of Bath, **IAAPS** is a world-leading research and innovation hub supporting the automotive industry to develop ultra-low and zero emissions vehicles.

IAAPS brings together academic expertise with industry focus to offer intellectual rigour, real-world analysis and commercial focus to support the future direction of the automotive industries and the rapid transition to low carbon mobility, including researching societal behaviours and the infrastructure required to transition to zero emissions vehicles. The EPSRC CDT in Advanced Automotive Propulsion Systems also trains the next generation of industrial, research and policy leaders in Automotive Propulsion Systems.

IAAPS
ADVANCING PROPULSION

Compound Semiconductor Centre Driving the 'Electric Revolution'

Tiny chips made using compound semiconductors are at the heart of a new breed of advanced electronics controlling the renewable energy networks and electrified vehicles that will help reduce our carbon emissions.

Cardiff University is playing a leading role in the delivery of UK government's 'electric revolution', along with its partners in the South Wales Semiconductor Cluster. **The Compound Semiconductor Centre**, a Cardiff University joint venture with semiconductor global leader IQE Plc, has been awarded funding from the £1 billion 'Automotive Transformation Fund' in partnership with Newport Wafer Fab. The project will focus on ensuring advanced semiconductor materials and components can reach the final buyer in the supply chain more efficiently.

Transport

Centre for Future Clean Mobility

The Centre for Future Clean Mobility, at the University of Exeter, partners with businesses to develop low-emissions, high-efficiency integrated power systems for applications in the marine, off-highway, rail, defence and energy sectors.

The Centre is part of a consortium of engineering experts and businesses collaborating on a pioneering project designed to develop the UK's first fully electric-powered domestic ferry, called e-Voyager. Initial work will focus on converting a conventional diesel boat to electric drive, using power from Lithium ion batteries. The motors, energy storage, control and charging systems will also be tested in a real-world environment, enabling the team to gain approval from regulatory bodies so they can be used in vessels across the sector and, eventually, carry passengers. The project is supported by the Department for Transport to boost the UK's goal of zero emission shipping.

UNIVERSITY OF EXETER | Centre for Future Clean Mobility

Intelligent Mobility for Future Societies

The University of Bristol and Cardiff University are part of **FLOURISH**, a multi-sector collaboration that helped to advance the successful implementation of connected and autonomous vehicles (CAVs) in the UK. The project adopted a user-focused approach and explored how technology can be harnessed to enhance and enable mobility for older adults and those with mobility-related needs, contributing to the development of a stronger and more inclusive society.

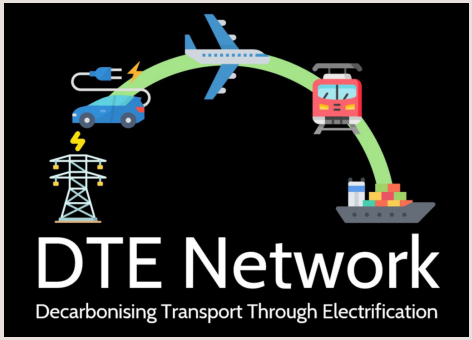
The University of Bristol is also part of the **VENTURER** consortium, a partnership of public, private and academic experts, investigating Connected and Autonomous Vehicles (CAV). VENTURER focuses on the people as well as the technology side and will attempt to understand the blockers and drivers to wide scale adoption of CAV capability.

flourish
EMPOWERMENT THROUGH TRUSTED SECURE MOBILITY

VENTURER

DTE Network+

Decarbonising Transport through Electrification (DTE) Network+ is a £1 million EPSRC-funded multidisciplinary project addressing the challenges of implementing an electrified, cost-effective and holistically operating transport sector for the UK. The network brings together academia, industry and the public sector with a focus on technological innovation, individual mobility needs and economic requirements. Set against the backdrop of environmental and social concerns regarding emissions reduction, it integrates road, rail and aerospace sectors in a whole system approach.



Land Use and Food

How can everyone access a healthy sustainable diet that doesn't cost the earth?

We believe in developing a systems approach to shaping fair and sustainable food production, through to equitable availability and consumption.

Our diversity of geography, regional partners and our socioeconomic complexity means this is a critical ambition for our region. We will be a living lab for technologies and innovation for the rest of the UK and the wider world.

Changing Consumers' Food Choices

The Centre for Climate Change and Social Transformations (CAST) at Cardiff University is looking at look at ways to reduce the carbon footprint of how and what society consumes.

This includes researching the transformations needed in household food preparation, purchasing and diets, examining how to create new cultural norms and implementing policies that reduce waste, promote plant-based diets, and incentivise shifts in agriculture to low-carbon food production. Following a whole systems approach, CAST also considers wider implications of dietary and food systems change, including for health, biodiversity, skills and just transition in agriculture.

Sustainable Agriculture

The North Wyke Farm Platform is a unique national and global research facility that is linked to real-world farming. North Wyke Farm platform shares staff with Bristol and Exeter Universities embedding collaborative sustainable agricultural science across our institutions. The platform enables crop/livestock expertise, world leading water researchers, alongside environmental psychology and policy – to understand fairness for producer, consumer and how to govern in fair way.

ROTHAMSTED RESEARCH

The CLIC Framework – Re-thinking Innovation for System Transformation

CLIC is a suggested framework for a holistic innovation approach that overcomes the tendency to confine the search for solutions to the two ends of a system (i.e., production and consumption) and that, at the same time, transcends the conventional separation between the social, organisational, economic and governance domains of innovation processes. It has been designed to achieve sustainable food system transformation through the implementation of a mix of synergistic innovations that deliver: Co-benefits, Linkages, Inclusion and Connectivities. (Sonnino, R. and Milbourne, P. Working Paper. Copyright © Cardiff University 2021).

Our Regional and Global Impact

What changes are required around policy making to have positive and long-lasting effects?

Transformational Change

The Global Systems Institute (GSI) at the University of Exeter creates networks for transformative change by developing projects that become initiators for change at a larger scale across a network.

Led by the GSI, and involving a consortium of 16 institutions worldwide, the Economics of Energy Innovation and System Transition is a £4.8 million project funded by the Department for Business, Energy and Industrial Strategy (BEIS) and the Children's Investment Fund Foundation. It aims to directly engage policy-makers worldwide to co-create new and effective science-policy bridges to close the gap between ambition and policy strategy in major economies worldwide.

UNIVERSITY OF EXETER | GLOBAL SYSTEMS INSTITUTE

Influencing Policy

PolicyBristol, aims to enhance the influence and impact of research on policy and practice at the local, national and international level. The House of Lords Science and Technology Committee is investigating the role of battery and fuel cell technologies in achieving the UK's ambition to reach net-zero greenhouse gas emissions by 2050. Professor Philip Taylor, Pro Vice-Chancellor for Research and Enterprise at the University of Bristol and Director of the EPSRC Supergen Energy Networks Hub, gave evidence to the Committee on the role of batteries and fuel cells in achieving Net Zero.

The Institute for Policy Research (IPR) is a leading public policy research institute, based at the University of Bath. It aims to further the public good through research into issues of significant relevance to policy debate and decision-making, building links with the worlds of policy and practice and increasing public understanding of policy research through public events and publications. It is active in research, debate and policymaking on climate change, food and farming, public health and social security.

IPR Institute for Policy Research

Our Regional and Global Impact

How can we support a green recovery, protecting and providing jobs in a circular economy?

Digital Innovation

Digital technologies, such as 5G, digital twins and the Internet of Things, will have a major part to play in accelerating the process of decarbonisation, reducing risks and speeding up investment and policy decision-making.

As a region, we have taken a leading role in developing the digital technologies that are transforming people's lives. The £100 million **Bristol Digital Futures Institute** is at the forefront, creating new digital technologies for more sustainable, inclusive and prosperous futures. It is developing a flagship Reality Emulator capable of dealing with an enormous range of digital twin and emulation experiments relevant to the net zero challenge, including digital manufacture, smart cities and improving farming efficiency.

Our GW4 universities are also helping to accelerate digital engineering capabilities and skills via a £5 million, two-year, research and development initiative funded by West of England Combined Authority (WECA). **The Digital Engineering Technology and Innovation (DETI)** programme brings together advanced engineering companies, digital technology pioneers and universities to push the boundaries of digital engineering.

University of BRISTOL
Bristol Digital Futures Institute

Circular Economy

The Interdisciplinary Circular Economy Centre in Technology Metals led by the University of Exeter and funded as part of a £22.5 million Government investment explores how to create a circular economy for the technology metals, such as cobalt, rare earths and lithium. These metals are essential in all clean and digital technologies including electric cars and wind turbines.

> "The move to a circular economy, where we use less resources and reuse more materials, is central to the UK's green industrial revolution and our commitment to achieving a net zero economy by 2050."
>
> **Professor Dame Lynn Gladden, EPSRC Executive Chair**

Met4Tech

GW4 Talent and Skills

We are committed to developing the researchers of tomorrow and building a highly skilled workforce, from our GW4 Doctoral Training Programmes, the professional development of our technical staff, and our annual GW4 Crucible programme – which provides hands-on training and mentoring to develop collaborative research leaders of the future.

Our investments in doctoral training programmes have secured our universities leadership in over 30 doctoral training entities across the full portfolio of disciplines, and many in areas relevant to low carbon. These programmes are highly collaborative, involving a range of academic and non-academic partners, such as national research organisations, industry, business, government and third sector partners.

Committed to collaboration, our PhD students benefit from shared training programmes, which allow any UKRI funded student access to the training programmes across all four universities, as well as coordinating a shared programme of skills training across our UKRI training investments.

Through these opportunities for researchers across our universities, we are able to focus our research effort towards challenges of global significance and genuinely enhance the capacity of our region to respond. The 2021 GW4 Crucible programme is focused on researchers seeking to respond to the net zero challenge, and our Generator Award Funding encourages interdisciplinary researchers to collaborate to solve global and social challenges

GW4WARD

- Driving forward the professional development of our technical staff -

Our Strategic Priorities and Partnerships

We identify areas of complementary expertise across our universities to develop research communities with far reaching impact.

As world-wide research leaders in Climate and Anti-Microbial Resistance (AMR), we have invested in collaborative strategic alliances to develop research at scale. Our new GW4 Climate Alliance and GW4 AMR Alliance compliments our existing alliance portfolio of the GW4 Water Security Alliance. **We will exploit the synergies across these alliances to Accelerate to Net Zero Further, Faster and Fairer.**

Our research communities have worked with over 400 external partners, and we also have strategic partnerships with a range of organisations based in our region and beyond including the Met Office, the National Trust, the Office of National Statistics, the NC3Rs, and the Alan Turing Institute, through our GW4 Data Science Network.

GW4 CLIMATE ALLIANCE

GW4 AMR ANTIMICROBIAL RESISTANCE ALLIANCE

GW4 bridging the gap

National Trust

GW4 Water Security Alliance

With over 280 academics across our four institutions, the GW4 Water Security Alliance (GW4 WSA) is the largest UK water research consortium – and one of the largest worldwide. It brings together academics and stakeholders with a common vision of addressing the impact of global change on water to benefit people and ecosystems and has generated almost £9 million in new external funding for our universities.

GW4 Water Security Alliance

Met Office Academic Partnership

The Met Office Academic Partnership is a cluster of research excellence that brings together the Met Office and institutions who are among the leading UK universities in weather and climate science, including the University of Bristol and the University of Exeter, through a formal collaboration to advance the science and skill of weather and climate prediction.

Met Office

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Further > Faster > Fairer

For more information about

GW4

Visit our website: **gw4.ac.uk**
Email us: **netzero@gw4.ac.uk**
Follow us: **@GW4Alliance**