



**RESPONDING THROUGH RESEARCH
TO GLOBAL CHALLENGES**

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“One of the core functions of a leading University is to play a part in solving the world’s greatest problems... the most urgent problems are now global in origin and input.”

PROFESSOR NIGEL THRIFT
VICE-CHANCELLOR AND PRESIDENT
UNIVERSITY OF WARWICK

Global Research Priorities Vice-Chancellor and President's Introduction



It is the job of great universities to respond to the needs of society. As a globally connected, research-led university, it is Warwick's mission to be part of the solution to the most pressing problems the world faces. Launched in 2011, the Global Research Priorities (GRPs) programme is part of Warwick's strategy to present our major areas of research strength around key global priorities and challenges currently confronting the world.

The GRP mission is three-fold. First, in our efforts to respond to the needs of global society, the GRP programme provides a focus for Warwick's multi-disciplinary research in key areas of international significance. Second, the programme serves as a platform from which to showcase Warwick's world-leading research. Third, the GRPs provide a forum in which to engage our multiple users and stakeholders throughout the research process, thus maximising the impact of our research.

The programme has been a considerable success to date, with ten themes firmly embedded in the structure of the University. Not only has the programme led to some large-scale successful grant applications, but it has also had an impact on the physical make-up of Warwick – as in the case of the energy trail which threads its way through the campus. As well as this, the programme has resulted in new ways of working, and connections being made across and beyond campus that would not otherwise have happened. From an external point of view, the programme invites interest from industry, the public and private sectors, and, of course, other universities. As a showcase of Warwick's strengths, the GRPs are a genuine example of what we do best.

Looking to the future, it is vital that the programme continues to respond to the needs of society, as diverse and dynamic as they may be. From sustainable cities to questions of global governance, from new ways of manufacturing to the development of materials that are of technological and societal importance, we believe that our ten GRPs represent some of the most serious challenges facing the world in the 21st century. I hope you enjoy reading about this exciting activity and Warwick, and invite you to share this brochure with those for whom this work is relevant.



Professor Nigel Thrift
Vice-Chancellor and President
The University of Warwick



Warwick's Global Research Priorities

Warwick's Global Research Priorities focus the University's world-class multi-disciplinary research on areas of international significance. The Global Research Priorities (GRPs) bring together research strengths from across the University, giving them clear thematic identities that show where Warwick can make a significant, and distinctive contribution to the resolution of some of the world's most pressing issues.

Of our current GRPs, some focus on established areas of global concern – food security; sustainable energy; international development; health and well-being; the challenges posed by our rapidly urbanising world. Others – connecting cultures, behavioural science, global governance – are concerned with issues that underpin some of the world's seemingly intractable problems. Researchers in the GRPs on innovative manufacturing and materials work in areas of vital importance to the world economy and to the fabric of 21st century life. Overall, the GRPs reflect Warwick's belief that, in the words of Vice-Chancellor and President, Professor Nigel Thrift: 'One of the core functions of a leading University is to play a part in solving the world's greatest problems ... the most urgent problems are now global in origin and input.'

Multi-disciplinary research is at the heart of the GRP concept. Research that crosses department boundaries has long been a feature of academic life at Warwick: examples include the Systems Biology Centre, the Centre for Complexity Science, the recently formed Centre for Industrial Biotechnology and Bio-refining, and one of the University's oldest cross-departmental centres, the Centre for Philosophy, Literature and the Arts. The University has eight interdisciplinary Doctoral Training Centres and supports a range of interdisciplinary doctoral and master's programmes.

The GRPs play a key role in enhancing the impact of Warwick's research. They enable experts from across departments and faculties to focus directly on important global challenges in a way that dramatically increases the impact of work by individual researchers. Impact – obviously important in itself – is also an increasingly important driver in research funding, both from the UK research councils and from other funding bodies. The GRPs enhance the University's ability to respond to funding bodies' current strategic priorities, to showcase research excellence and to demonstrate its impact.

Launched in 2011, the GRPs have played a key role in the development and updating of Warwick's research strategy. Support and resources have been reoriented to enhance the key policy areas that they represent. They are now firmly embedded in the University's research culture – a vital part of Warwick's drive to become a world leader in research and scholarship.



“The GRPs enable experts from across the University to focus directly on important global challenges in a way that dramatically increases the impact of work by individuals.”

Global Research Priorities Behavioural Science



PROFESSOR DANIEL READ
ACADEMIC LEAD



DR THOMAS HILLS
ACADEMIC LEAD

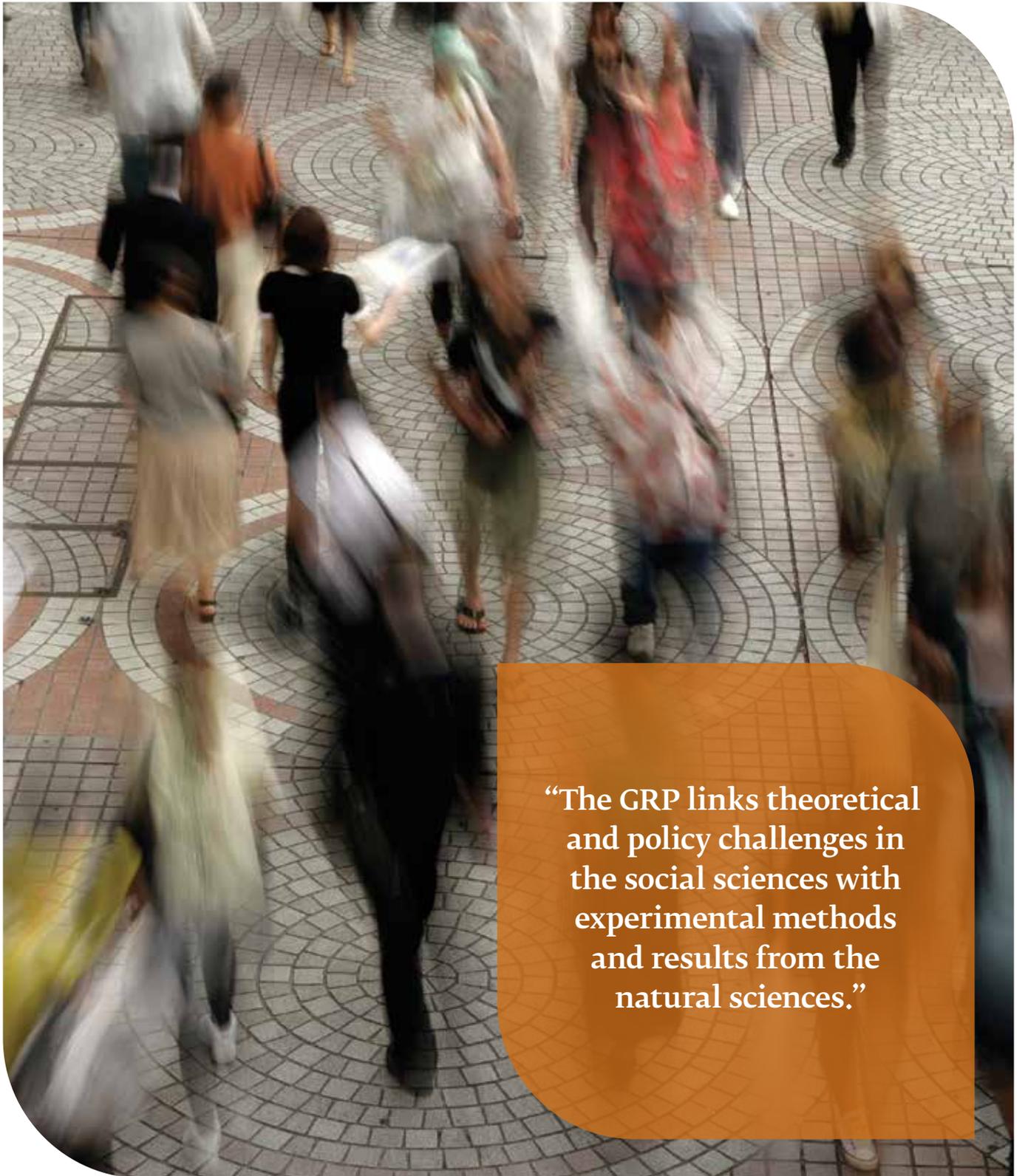
The GRP on Behavioural Science brings together experts in psychology, cognitive science, economics, business and statistics to investigate the factors that influence human behaviour, and its consequences. Work focuses on how people predict, explore, evaluate, decide and make judgements under both familiar and novel circumstances. The GRP seeks to link theoretical and policy challenges in the social sciences with experimental methods and results drawn from the natural sciences – a state-of-the-art Behavioural Science Research Laboratory was opened in the University in 2011. This is a truly multi-disciplinary approach to studying human behaviour and those decision-making processes that influence subjects of vital importance, such as economic systems, the global environment, and individual well-being.

Current themes in the Behavioural Science GRP include the problem of rationality – whether, and in what sense, human choices are rational. This work, which includes both fundamental and applied research, is being carried out by Professor Nick Chater, financed by a European Research Council Advanced Grant of £2 million. A project on Risk, Time and Society: the Behavioural Economics of Value investigates how people arrive at valuations of goods and services, and the implications for public policy; members of the GRP involved in this project, funded by a £902K Leverhulme grant, include Graham Loomes, Daniel Read, Neil Stewart and Nick Chater. A Research Councils UK grant of £697K is enabling GRP members to explore the opportunities offered by huge online information streams to provide an insight into the early stages of collective decision-making.

Work is also under way to develop methods for the continuous analysis of publicly available data to anticipate and detect significant societal events, such as outbreaks of disease, mass migrations, riots and humanitarian crises. On-going work on policing includes a collaboration with Dorset police, investigating the effects of driver distraction; Dorset Police's driver education courses are based on the work of Warwick psychologists.

Members of the GRP have been active in collaborating with colleagues outside the University. They have joined with the Universities of Nottingham and East Anglia to form the Network for Integrated Behavioural Science: funded by an ESRC grant of £4 million over four years, this Network promotes foundational, cross-disciplinary research, modelling human behaviour and behaviour change and examining implications for policy decision-making. In 2012, Warwick joined with the Design Council to set up the world's first Behavioural Design Lab. This pioneering venture aims to transform a better understanding of people's behaviour into innovative solutions that will impact on society: designers will use the insights from research to produce products and services that, in turn, will change people's behaviour. Current areas of interest to the Behavioural Design Lab include binge drinking, the impact of the internet on teenagers, and energy consumption.

Finally, the work of Warwick's behavioural scientists was brought to a wider public in the spring of 2013, when both Professor Nick Chater and Professor Daniel Read were involved in a BBC Radio 4 series, 'Exploring behaviour in the human zoo'.



“The GRP links theoretical and policy challenges in the social sciences with experimental methods and results from the natural sciences.”

Global Research Priorities Connecting Cultures



DR LOREDANA POLEZZI
ACADEMIC LEAD

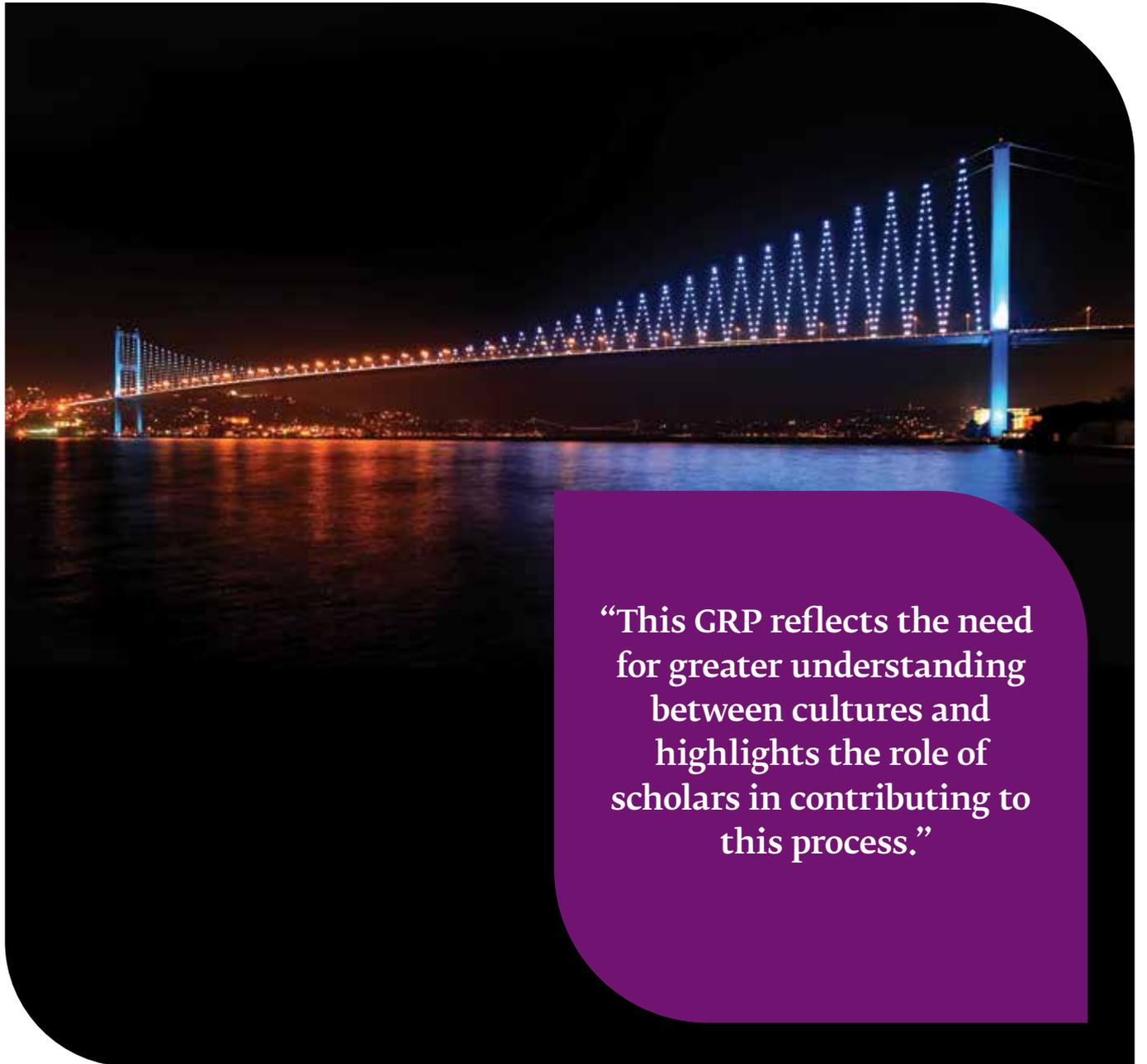
Building bridges to cultural understanding

In an age where technology shrinks the space around us, turning 'local' into 'global', the GRP on Connecting Cultures reflects the need for greater understanding between cultures and highlights the role of scholars in contributing to this process. This GRP brings together experts from the Faculties of Arts, Medicine and Social Sciences. Its focus is on inter- and multi-disciplinary areas linked to broad definitions of the notion of 'culture', including national and transnational cultural phenomena, professional and disciplinary cultures, cultural heritage and cultural value. It aims to contribute at both the theoretical and applied levels to the on-going debates around what connects and what divides cultures.

Activities currently focus on six sub-themes: cultural value; cultures of translation; health and culture; postcolonial studies; memory studies, and religion, rights and social justice. Research in all these areas shares an interest in spatial perspectives and modes of cultural exchange, in the historical dimension of cultural traditions as well as cultural change and transformation, and on the social impact of cultural practices. Some of the topics currently being considered include the influence of cultural diversity on health and wellbeing; identity, religion and sectarian conflict; the transmission, interpretation and sharing of values, narratives and languages across cultures, borders, generations and media. The GRP is also contributing to the work of the Warwick Commission on the Future of Cultural Value: this, the fourth of the Warwick Commissions (which bring together Warwick scholars, practitioners and politicians to examine issues of global importance) will report in March 2015, and aspires to make a significant contribution to improving the quality of public debate and policy thinking in the area of cultural policy.

Initiatives supported by 'Connecting Cultures' stem from what the academic lead, Dr Loredana Polezzi, describes as 'a genuinely bottom-up approach'. An on-going census of staff profiles aims to identify and bring together strands of research being developed within the University which resonate with the interests of the GRP. There is a strong emphasis on methodology and on the training of the next generation of researchers via dedicated postgraduate programmes. The GRP has supported public meetings, workshops and seminars providing focus and structure for interdepartmental activities, funding bids and internal and external collaborations, aimed at both the academic and the general public. Externally, strong ties have been made with Warwick's key partner institutions, especially Monash University, Melbourne, in the field of translation studies, and Venice's Ca' Foscari University in areas such as literary and cultural studies. In April 2013, as part of its impact-oriented activities, the GRP took part in Venice's International Festival of Literature (Incroci di Civiltà), sponsoring a debate on 'Writing and Translating for the World' by a team of international experts which included Warwick's Professor Maureen Freely; attended by over 100 people, the debate was held in the Palazzo Pesaro Papafava, Warwick's permanent base in Venice. Members of the GRP are also involved in a £1.8 million AHRC funded project, 'Transnationalizing Modern Languages: Mobility, Identity and Translation in Modern European Cultures', one of only three Large Grants given out across the UK under the AHRC's Translating Cultures theme.

Joining Europe and Asia – the bridge across the Bosphorus in Istanbul.



“This GRP reflects the need for greater understanding between cultures and highlights the role of scholars in contributing to this process.”

Global Research Priorities Energy



PROFESSOR PHILIP MAWBY
ACADEMIC LEAD

Powering the world through sustainable energy

The need for sustainable energy and the drastic reduction of greenhouse gases has been given new impetus by the recent report of the UN's intergovernmental Panel on Climate Change (September 2013). This reinforces the need for sustained investment in energy research and innovation. Warwick has core strengths in the key areas of power electronics, solar and thermal energy, and confined fusion for clean energy, with a current grant portfolio of over £20 million. Energy research at Warwick is multi-disciplinary and multi-sectoral, carried out in collaboration with industry and with input from policy makers. This activity has been given greater cohesion by the creation of the Energy GRP.

The Energy GRP has identified six key research themes:

Electrical Power: Warwick researchers focus on energy networks and storage. Warwick is a member of HubNet – a group of research intensive UK universities that aims to catalyse and focus research on energy networks in the UK. The University is also leading a £3.7 million project to ensure the UK has secure, environmentally friendly and affordable power for the future. With Western Power Distribution, Warwick is part of a £13.5 million project funded by Ofgem's Low Carbon Network Fund to revolutionise Birmingham's power network, using new, ground-breaking solutions to accommodate more low carbon electricity generation across the city.

Solar Energy: GRP members have expertise in evaluation and testing of solar, thermal and photovoltaic systems. A Warwick spin-out company, Molecular Solar, has achieved and demonstrated a record voltage for organic photovoltaic cells (highly flexible and low cost) that can be evolved for commercial use in consumer electronics.

Low Carbon Transport: Warwick is at the centre of developments in electric vehicle technologies in the UK. The Vehicle Energy Facility is a state-of-the-art research facility capable of testing electric and hybrid vehicle powertrains, components and subsystems. Research also includes lightweighting and the integration of vehicle electrical control systems. The Vehicle Electrical Systems Integration project is concerned with two crucial issues in the production of electric vehicles – the cost and power density of the electrical drive system. Warwick engineers are also working on External Sound Synthesis systems to address the fact that electric vehicles are almost silent up to speeds of 20mph, presenting a danger to other road users and pedestrians.

Thermal Energy: Warwick has developed cutting-edge facilities to evaluate and test solar, thermal and photovoltaic systems. The University is leading a £5.2 million project, 'The Interdisciplinary Centre for Storage, Transformation and Upgrading of Thermal Energy' (ISTUTE), combining engineering, behavioural economics and policy research to reduce energy consumption in heating and cooling technology, including thermal energy storage, industrial heat pumps and thermal transformers.



Nuclear Fusion: The Centre for Fusion, Space and Astrophysics (CFSA) is part of Warwick's Department of Physics. Research focuses on plasma physics applied to the grand challenges of magnetic and inertial fusion power, space physics, solar physics, and astrophysics. The Centre's work spans fundamental theory, observation, and the analysis of experimental data, combined with high-performance computing. It has a strong record of joint work with the UK fusion research programmes, and extensive engagement with space plasma and solar physics missions.

Energy Management: The Warwick Global Energy MBA ensures that tomorrow's industry leaders benefit from the University's expertise in both management and energy research. The University has set a 2020 Carbon Challenge to reduce carbon emissions on campus. Warwick's campus is increasingly used to demonstrate low carbon research, including analysis of the Combined Heat and Power Plant, the student wind turbine demonstrator, and analysis of building performance. Warwick was one of the first universities to develop a carbon management plan. A campus Energy Trail gives information about research activities and campus services related to energy.

“Energy research at Warwick is multi-disciplinary and multi-sectoral, carried out in collaboration with industry and with input from policy makers.”



FOOD

Global Research Priorities

Food

Developing a sustainable food system for all

Developing a sustainable food system for all – one that operates at international, national and local levels – is one of the most fundamental issues of the 21st century. It is a complex problem, involving issues of food supply, environmental and social sustainability, governance, social justice, nutrition and public health. The GRP on Food brings together expertise from across the Faculties of Arts, Science and Social Sciences, complemented by on-going, collaborative work on health and diet between the School of Life Sciences and Warwick Medical School. Its vision is of a world in which people eat regularly, sustainably, fairly and well, served by a food system which draws on the best science and social science to meet continual challenges.

Themes currently being investigated by members of this GRP include the underlying politics of the food system – the regional governance of food and agriculture; negotiations in the World Trade Organisation and the construction of alternative fair-trade rules (one of the topics considered by the very first Warwick Commission that reported in 2008); the democratic engagement of farmers and food activists in decision-making spheres; the legal regulation of bio-pesticides and animal welfare. The University has also resourced a team of experts to look at methods of providing integrated probabilistic modelling for decision support in scenarios that pose a threat to food security.

The GRP also promotes vital work in crop science. This is currently focused on the genetic improvement of vegetable crops (with particular reference to brassica, lettuce, carrot and onion) and its contribution to a sustainable increase in food production; integrated crop protection (detailed studies on key pathogen, insect and weed pests with a view to improving their control), and resource use efficiency. This research is carried out by scientists in Warwick Crop Centre, home to the Genetic Resources Unit, a leading international resource for the collection, documentation, conservation,

characterisation and research study of a range of vegetable crops and their wild relatives – important collections that could provide new material for crop improvement programmes in Africa and other similarly challenging environments. The University's new £5 million Phytobiology Facility, which includes state-of-the-art greenhouses and controlled environment facilities, is being used for research into plant pests and disease, how plants cope with environmental stress and the mechanism behind plant reproduction – all areas of vital importance to food production, particularly in the developing world.

Nearer home, the growing problem of food poverty – as witnessed by the increasing use of food banks in the UK – is explored by the GRP in the theme of food policy and insecurity at household level. An international symposium held at Warwick in June 2012 examined the civic and political consequences of the re-emergence of large-scale hunger in rich countries. A symposium on Gendering Food Security (February 2013) brought to Warwick people from across the UK to discuss the international gender dimensions of food security, focusing on women as producers as well as consumers of food. In June 2013, Professor Liz Dowler was one of the experts in the BBC's Great British Budget Menu Programme, which brought leading chefs face-to-face with food poverty in Britain. On a more local level, Food Systems and the Arts works through participatory theatre and arts events designed in collaboration with community groups, offering new ways for the public to engage with food, generating new understanding of global food systems, their problems and potential remedies. In October 2013, an outdoor event held around the Warwick campus – 'Future Foodscape: Grow Warwick' – used the arts to imagine what growing food locally might mean in the West Midlands; this was the second stage of a multi-stage international project, financed by the Warwick Research Development Fund.



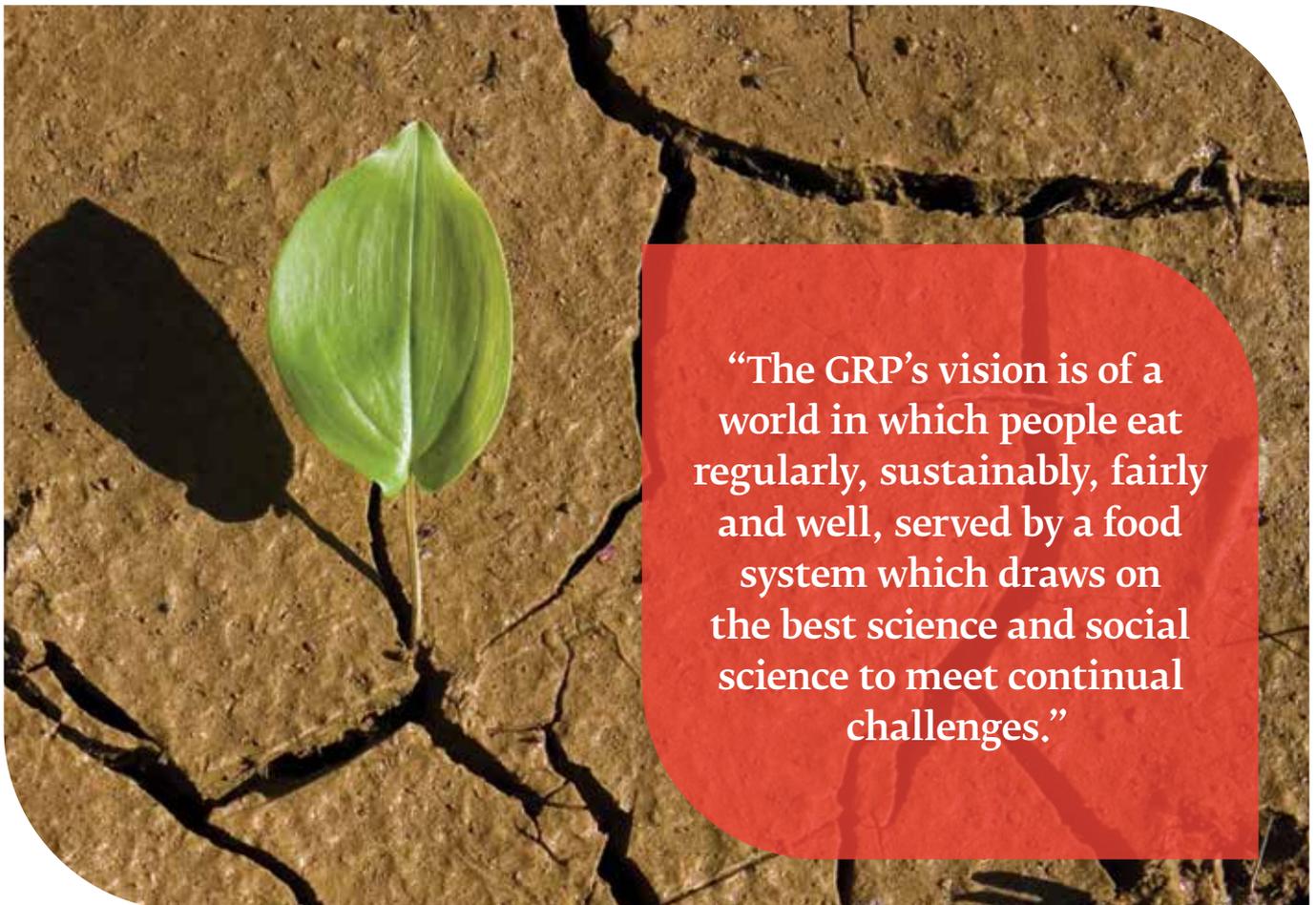
DR ROSEMARY COLLIER
ACADEMIC LEAD



PROFESSOR LIZ DOWLER
ACADEMIC LEAD



PROFESSOR JIM SMITH
ACADEMIC LEAD



“The GRP’s vision is of a world in which people eat regularly, sustainably, fairly and well, served by a food system which draws on the best science and social science to meet continual challenges.”

Global Research Priorities Global Governance



DR JAMES HARRISON
ACADEMIC LEAD

How can we establish better rules for a better world?

Global governance is a field of research that recognises that the world today has evolved far beyond the traditional picture of individual states exclusively regulating their own distinct territories. Global governance concerns issues and problems that cross borders and even involve the whole planet – for example, global warming; the management of the internet; disease control; flows of trade and finance; human rights, and food security. This GRP brings together – amongst others – legal experts, international relations scholars, linguists, economists, historians, philosophers, and experts in food security, global health and global business. Building on Warwick's international reputation for research in the fields of internet governance, human rights, global conflicts and wars, global finance and trade, global migration, and global health challenges, it aims to improve knowledge of the regulatory processes and constitutive practices that address these vital challenges, and to engage in debate and discussion at both national and international level. Its expertise is already in demand: recently, members of the GRP were commissioned by the Carnegie UK Trust to comment on a report entitled 'Global Rules, Local Rules' – a study that aims to reinvigorate discussion, capacity building and mobilisation in civil society around questions of global economic governance.

Crucial to any investigation into global governance are questions of legitimacy, accountability and leadership. A Global Governance pilot project, 'Crisis Leadership in Global Governance', funded by a University of Warwick Strategic Award, is exploring innovative, multi-disciplinary and problem-driven pathways to understanding crisis leadership in global governance: currently, we have very little understanding of the dynamics that shape the emergence, success and failure of crisis leadership; the key types, characteristics and strategies of crisis leadership, or which leadership conditions encourage others to follow. The policy relevance of research on these issues is high, and the GRP is already contributing to the discussion: a Warwick panel on Crisis Leadership in Global Governance presented its preliminary research findings at the 2013 Academic Council on the United Nations System Annual Meeting.

The GRP also focuses on various 'non-traditional' mechanisms of global governance – new forms of governance that go beyond traditional, state-based regulations. Within this theme, Warwick scholars are working on the development of an integrated, inter-disciplinary approach to the whole spectrum of global labour governance challenges – trade, migration, global supply chains, transnational provision of services. With members of Warwick's partner institution, Queen Mary University of London, GRP researchers are also involved in a new project concerning the externalisation of the EU's economic governance; its aim is to explore the emerging architecture of governance of the EU's external economic relations, and the consequences for human rights, labour standards and development outcomes in countries outside the EU.

Global Research Priorities Innovative Manufacturing



DR KERRY KIRWAN
ACADEMIC LEAD

Ensuring global prosperity

As the UK moves out of recession and seeks to reposition itself in the global economy, the government's Technology Strategy Board has identified innovation in manufacture 'through commercialising the world-class output of UK science' as fundamental to long-term growth ambitions. Increasingly, UK funding bodies are re-positioning their activities to focus on manufacturing through aligning the underpinning science. Specific calls for proposals under development by the research councils include sustainable manufacturing; mathematics for manufacturing; ICT enabled manufacturing, and industrial biotechnology – all areas in which Warwick has world-class expertise. The vision of the Innovative Manufacturing GRP – which brings together engineers, chemists, physicists, computer scientists, mathematicians, statisticians and life scientists – is to establish Warwick as a global centre of excellence in the multi-disciplinary research that underpins these innovative manufacturing priority areas.

GRP members are already involved in a number of important projects which contribute to the realisation of this vision. For example, 2012 saw the launch at WMG (Warwick Manufacturing Group) of one of the government's seven High Value Manufacturing Catapults – technology innovation centres that aim to speed up the transfer and commercialisation of new and emerging technologies. The Warwick Catapult focuses on Low Carbon Mobility, addressing the key technology priorities of the automotive, commercial and off-road, rail and marine sectors. It brings together global companies and SMEs, enabling them to access cutting-edge equipment and expertise, as well as new funding streams, and provides a vital link between academia and manufacturing industry.

Warwick is also to be the seat of a unique resource for the automotive industry that will provide a national focus and critical mass of research capability, combining national and international expertise from industry, universities, supply chain companies and SMEs. The National Automotive Innovation Campus (NAIC) – a £92 million project funded by the government's UK Research Partnership Investment Fund, Jaguar Land Rover and Tata Motors – will be a centre for world-leading research on developing new technologies in the automotive sector aimed at reducing CO₂ emissions and fossil fuel dependency. It will also address the shortage of skilled R&D staff in the automotive supply chain. NAIC will provide the state-of-the-art environment for robotics and autonomous systems research to lead the development and implementation of intelligent vehicles: funding of £7 million from the EPSRC and industry was announced for this project ('The Smart and Connected Vehicle') in August 2013.



Industrial biotechnology is an important research priority and in response, the GRP has overseen the creation of the Warwick Centre for Industrial Biotechnology and Biorefining. This new research centre brings together the University's unique collection of scientists working in the areas of plant feed stocks for renewables, fermentation and bioseparation technology, enzymology, renewable chemicals from biomass, industrially important natural products, biopharmaceuticals, bio-based materials, and metabolic modelling. Launched in March 2013, the Centre aims to promote collaboration between scientists and industry and to foster interdisciplinary research in biotechnology. It will also provide advanced training in biotechnology, building on Warwick's successful MSc in Biotechnology, Bioprocessing and Business Management.

Maths and Manufacturing is another area in which the GRP can bring together experts from across the University. Informal discussions are being held between the Mathematics Institute, the Department of Statistics and WMG to explore areas of research collaboration spanning the full spectrum of possible outcomes – from the direct application of existing mathematical or statistical methodologies to solve engineering problems to the formulation of novel mathematical or statistical problems of a theoretical nature which take their inspiration from engineering problems.

“The GRP’s vision is to establish Warwick as a global centre of excellence in the multi-disciplinary research that underpins innovative manufacturing priority areas.”

Global Research Priorities International Development



PROFESSOR SHIRIN RAI
ACADEMIC LEAD



ASSOCIATE PROFESSOR
ANN STEWART
ACADEMIC LEAD

Strengthening global communities

International development – finding sustainable, long-term solutions to the major challenges facing the world’s poorest and most vulnerable countries and people – is an area in which Warwick has long had expertise. This is also a contested concept needing critical attention: Warwick scholars provide a critical lens to its complexities.

International Development at Warwick has a vision based on cutting-edge research, which leads our teaching and knowledge exchange. We contribute to understanding, researching and analysing the key issues that shape development in a globalising world. We provide a bridge between research and policy through working with state and non-state actors to address poverty reduction, social justice and rights-based development. By developing a knowledge exchange programme with diverse audiences, we broaden the appeal of development debates. We are also establishing a network of individuals and groups with shared intellectual experiences, values and institutional allegiance.

Warwick is engaged in an innovative five-year capacity building project to promote postgraduate legal education in Ethiopia. Warwick researchers have studied the lives of street children in Ghana and sex workers in India (‘forgotten people’), are working with political and business leaders to develop and assess policies for growth, and are part of a long-term collaborative research project that aims to understand, promote and deliver sustainable urban form in India’s fast growing cities.

The GRP thus brings together expertise from across the University, making possible a more co-ordinated examination of and response to the challenges of international development. Four currently profiled research themes, each representing an area of particular research strength, are:

Gender: The study of gendered social relations has been a critically important intervention to the study of development. From early concerns about how to ensure that the benefits of modernisation accrued to women as well as men in the Third World, to current debates about gendered division of labour, institutions and distribution of resources, gender and development has emerged as a strong field of enquiry. Scholars at Warwick are working on these important issues, through research and teaching and through developing vibrant and multi-disciplinary networks across countries and regions.

Health: Developing countries have high levels of child/maternal mortality, people are more susceptible to disease and have limited access to healthcare. Work focuses on strengthening healthcare systems, providing access to healthcare and tackling diseases such as malaria and HIV/Aids: members of the GRP have been active in all these areas. Warwick is part of the Wellcome funded international CARTA consortium to build public health capacity in Africa and has a partnership with the Liverpool School of Tropical Medicine for developing applied healthcare research globally to increase the right to health which is part of international conventions.



Rights and social justice: The last quarter of the 20th century saw the development of a robust international discourse around human rights. This discourse, putting the individual centre stage, now informs the way in which international development is understood. The objective of much development policy is the promotion of freedom and the expansion of choice. Rights and development are closely interwoven but has the focus on rights contributed to reducing the emphasis on social and economic injustices particularly in a global marketplace? Scholars at Warwick consider the relationship between development, human rights and global justice, including the power to govern and to resist domination. They engage in collaborative research and teaching projects involving networks across countries and regions.

Private sector development: Sustained economic growth – the most effective way to raise living standards – needs a vibrant private sector that can create jobs and generate tax revenue to fund vital public services. Warwick researchers are currently studying how market forces in developing countries impede private sector development.

“This GRP challenges orthodox understanding of international development to find robust answers to urgent problems affecting the global South.”

Global Research Priorities Materials



PROFESSOR DAVID LEADLEY
ACADEMIC LEAD



PROFESSOR RACHEL O'REILLY
ACADEMIC LEAD

Creating the fabric of 21st century life

In the 21st century, materials development remains the key to technological progress. Developments are driven by consumer demands for lower power and higher efficiency devices, less intrusive and life-prolonging healthcare, or multi-functional fabrics. All of these must be cost effective and environmentally friendly to produce and use: today, as never before, we need to balance technological development with environmental responsibility, to take account of the availability of raw materials and how the finished product can eventually be disposed of, reused or recycled.

The Materials GRP is an interdisciplinary programme that spans the physical and engineering sciences. This programme encompasses both the structure and understanding of materials at the atomic or molecular scales, through to their macroscopic properties and applications. It addresses those materials that are vital for the development of future technology: hard materials (functional, adaptive, electronic, and meta-material); soft materials (supramolecules, polymers, proteins and *in vivo* soft matter); materials for energy, catalysis and biomaterials; combinations of materials, their surfaces and interfaces; hard-soft material interfaces and composites. Activities range from the fundamental science that determines a material's properties, through highly advanced nanofabrication and atomic scale characterisation, to application development; issues to be considered include security and supply of materials, product design and manufacture, and the customer interface.

The Materials GRP has identified nine research themes:

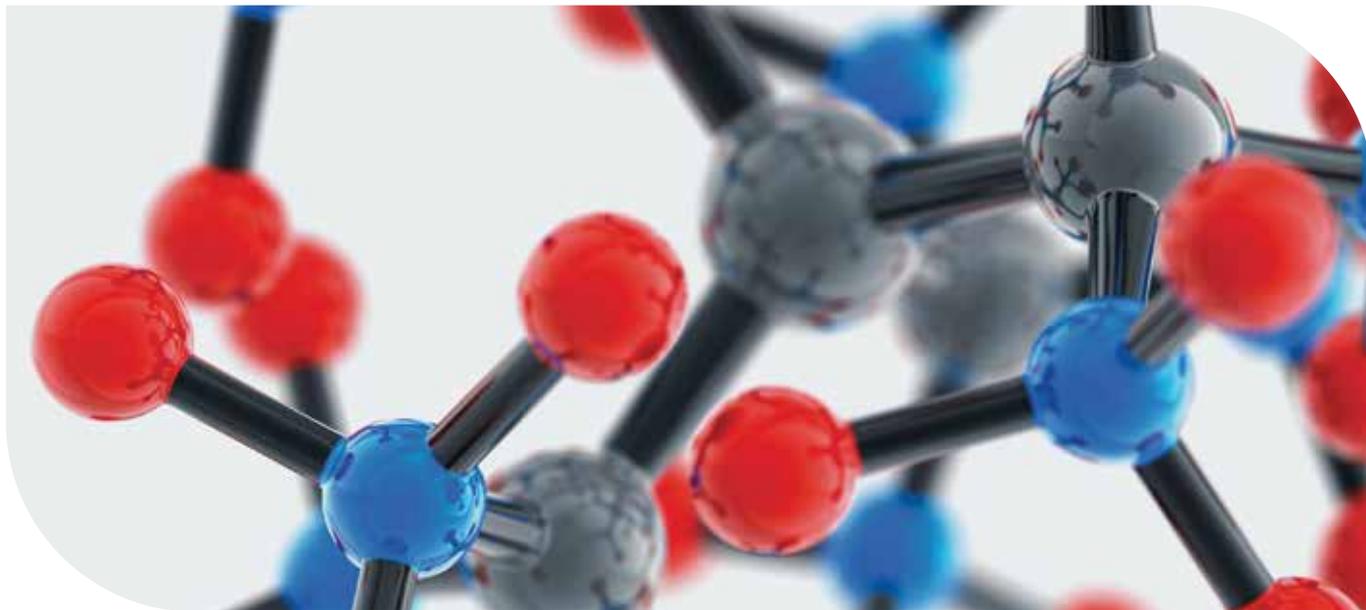
Polymers: Research here impacts in areas from automotive to therapeutic and nanomedicine, energy and food security; this is application-led research to meet today's challenges. Warwick is one of the best-equipped universities in the UK for polymer science.

Adaptive/functional materials: Used in technologies as sensors, actuators, memories and energy harvesters, these materials show a large response to small stimuli. Modelling and advanced characterisation enables us to optimise their performance and enhance their capabilities.

Diamond: This multi-functional high performance material has unrivalled properties (optical, electronic, electrical, mechanical, chemical, thermal), and the potential to impact significantly in areas such as power electronics, measurement and sensing, photonics, quantum computing, manufacture, innovative production processing and nuclear research.

Interfaces: This theme considers surfaces and interfaces of diverse hard and soft materials, such as carbon nanotubes, semiconductor heterostructures, organic solar cells and cell membranes.

Biomaterials: These are designed to mimic or interact with biological systems: their design, synthesis and study is a critical aspect of advanced healthcare technologies. Research includes hard and soft materials from natural or synthetic sources for applications such as tissue engineering, regenerative medicine and drug delivery.



Nano-composites: These are functional materials with at least one dimension on the nanoscale, dispersed in a matrix such as a polymer, metal or ceramic. Examples include carbon nanotubes, graphene, nano-cellulose, and layered silicates. The unique properties of the functional material can be transferred to the matrix to form a composite with multi-functional properties.

Electronic materials: These encompass semiconductors, dielectrics, ferroelectrics, half metals and superconductors. Warwick research includes epitaxial growth of a range of electronic materials; fabrication of devices from the materials, and demonstration of their functionality for applications in healthcare, the low-carbon economy, and information processing.

Catalysis: This is the key to producing new polymer and nanomaterials. Well-defined solid materials are used as catalysts for sustainable production of commodity chemicals including renewables.

Sustainable materials: Research includes the use of renewable or waste feed stocks, energy and water usage, and adapting processing methodologies to reduce the impact of materials on the surrounding environments, whilst making their production and use more resource efficient.

Common to all these research themes are the issues of sustainability; manufacturability; characterisation; performance; modelling; efficiency; ethics and societal concerns.

“We must balance technological development with environmental responsibility, taking account of the availability of raw materials and the disposal, reuse or recycling of the finished product.”

Global Research Priorities Science & Technology for Health



PROFESSOR SUDHESH KUMAR
ACADEMIC LEAD

Healthcare for the Digital Age

This GRP aims to create a powerful cross-disciplinary programme that will harness science and technology to address global health issues. It brings together experts from the Faculties of Medicine, Science and Social Sciences, including the Institute of Digital Healthcare. It also draws on Warwick's partnership with the Liverpool School of Tropical Medicine (LSTM) and with external organisations such as the West Midlands Academic Health Science Network, in which the University participates. The research, education and development programmes resulting from this wide collaboration will tackle some of the world's most pressing health problems.

The GRP's research agenda centres on the concept of lifelong health and wellbeing. It recognises the significant influence on lifelong health and wellbeing of many biological, social and economic variables – prenatal and childhood nutrition; mental health; lifestyle choices, and public health policies, all areas in which the University has core research strengths. The key need is for insights from a range of disciplines that have the potential to deliver measurable impacts. This is the challenge for the GRP.

Within this research agenda, the GRP has identified three priorities. Underpinning these is Warwick's expertise in analytical science (synthesis, imaging, biomedical science, sensors, innovative materials and processes, digitalisation); healthcare technology (digital technologies, biomedical engineering, biosensors); research to practice (clinical trials, translational medicine); evaluation (RCTs, multivariate analysis), and public involvement (aspects of social dimension and behaviour).

The first priority is Healthy Ageing – a national and international challenge. Members of the GRP are involved in research into many aspects of the ageing process. For example, there is on-going research in the study of iron in the brain as a key feature of Alzheimer's Disease. Warwick is working with the University of Manchester in a £5.2 million BBSRC funded project to investigate how the human immune response is affected by ageing. In collaboration with one of Warwick's long-term international partners, the University of Boston, researchers are studying the links between sleep disorders – a field in which Warwick has particular expertise – and future cognitive decline; findings will feed into the English Longitudinal Study of Ageing.



Clinical Trials Unit, Warwick Medical School

The second priority is Early Diagnosis and Treatment. Warwick researchers are working on digital technologies that speed up breast cancer screening and make it less prone to error and uncertainty. Scientists are studying the mechanism inside cells that drives them to divide – work that may help in an earlier detection of cancer, opening up opportunities for both diagnosis and treatment. Warwick has an international reputation for diabetes research and work is continuing on the early diagnosis of the disease. The use of a portable electronic nose for early detection of gastrointestinal diseases is another on-going project. On the treatment side, researchers are developing scalp cooling treatments to reduce the risk of hair loss during chemotherapy; a trial concerning the treatment of head and neck cancers is also underway.

Improving Health in Resource Poor Settings is the third research theme. Here Warwick has already made a significant contribution. Through the Infant and Maternal Health Programme in Malawi, Warwick has collaborated with partner institutions to train non-physician clinicians in advanced neonatal and obstetrics care to compensate for the lack of medical doctors. Warwick researchers are also leading a programme in Malawi to study the effectiveness of a home-based test for HIV, thus again tackling the problem of lack of easy access to doctors and hospitals. The University has recently set up the Warwick Centre for Applied Health Research and Delivery – part of the CAHRD network co-ordinated by LSTM which works with resource limited nations to improve health systems.

“Underpinning the GRP’s research priorities is Warwick’s expertise in analytical science; healthcare technology; research to practice; evaluation, and public involvement.”

Global Research Priorities

Sustainable Cities

Addressing changes posed by a rapidly urbanising world

For the first time in history more than 50% of the world's population lives in cities, expected to rise to 70% by 2050. Addressing urban issues of overcrowding, transport, housing, public health and infrastructures require the skills of computer scientists, engineers, mathematicians, life scientists, economists, sociologists, geographers, political scientists and experts in business and theatre. The GRP works in partnership with the Center for Urban Science and Progress (CUSP) in New York, an applied science institute exploring new solutions for these complex challenges. Warwick is part of a consortium of world-class academic institutions and private technology companies chosen by The Mayor's Office to work in partnership with New York City and New York's Metropolitan Transportation Authority. Warwick has appointed several new academic staff to work with CUSP which will host 50 principal scientists, over 400 Master's students, 100 doctoral students and 30 post-docs.

There are eight interconnected GRP research themes in which Warwick has expertise:

Environment and Energy: A reliable, sustainable source of energy and a clean environment underpins the business, domestic and cultural activities that enable cities to be drivers of economic growth and prosperity. This requires expertise in power electronics, solar, thermal and fusion energy, energy efficiency and storage as well as pollution modelling, control and dispersion.



PROFESSOR STEPHEN JARVIS
ACADEMIC LEAD



PROFESSOR IAN GUYMER
ACADEMIC LEAD

Urban Mobility: This theme covers the movement of people and goods around a city. New hybrid vehicle powertrains, components and sub-systems enable physical movement in cities; understanding the role of mobile communications and social networking supports mass movement of people during, for example, evacuation or attendance at mega-events.

Resilience and Security: Planning for, detecting and responding rapidly to natural disaster, disease outbreak, terrorist threat or social unrest is central to this theme. Understanding factors that contribute to resilience and security requires expertise in social and health informatics, epidemiology, counter-terrorism, urban governance, safer urban spaces, text mining and participatory design.

Health: Providing health services in cities requires multi-disciplinary approaches to predictive modelling and investigating transmission dynamics. Significant expertise in complexity science, modelling and epidemiology provides a core set of skills in addressing these challenges.

Urban Cultures and Creative Spaces: Understanding the role played by the arts in developing sustainable urban futures and how different cultures mix and change in the urban setting is central to this theme. Expertise in theatre and performance studies, and in the Connecting Cultures GRP, contributes to this work.

“Through this GRP, Warwick is responding to the unprecedented growth of urbanisation in the 21st century.”



Artist's impression of CUSP in New York

Sustainable Infrastructure: Developing lighter, stronger, sustainably constructed buildings that are resistant to the depleting effects of vibration, that are capable of monitoring their own structural health and damage detection is central to this theme. The improvement of existing, and novel approaches to, waste and storm water handling infrastructure are addressed by world-leading civil and mechanical engineers at Warwick.

Big Data and Digital Life: Warwick expertise in data collection and analytics, mobile sensing, wireless communications, sentiment analysis, and Adaptive Hypermedia help draw knowledge from data collected through the increasing range of sensors, mobile devices and other interconnected sources in the urban environment. A better understanding of these issues will help develop a truly 'smart city'.

Urban Populations, Economies and Governance: This theme explores the human side of the city in terms of, for example, how it provides the labour market to drive the urban economy, behaves as consumers of goods and services and the policy landscape in which it functions. Expertise drawn from politics, economics and business supports work in this area.

The GRP draws upon expertise from every faculty in the University and has synergies with several other GRPs (including International Development, Energy, Connecting Cultures, Food, and Global Governance). With the GRPs, strong connections with UK and international industry, local and UK government and CUSP in New York, the Sustainable Cities GRP is making a prominent contribution to addressing issues relating to increasing urbanisation worldwide.



Global Research Priorities The University of Warwick

The University of Warwick is globally connected, forward-looking and entrepreneurial. We create new ways of thinking and achieving, making us stand out from the more 'traditional universities' and creating an inspiring place to study and undertake research.

Warwick is one of the UK's great success stories. In less than 50 years since our foundation, we've become one of the UK's best universities, rapidly climbing the international league tables of world-class universities.

We're a university that champions independent thinking as well as being founded, first and foremost, on academic excellence. This has led to truly world class research. Two recent events confirm our international research standing: Warwick is the only European university in the consortium chosen by the Mayor of New York to collaborate with New York City authorities and other academic and industrial institutions in establishing the Center for Urban Science and Progress – an applied science research institute currently being built in New York, and in 2012, Warwick was selected to be the home of the £92 million National Automotive Innovation Campus, funded by the UK government's Research Partnership Investment Fund, Jaguar Land Rover and Tata Motors.

A key driver of the Warwick success story is our entrepreneurial spirit: a key strength is our relevance to society and our close links with business and industry. Companies tap into Warwick knowledge to develop their own strengths and ensure they remain at the cutting edge within their industries. That cutting-edge insight has developed, in turn, out of our world class research – research whose impact will be further enhanced and internationalised through our Global Research Priorities.



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