

The social impact of research conducted in Russell Group universities

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Research has an impact on all of our lives in every area from business and industry to healthcare, technology and culture. But its impact is sometimes hard to predict and research currently underway in our world-class universities has the power to transform radically our society in ways none of us can imagine.

The Russell Group's first report, *The economic impact of research conducted in Russell Group universities*, focused on the impact of research on the economy and found that just a small number of breakthroughs at our universities had generated a combined wealth of almost £2 billion.

But research does not only benefit the economy. World-class research, in its many guises, can transform our lives and reach areas we may never have thought of.

In this paper we hope to demonstrate the benefits of research for the nation's health, quality of life, culture and environment.

We include a range of case studies that give a snapshot of what our research can achieve from addressing sectarianism to making food production more efficient or tackling global health epidemics.

But it can be hard to predict the exact benefits of individual pieces of research and the role of serendipity in scientific discoveries has been shown throughout history.

Sometimes, when least expected, the most important discoveries and breakthroughs can be made by talented researchers who were, in fact, trying to prove something else.

Long-term curiosity-driven research produces the biggest pay-offs in the end which is why sustained investment in research that reaches across discipline boundaries is so important.

The Government can help produce more of these breakthroughs by committing to long-term investment. And in turn universities are committed to finding new and better ways to make sure the UK benefits from the research they carry out.

Professor Michael Arthur
Chair of the Russell Group

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the Russell Group



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The UK is one of the world's leading research nations, with a research base that is the envy of many, a research base that needs to be underpinned by sustained public investment.

- 1 The world-class research undertaken in our leading research-intensive universities is an essential ingredient for the UK's international competitiveness, economic growth and quality of life. As the UK's largest source of world-class research, Russell Group universities have a crucial role to play in the national drive for growth through innovation.
- 2 The economic and social benefits of research conducted in research-intensive universities – both 'basic' and 'applied' – are extremely significant and wide-ranging. We should not underestimate the importance of serendipity in considering the impact of research. Some of the most ground-breaking products have resulted from research which set out to explore something completely different. Basic long-term research has been enormously beneficial for our nation's economy, and for the health and wellbeing of the UK population.
- 3 This report is the second Russell Group report exploring the benefits of research conducted in Russell Group universities. Our first report, *The economic impact of research conducted in Russell Group universities*, demonstrated how innovative and excellent research brings value to the UK economy through its many benefits to businesses and the commercial exploitation of new technologies. This report builds on the findings of our first report, and explores the impacts of research more broadly – beyond commercialisation – and examines the wider impact on the UK's economy, society and culture.
- 4 It is critical that we recognise the importance of our leading research-intensive universities and continue to support them to deliver world-class research across a broad range of disciplines – research which generates a wide range of impacts and benefits to our nation. Our economic future depends on the country's research-intensive universities maintaining and enhancing their competitive position, and matching the best in the world.
- 5 The impact of our leading research-intensive universities on business is considerable, as demonstrated in our first report on impact. Universities, and the highly skilled workforce they produce, are national repositories of the knowledge required by businesses to innovate, to stimulate new and better products and services, to achieve efficiencies and reduce waste, to solve problems and enhance decision-making.
- 6 But this only tells part of the story. The research generated in leading universities helps us understand our society and informs the infrastructure that supports social cohesion. It informs policy and practice across areas that touch all our lives directly, such as medical treatment for the ill or the education of our children, and shapes our social environment through debate on topics such as human rights, equality and national security. Our research also helps us to preserve and appreciate our magnificent cultural heritage, playing a vital role in our appeal to individuals, organisations and governments as a nation to visit and to do business with. It supports the production of numerous art forms, often in ways that allow the public to engage with the art in an interactive and enjoyable way.
- 7 Evaluating and quantifying some aspects of the impact of research is not an easy task. There has for some years now been a debate about how to define and describe the broadest impacts of excellent research. These discussions have intensified in the UK with 'impact' becoming part of the formalised assessment of research which shapes the public funding of research. A number of other countries have struggled to develop assessment criteria for research impact and in many ways the UK is now leading the world in how it is addressing this conundrum. Still, the UK must be careful that in doing so it takes into account the full complexity and breadth of the impacts of research, and supports the UK's leading research-intensive universities in generating those impacts. It is this complexity that makes it critical for the Government to use proven and robust methods to assess impact, and be cautious in assigning too great a weighting to formal assessment, such as the embryonic Impact element of the UK's Research Excellence Framework.
- 8 Research projects may have a broad range of impacts, and these can be difficult, if not impossible, to predict at the outset. Too narrow a concept of what constitutes 'impact' risks overlooking the unexpected or longer-term outcomes of research. Moreover, an understanding of impact that focuses solely on immediate financial returns can underestimate the broader, longer-term returns to

EXECUTIVE SUMMARY

society resulting, for example, from new technologies to address climate change, healthcare challenges, and improve people's quality of life.

- 9 Governments have to some degree recognised and supported the importance of research, both in times of economic growth and in times of economic restraint. Excellence in research requires considerable and sustained investment. However, much of the support that UK universities have received in recent years has been needed to rebuild our universities following earlier cuts to higher education that might have crippled our national research capacity had they continued. We must learn the lessons from the past.
- 10 New challenges are also on the horizon – the UK invests just 0.6% of Gross Domestic Product (GDP) on higher education, one of the lowest levels in the Organisation for Economic Co-operation and Development (OECD). And the competition is fierce. The UK's global competitors are pumping billions into higher education and snapping at our heels, making it increasingly difficult for UK universities to compete with better resourced institutions internationally. We must not risk our international competitiveness as an outstanding research nation.
- 11 The 2010 Comprehensive Spending Review showed some recognition of the contribution of the UK's excellent research base to long-term economic growth, through the protection (in cash terms) of the science and research budget. It is essential now that the Government continues to maintain this commitment into the next Spending Review and beyond. The impacts of research take many years to come to fruition, and maintaining the UK's position as a world leader in science and research means we must take the long view, and continue to support the UK's capacity to undertake and produce world-class research, with wide-ranging impacts to the economy and society.
- 12 It is also important to prioritise investment where research funds have the most impact. A significant proportion of the world-class research that delivers economic and social benefits comes from the UK's leading research-intensive universities. This report explores the scope and broader impacts of our world-class research. The case studies examined here provide just a snap-shot of the way in which research impacts are realised, and hopefully give an indication of just how important university research is, not only to fuelling economic growth but also to improving quality of life in the UK and beyond.

Introduction



“Britain has historically led the world in scientific knowledge – most of it generated in universities... I’ve seen this excellence first hand. It’s one of the most exciting things about working at Dyson. Newcastle and Cambridge universities are helping us develop new technologies. You might not see or hear about them for years, but at the moment I am confident that they are the most advanced in the world. The knowledge from university ‘blue skies’ research can eventually result in new applications and great products.”

JAMES DYSON ¹

1.1 In these comments world-renowned inventor and businessman James Dyson paints a positive picture for the future of the UK economy. However, he also highlights the complexity and the timescales involved in the relationship between fundamental research and its broader impact. The Russell Group’s first report explored the economic impact of research through the relationship between research and business.² That report demonstrated that industry gains competitive advantage through collaborating with universities on research and that university research plays a vital role in developing human capital and in addressing specific business problems. That report demonstrated also how UK research attracts international investment and that the commercial exploitation of research leads to new businesses and business activities. This report builds on our first report, and explores the many aspects of impact generated by research, including impacts on society, health, the environment, policy and culture.

1.2 At the heart of any university lies a vision to create, advance, disseminate and apply knowledge through education, learning and research to benefit society. The economic value of universities, which has been well documented whether in terms of enhanced earning potential for individual students or contributions to national GDP, sits alongside a social value of educating

a skilled, questioning and engaged population and developing the leaders of tomorrow, and a spirit of intellectual exchange between universities and local communities, business and public bodies. Leading research universities play a major role in the intellectual, cultural and economic life of the UK. They have an international reputation for the quality of their research and teaching, which attracts some of the very brightest students and academics to our shores and investment from multinational business. Russell Group universities are found in the major cities of all four of the UK nations, and are equally comfortable engaging with their local and regional communities as they are in reaching across national boundaries to the global arena.

- Through their work with schools and colleges Russell Group universities help raise the aspirations and attainment of young people and in building a more cohesive society.
- With their exceptional libraries, museums and galleries, and range of public arts and science events, our universities make a major and direct contribution to the cultural life of the nation and their local communities.

By training so many of the UK’s scientists, engineers, doctors, dentists, teachers, social workers and other professionals, Russell Group universities are essential to the UK’s public services and quality of life.

- 1.3 Successive governments have identified intellectual capital as one of the key drivers of national prosperity, critical to supporting economic growth, enabling competitiveness and improving the quality of life of everyone in the UK. The 2010 National Infrastructure Plan placed maintaining the UK's position as a world leader in science, research and innovation at the forefront of its strategy recognising that, through our world-class universities and with the right investment, the Government can:
- create new knowledge – research funding directly leads to the creation of new knowledge, with the UK research base producing 8% of global publications and 12% of global citations
 - provide a supply of highly skilled people to the labour market with both specialist knowledge and transferable skills
 - create new businesses, improving business performance and attracting inward investment and
 - stimulate innovation in public policy and in UK businesses.³
- 1.4 To deliver these benefits, universities need a supportive environment that fosters intellectual curiosity and creative thinking in our very best researchers. The impacts of research are often unpredictable at the outset, but patience can reap extraordinary rewards. This report looks specifically at some of the wider impacts of research from Russell Group universities, looking beyond the economic impacts explored in the earlier Russell Group report. The report also considers some of the ways in which research can improve our quality of life through impacts on society, health, the environment, policy and culture.

Defining impact

- 1.5 In recent years there has been much discussion about research impact – mainly driven by the introduction of impact into public funding mechanisms – which has prompted debate about the limitations of methodologies to measure impact, and the dangers of focusing disproportionately on the aspects of impact that are more readily quantifiable, such as those arising from the commercialisation of research and the financial benefits derived by business. This report examines some of the broader, less easily quantifiable, benefits of research, and explores how research is transformed into impact.
- 1.6 Understanding the diversity and complexity of research impact has become increasingly important as impact drives some of the funding that is critical to our world-class universities conducting the very best research. The impact of university research is diverse in its nature and form, and is wider than that which can be easily quantified. Identifying a direct relationship between research and a tangible benefit is rarely straightforward.
- 1.7 This report focuses on a wide-ranging set of benefits from research undertaken by Russell Group universities. The potential impact of research can derive from the added value of effects of research not just on the economy but on society in general through better healthcare outcomes, improvements to the environment, and many cultural and quality of life benefits.
- 1.8 Public funders of UK research define impact in broad terms. In the Research Excellence Framework, impact is defined as “an effect on, change or benefit to the economy, society, culture, public policy or services, health, the environment or quality of life, beyond academia”.⁴ The Research Councils share a core definition of impact as “the demonstrable contribution that excellent research makes to society and the economy”. The Research Councils’ definition encompasses economic performance and competitiveness, effectiveness of public services and policy and enhancing quality of life, health and creative benefits.
- 1.9 The ability to measure and attribute the impact of research within this broader framework is one that challenges researchers, funders and government. This report builds on our earlier work to demonstrate the contribution of Russell Group universities, exploring the influence and worth of our research beyond the easily quantifiable. The report shows how research adds value and benefits through wider economic, societal and public means from the level of a single individual to global challenges. The report presents a number of case studies, which give a rich picture of the diverse impact of our university research. It also explores the definitions that form part of a very animated and live debate amongst academic and funding communities, and examines some of the challenges found when evaluating research impact and the methodologies that can be used in assessments.

Structure of this report

- 1.10 Section 2 of this report explores what research impact means and the methods and tools used by universities to maximise the broad impact of research. The report looks at some of the challenges in translating research into demonstrable benefit and how Russell Group universities address those challenges. This report begins by considering a broad framework of the impact of research, starting with the civic history of those Russell Group universities founded with a vision for improving the economy and society. It then examines some of the mechanisms our universities employ to support the transformation of research into impact, in collaborating with partners, engaging with their local communities, and driving global networks. Finally it explores some of the difficulties in attributing impact to research and the challenge this presents to those who seek to evaluate research.
- 1.11 Building on the evidence of economic impact in our earlier publication, Section 3 of the report uses key themes to demonstrate how Russell Group universities deliver benefits in ways that have an effect across every spectrum of society. This report looks in turn at how research improves quality of life in the broad spheres of society, health, the environment, policymaking and culture. In each of these areas the report presents a selection of case studies that give a flavour of the diversity and wide-ranging impacts of Russell Group research.

From research to impact



What is impact and why does it matter?

- 2.1 The first decade of the 21st century saw a growing interest in the impact of research, debate about definitions of 'impact' and exercises to measure it.⁵ Economic impact started to become noticeable as an explicit element in research funding programmes following the 2006 'Warry report'. The Government asked Peter Warry, Chair of the Engineering and Physical Sciences Research Council, to establish a group of experts to advise the Research Councils on how they could deliver and demonstrate an increase in the economic impact of their investments. The report challenged the Research Councils to lead the knowledge transfer agenda, influencing knowledge transfer behaviour and increasing engagement with the users of research.⁶ The Warry report set the agenda for the following years, as Research Councils and other organisations sought to demonstrate the economic impact of research.⁷
- 2.2 Understanding of research impact has moved on since those early days of debate and an active discourse around the wider value of research to society has emerged. The inclusion of impact into the Research Excellence Framework (REF) and Research Councils' schemes has played some part in this. But also critical to the debate has been a growing willingness and enthusiasm from academia to explore the economic and societal value of research in a wide variety of forms.
- 2.3 Academics recognise the benefits of actively engaging with non-academic uses of research; they include allowing researchers to test their research, to find out what works and what does not, and to explore and fine-tune the most effective ways of working with policymakers or business. Often this 'upstream engagement', at the outset of research and during its development, can help the way an academic frames their research. A Biotechnology and Biological Sciences Research Council (BBSRC) competition promoting research impact found that many young researchers saw intrinsic value in being open to others in terms of what research questions they were asking.⁸ A survey of 22,000 academics found they perceived a long list of benefits to working with external organisations; in fact the benefits were such that academics are far more likely to be proactive and approach external organisations directly themselves rather than depend on university administrative offices to initiate such relationships.⁹
- 2.4 From the other side of the fence, external stakeholders who see benefits in interacting with universities are becoming more open to a broader understanding of the economic and social value of universities and their research. In 2006 Warry had already recognised that economic impact included "less easily quantifiable [impacts], such as effects on the environment, public health and quality of life" and this broader definition of impact has been proposed and adopted by Research Council UK (RCUK)¹⁰ and others.
- 2.5 The British Academy has argued that "the benefits of work in the humanities and social sciences (and indeed many other subjects) are not limited to the specific impact of specific pieces of research, but also have numerous other pathways" and that concepts of impact should include "notions such as 'public value' or 'public benefit'".¹¹ An alternative definition that has been proposed is "a recorded or otherwise auditable occasion of influence from academic research on another actor or organisation".¹² RCUK gives a useful overview of research impact:
- "Impact is the demonstrable contribution that excellent research makes to society and the economy. Impact embraces all the extremely diverse ways in which research-related knowledge and skills benefit individual, organisations and nations by:***
- fostering global economic performance, and specifically the economic competitiveness of the United Kingdom***
 - increasing the effectiveness of public services and policy***
 - enhancing quality of life, health and creative output."***¹³
- 2.6 The Russell Group's first report on impact defined economic impact as *the effects of research on the long-term economic growth and wellbeing of the nation that benefit organisations, government and the general public*. This definition includes the broader impacts of research including the impact on society, health, the environment, policymaking and culture. The first report focused on the more quantifiable elements of economic impact, including the impacts associated with the commercialisation of research and benefits to business. This report builds on the findings of the first report, and considers those aspects of impact that are more difficult to quantify, including the broader aspects such as:
- Social impact arising from the infrastructure and policy that supports a nation to meet its social needs and improved quality of life, such as health and education systems. Informed public and policy debate can enhance understanding of social and ethical values which contribute to a civilised, democratic and secure society.
 - Cultural impact through stimulating creativity and cultural production, as well as understanding and preserving national cultural heritage. The UK's creative industries and great cultural history are a key factor in the country's attraction as a destination for tourists and business alike. Other benefits come through better understanding of social and cultural values and differences, and being able to challenge areas that are detrimental to social cohesion.

- 2.7 While our definition of 'economic impact' includes social impacts, throughout this report the phrase 'economic and social impact' is used to emphasise the meaning of impact in its broader sense, rather than only directly quantifiable financial impacts from research.
- 2.8 The pathway from research to impact is complex and more often realised through indirect routes than a linear path. There may be many players involved along the way, the time lag before a benefit is realised can be many years, and there is often more than one stage and level of impact. For these reasons, pinpointing a direct relationship between a specific piece of research and a specific outcome is one of the greatest challenges in understanding and assessing research, and this is critically important, for the impact of research is now a significant criterion by which the quality of university research is judged and funded in the UK. The following example illustrates perfectly some of these challenges, which are explored in more detail at the end of this part of the report.
- 2.9 Jonathan Wolff, Professor of Philosophy at University College London, describes an instance where his influence was critical but impact virtually impossible to quantify.¹⁴ Professor Wolff was employed as a consultant to the rail industry as part of a major government initiative to improve safety following the Ladbroke Grove and Hatfield rail accidents. He explains how the industry was under enormous pressure from the media to adopt a new signalling system. Though a new system was actually considered a poor option in terms of rate of return on saved lives, it was a difficult argument to have in the public climate. Professor Wolff's advice was to engage with the public directly to elicit their views, unencumbered by media and other interested parties, and it transpired that the public also did not have a huge appetite for the system (they were far more concerned with proper maintenance than "fancy" technology). So, Professor Wolff's input, amongst that of many others, had a helpful part to play in refocusing the industry's strategy. However, nothing tangible (i.e. a new signalling system) resulted and the final report was never published because of concerns about unwanted media attention.

How Russell Group universities transform research into impact

Building on a civic past

- 2.10 Russell Group universities, from their very inception, have been outward looking and innovative in seeking to maximise their benefit to society. A mission to pursue knowledge for its own sake, to make that knowledge relevant to their communities and to address difficult questions that matter to us all has been central to our universities.
- 2.11 The expansion of universities in the 19th century can be attributed to the growing needs of an industrialising nation, one in which manufacturing and industry was geographically specific, and at the same time was tied into global trade. In emerging cities, local industries moulded the way universities evolved, each meeting needs for specific skills critical to the regional economy. A vision of civic duty and mission to deliver social and economic benefit is the foundation on which they were built and fundamental to the vision of their founders, as the selected histories below show.
- 2.12 The founders of many of our great universities were civic leaders whose vision incorporated a desire to produce a civilised and educated population alongside delivering the skills needed to grow their local economy, and enshrined these aspirations in their university charters. Whilst Chief Executive of Higher Education Funding Council for England (HEFCE), Professor David Eastwood – now Vice Chancellor of the University of Birmingham – noted that "the founders of much of our higher education system, who sought to enable the advancement of learning and the ennoblement of life...were particularly interested in universities' civilising influences and how they could boost economies and transform people within their communities and beyond".¹⁵
- 2.13 As city populations and workforce expanded so grew the need for a trained medical workforce. The very beginnings of many Russell Group universities can be traced back to the Medical Schools built to meet such needs (23 of the Group's 24 universities train doctors). Often the Medical Schools united with other local learning institutions also established specifically to meet the needs of the local industry and communities, and they grew to become the fully rounded universities recognised today from these original seats of learning with a social and economic intent.
- 2.14 This intrinsic mission to benefit society is one that continues today as is apparent in the evidence of Russell Group impact included in this report.



Case study 1 Civic Histories

The foundation of Imperial College London was partly funded by the profits of the 1851 Great Exhibition, which was dedicated to ‘increasing the means of industrial education and extending the influence of science and art upon productive industry’. Leading industrialists saw the benefits of a technical scientific education and provided further financial support for the institutions which merged to form Imperial in 1907. Yet in keeping with the wider aims of the Great Exhibition, these institutions also provided classes, lectures, and museums, which were open to all.

Established by members of the Fabian Society with the help of a society donation, the very founding purpose of the London School of Economics and Politics was the betterment of society, which sought improvements through understanding of the causes of poverty and inequalities in society.

The University of Birmingham was built on the foundations of the Mason Science College, founded by one of the country’s most esteemed industrialists Josiah Mason. Joseph Chamberlain, President of the College Court of Governors, saw the opportunity to build a university as part of his wider vision for the city of Birmingham. Chamberlain’s vision was to establish “a great school of university instruction” so “the most important work of original research should be continuously carried on under the most favourable circumstances” and “the individual trades of the new University [would] forever associate their names and their industry with this new university”.

The University of Leeds can trace its routes back to the Yorkshire College of Science which was founded to meet the concerns of the wool and textile industries and the rapid development of new technologies in Europe which by then were posing a threat to the local industry, and the Sheffield Technical School born out of a need for technical training in local industries, particularly steelmaking.

The University of Manchester, in its current formation, is the Russell Group’s newest university having been created in 2004. However, the history of partnership between its two constituent parts, UMIST and the Victoria University of Manchester, is a long one. Going back as far as the ‘Mechanics’ Institute’ and ‘Owens College’ both founded by local businessmen and industrialists, the partnership has long benefited local employers.

Since its earliest days in the 1960s the University of Warwick has been a pioneer of ‘modern’ universities by seeking industrial-academic links in the manufacturing heartlands of the West Midlands. At the time such an approach was out of favour but the university was always outward-looking and sought to match academic excellence with relevance.

Mechanisms that universities use to deliver research impact

2.15 Research may be translated into social, cultural and economic benefit when there are connections between individual academics and potential users of the research. Universities need to be proactive in building and facilitating such relationships. Russell Group universities offer a broad range of creative schemes and employ a number of different mechanisms to facilitate the exchange between researcher and user, including:

- engaging directly with the public, business and policymakers (examples are given in Case studies 2-4)
- formal partnerships and collaborations with other universities, business and communities, to generate and disseminate excellent new ideas, knowledge and discoveries
- engagement with partners at a local and regional level, whereby Russell Group universities contribute directly to the prosperity of communities and regions throughout the UK
- through global and interdisciplinary networks, through which Russell Group universities address global challenges and have considerable reach.

2.16 There is a strong correlation between the quality of research and quality of impact. An international review of UK research by the Engineering and Physical Sciences Research Council (EPSRC) entitled *The Wealth of a Nation: An Evaluation of Engineering Research in the United Kingdom* found that no research group whose quality was assessed as below world-class had world-class standing in its impact. The review concluded that “it is possible to have high quality without much impact, but it is highly unlikely to have much impact without high quality [research]”.¹⁶ Groups who are most likely to generate world-leading research and world-leading impact exhibit a number of attributes that can be recognised in research-intensive universities, such as excellent people, resources and infrastructure; strong leadership and vision; influence and strong interaction with external stakeholders; the ability to draw on a body of excellent postgraduate and postdoctoral researchers from home and abroad. It is attributes such as these that allow Russell Group universities to generate the greatest impact. The very best research is concentrated in the 24 Russell Group universities: analysis of the 2008 RAE data shows that over two thirds of the UK's world-class research is undertaken in Russell Group universities, which receive 72% of competitively awarded research income (HESA Finance 2010-11).



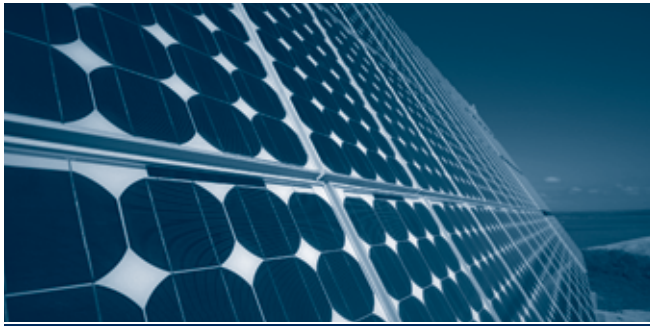
Case study 2

The Great War: Oxford digitisation projects: University of Oxford

There are few of the generation left who remember and can tell the story of the Great War from a personal perspective, but those who lived through the war left evidence of their experiences through personal archives such as family letters, diaries, photographs, films and official documents. The public has a great appetite for remembering the war, as can be seen by the overwhelming participation in the University of Oxford's ground-breaking digitisation initiative, where 6,500 items were collected from the public to become part of a vast digital archive, supported by initial funding from JISC.

The 'Great War Archive' has delivered a fascinating opportunity for the British public to contribute to the collections by encouraging them to scan in images of objects through online submission or in person at roadshows held around the country, from the Orkneys to South Wales. The invitation to submit material was extended to Germany with an overwhelming response. Over 14,000 pieces were submitted in just four days and continue to grow. The project has now expanded further with Europe's digital archive Europeana collaborating with partner national libraries from Germany, Luxembourg, Ireland, Slovenia and Denmark.

The material gathered supplemented Oxford's world-famous online collections of manuscripts and other material related to the War Poets (Owen, Sassoon, Graves, Rosenberg, Thomas, Gurney, Blunden, Brittain, Leighton). With over 12,000 items surrounded by a series of online course material this is now a mainstay of teaching at all Key Stages, and an unparalleled collection for researchers. The archive allows pupils, and the wider public, to understand how the events of the past affected society through experiencing them at a personal level. Commenting on the archive, one year 13 teacher describes how her students enjoy the website so much they even take home printouts of handwritten letters to decipher and have used it to write their own war wiki. The project has created online videos, audio interviews, timelines, mindmaps, and even a display in SecondLife.



Case study 3

Imperial consultants: connecting with business Imperial College London

Imperial Consultants is one of the UK's largest academic consultancy providers. Based at and owned by Imperial College London, it draws on the expertise of the College's 3,000 academics to facilitate quality commercial services for industry, commerce and governments worldwide.

Over the past two decades, consultants have applied their scientific expertise to a diverse range of business-driven challenges. From modelling electric vehicle infrastructure across the UK, to testing solar powered lighting in Madagascar, consultancy can deliver both economic and societal benefits. Closer to home, consultants were involved in the re-design of Exhibition Road, London, which is now an open and accessible space for pedestrians and vehicles.

Acting as an interface between academia and industry, Imperial Consultants provides a professional support service for its consultants, including business development, contract negotiation, indemnity insurance and administrative back-up. The company operates under a self-funded model, channelling profits back into Imperial research and support functions.

Consultancy offers businesses a flexible and efficient mechanism for engaging with a university, whilst giving researchers opportunities to work on real-world problems, which can enhance their research prospects and teaching activities.



Case study 4

Birmingham Policy Commissions University of Birmingham

The University of Birmingham's Policy Commissions bring leading figures from the public, private and third sectors together with academics to generate new thinking on contemporary issues of global, national and civic concerns.

Each commission explores a major policy challenge, in a collaborative format benefiting from the expertise of world-class university research alongside organisations and experts from interested parties outside of academia.

The Commissions host meetings with interest groups and individuals and themed workshops which involve members of relevant communities, business leaders and government officials. Bringing together a wide range of stakeholders and hearing different views allows the Commissions to examine the implications of policy-making for different sections of society and results in innovative and challenging policy recommendations.

Launched in September 2010, the inaugural commission included amongst its members politicians and leaders from local government, welfare, voluntary and development agencies. The commission brought together evidence of past attempts at reform with new research and thinking to generate policy options. The breadth of participants allows the commission to explore what local, state, civic and private actors can do to meet the challenges of designing and delivering local public services in a society that supports individual and collective efficacy, social justice and local democracy.

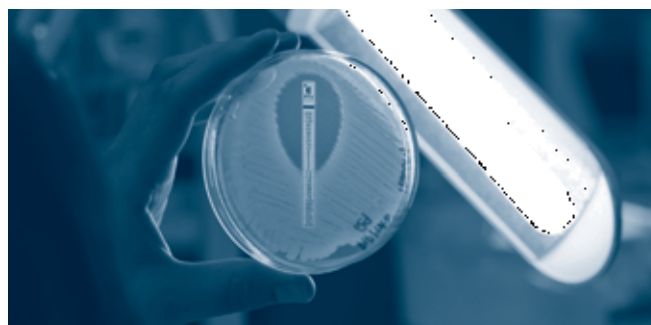
How collaboration and partnerships support impact

2.17 The benefits of collaboration in high-quality research have been well documented.¹⁷ The growth of 'big science' and interdisciplinarity in recent decades requires more specialisation and sharing of knowledge, skills and techniques, and collaboration increases capacity to realise these benefits. Abreu et al "observed that value arises especially where businesses and universities collaborate formally" and that "the process of collaboration is important because this enables the generic academic knowledge to be localised to company specific requirements and application which in turn can then feed back to the generic."¹⁸

2.18 A Royal Society report recognises scientific collaboration as a key component to 21st century science, enabled by a 'shrinking world' of affordable travel and sophisticated communications, and driven by efficiency and sharing of knowledge and resource, but most critically by the nature of the problems modern science seeks to address.

"Today collaboration has never been more important. With human society facing a number of wide-ranging and interlinked 'global challenges' such as climate change, food security, energy security and infectious disease, international scientific collaboration is essential if we are to have any chance of addressing the causes, or dealing with the impacts, of these problems."¹⁹

2.19 The depth and breadth of specialist expertise in leading universities and access to broad-ranging networks delivers an ideal platform for collaboration and partnerships. Collaborations occur across many different disciplines, from health to high value manufacturing, and are between Russell Group and other universities, businesses, and public service providers (Case studies 5 and 6). In biomedical and health research a strong interface with the NHS is critical for innovation and improvements in healthcare practice. Academic Health Science Centres (AHSCs) are all formed around partnerships between healthcare providers and leading universities,²⁰ a model that is recognised worldwide with the potential to deliver transformation in medicine through networks that disseminate knowledge and innovations, at potentially a global level. AHSCs are able to fill gaps in a 'discovery-care continuum', in other words from lab bench to bedside, and from bedside to national or global populations.²¹ (Case study 8)



Case study 5 Translational Medicine: Wellcome Clinical Research Facilities

The Wellcome Trust is one of the most significant sources of charitable funding for medical research in the world. After support for experimental medicine was identified as being key to addressing national deficits in clinical research capacity, the Trust established a unique network of Clinical Research Facilities (CRF) to act as UK centres for experimental medicine. CRFs speed up the translation of scientific advances into real benefits for patients. The centres provide significant opportunities for scientists to work more closely with clinical researchers, enabling the development of new therapies and treatments. All 10 UK-based CRFs are based on partnership with Russell Group universities (Belfast, Birmingham, Cambridge, Edinburgh, Imperial College London, King's College London, Manchester, Newcastle, Southampton, University College London).

The Facilities provide a purpose-built environment for patient-oriented research, where clinical researchers have access to cutting-edge clinical facilities, scientific experts and patients. They help to encourage collaborations between basic and clinical scientists helping to ensure that advances in biomedical research feed through into improvements in healthcare.



Case study 6

High Value Manufacturing Catapult

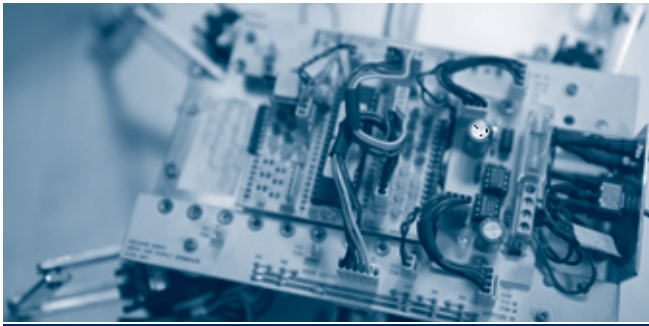
The High Value Manufacturing Catapult draws on excellent university research to accelerate commercialisation of new and emerging manufacturing technologies. Through its partner bodies, businesses are able to access cutting-edge equipment and expertise that would otherwise be out of their reach, and are able to train and up-skill staff. Over 200 business partners are linked with the Catapult across a range of global sectors such as aerospace, automotive, marine, renewable, energy, oil, gas, rail, off-road, nuclear, electronics, chemicals, biotechnology and pharmaceuticals.

Russell Group hosted Catapult partners:

- Advanced Manufacturing Research Centre (University of Sheffield)
- Manufacturing Technology Centre (Universities of Birmingham, Nottingham, Loughborough)
- National Composites Centre (University of Bristol)
- Nuclear Advanced Manufacturing Centre (University of Sheffield)
- Warwick Manufacturing Group (University of Warwick)

2.20 Research is made available to benefit business and society through a variety of avenues, whether through direct partnerships or by making research findings openly available. Russell Group universities are committed to breaking down the barriers for business to access research findings, and helping business navigate the complex arrangements around intellectual property. Details of the 'Easy Access IP' scheme in which the Universities of Birmingham, Bristol, Exeter, Glasgow and King's College London are involved are given in Case study 7.

2.21 Openness to research and scientific data is increasingly important, especially as new opportunities are created by technological advances. Research universities in the UK are actively engaged in seeking ways in which to open up access to their research data and publications, but this is a complex process. It is essential that government policies intended to make rapid progress towards openness and transparency do not put at risk the excellence and international standing of the UK's research base.



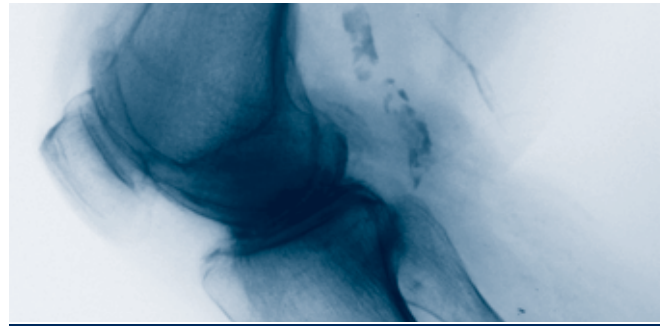
Case study 7 **Easy Access IP scheme**

'Easy Access IP' is a bold initiative that sees valuable university intellectual property (IP) released to companies for free, using quick and simple agreements.

Easy Access IP was established by the University of Glasgow as a completely new approach to maximising the impact of research. Through the scheme companies, particularly small or medium-sized enterprises, are encouraged to exploit the University's inventions for the benefit of the UK economy. Under an Easy Access IP agreement, the University asks for no royalties, seeking only to maximise the speed at which its work can bring benefit to the UK. A range of IP is made available free of charge to businesses and individuals who think they can exploit the technology and are interested in working with the university under special agreements, offering cutting-edge innovation and patents to those who can make best use of the research.

A number of other universities in the UK and around the world have joined Glasgow in the scheme, establishing an Easy Access Innovation Partnership, a collaborative project to promote new ways of sharing intellectual property with industry through increasing engagement between universities and industry, accelerating transfer of university knowledge and expertise into the hands of the best commercial partner who can develop it to benefit the economy and society.

The scheme has received praise from major industrial business, such as GlaxoSmithKline, whose Director of Academic Liaison has praised the transfer of "new technology into the marketplace quicker" and said "this new approach presents another way for universities to drive the development of new technology."



Case study 8 **London AHSC Concordat**

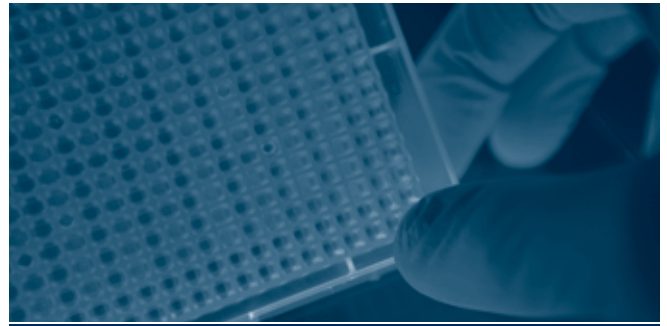
The three Academic Health Sciences Centres (AHSCs) serving London are: Imperial AHSC and Academic Health Science Partnership (AHSP), King's Health Partners and University College London (UCL) Partners. The AHSCs are partnerships between world-class academic medical research schools and leading NHS organisations.

The three AHSCs in London have recognised a significant number of areas of potential synergy in areas of common interest, and wish to develop a closer working relationship in order to promote innovation in areas of strategic importance. The London AHSC Concordat establishes a framework to promote effective interaction between the three AHSCs.

The Concordat encourages and enables the three AHSCs to work together to deliver world-class research, education and patient care for the benefit of Londoners, the public nationally and around the world. The aim is to work together to reposition London as a global leader, attracting talent and inward investment. The immediate focus will be the development of a life science strategy for London, which will address the strategic challenges and opportunities for London. The strategy will be led by the AHSCs and will lay out the areas of focus and rationale for these, the roadmap and the requirements for success.

Regional engagement

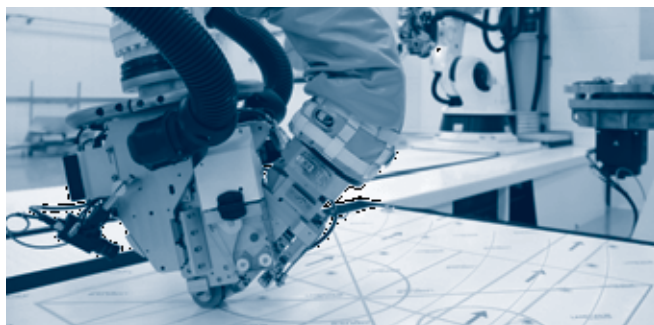
- 2.22 Universities have a long history of contributing to their local economies, and this has often been recognised in the development strategies of local and regional authorities. A report by the Work Foundation (2008) said that “the contribution of universities to regional and local economies is not a new phenomenon. For centuries, universities have had a deep and dynamic relationship with the economic, social and cultural life of the cities in which they are based”.²² In recent years a linear model of funding, where governments fund institutions directly, has been overtaken by what is known as a ‘triple-helix’ model. In this model of funding, arrangements for regional research and innovation overlap between universities, government and industry. The model recognises the importance of innovation to regional competitiveness and economic development.
- 2.23 US research has found that universities act as ‘anchor’ institutions providing stable means for attracting staff and students into the local economy, bringing vitality and intellectual stimulation into host cities.²³ The 2003 Lambert Review of Business-University collaboration recognised an increasingly important role for universities in regional economies. More recently Professor Sir Tim Wilson’s 2012 Review of University-Business Collaboration reiterated the importance of universities as drivers of innovation and growth. The Lambert review found two major trends in business research and development (R&D). Firstly, that private business was moving away from doing ‘secret’ research in in-house facilities and actively seeking a more collaborative R&D model. Secondly, that business R&D was ‘going global’, in other words the location of the research need no longer be geographically linked to the company headquarters, but is often better located in areas where there is already outstanding research. As Lambert found, research-intensive universities act as hubs around which broad research communities thrive, commonly known as ‘clusters’ (Case study 9). Russell Group universities have been proactive in developing regional groupings, such as the N8 Research Partnership, ‘White Rose’ consortium and SETsquared (Case study 10), ‘Science Cities’ and other regional consortia.
- 2.24 Partnerships and collaboration across universities and regional economic and social spheres is particularly important to regional communities and government. Schemes such as Northern Ireland’s *Connected 2 Knowledge Transfer*, Scotland’s *Horizon Fund for Universities and Wales’ Beacon for Wales* give some indication that policy-makers are increasingly recognising the critical role leading universities play in regional economic prosperity (Case study 11).



Case study 9 Clusters

The UK’s highest profile technology cluster, sometimes known as ‘Silicon Fen’, around Cambridge, is host to Europe’s largest concentration of high-technology firms, particularly life science and IT companies. The cluster has developed over the last half century after 1950s local planning policies discouraged large industry but left space in the area around the city for small businesses whose numbers grew, albeit slowly to begin with, over the years. A real breakthrough came when the setting up of technology consultancies, fuelled by the recruitment of academic talent, created a group of people with both a commercial and a technical skills-set. Many of these talented individuals founded start-ups, and so the cluster expanded further in subsequent decades. In 1967 the Cambridge Science Park was established by the university, the very first in England. Cambridge has now become a magnet for international enterprise, as companies vie to be close to world-leading knowledge, bringing significant investment into the region. A 2006 estimate calculated that the impact of the loss of the cluster would equate to at least 42,700 jobs and £1.98 billion GDP.

The University of Manchester has a strong record in health research and its commercialisation. Recently it has embarked upon a series of projects which are building links between clinicians, pharmaceutical companies and medical device makers through University research centres: Biomedical Research Centre, Centre for Integrating Medicine and Innovative Technology, Academic Health Centre. These initiatives sit naturally in the North West region which has a heritage in pharmaceuticals, emerging from chemical industry dating back to late 18th century. Today this pharmaceutical presence underpins a successful and expanding biomedical cluster, housing over 200 biomedical companies. The region is the largest producer of pharmaceutical exports in the UK. Supported by strong links between the University and industry, researchers collaborate with leading global companies such as AstraZeneca, Aventis Pharma, Eli Lilly, GSK and Pfizer.



Case study 10 Regional partnerships

SETsquared is a collaboration between the Russell Group universities of Bristol, Exeter and Southampton and partner universities of Bath and Surrey, that aims to accelerate the growth of innovation and technology businesses to stimulate economic growth in the region's economy. The partnership has a track record of supporting early-stage companies through access to industry specialists, investors and experienced entrepreneurs, and provides opportunities for industry to access academic ideas with commercial potential and develop collaborative research relationships.

The Southern region is home to many leading research-based technology corporates, universities, public-sector research establishments and successful entrepreneurs. It is also within easy reach of London – the UK's venture capital centre. Through SETsquared, the universities support innovation from academics, students and the wider business community, creating an infrastructure around which an entrepreneurial community and culture can develop.



Case study 11 Russell Group universities and knowledge transfer in the devolved administrations

Queen's University Belfast provides a wide range of support and services to business, including the Northern Ireland Technology Centre, helping companies to improve competitiveness through better design and manufacturing; the Polymer Processing Research Centre, assisting plastics companies to develop new products and processes; and QUESTOR, helping companies to address environmental issues that may adversely impact costs, performance and overall competitiveness; the Analytical Services and Environmental Projects Unit, offering an extensive range of analytical and testing services.

The Universities of Glasgow and Edinburgh together are participating in seven projects with businesses which are supported by the Scottish Funding Council's Horizon Fund, and worth a total investment of over £6 million.²⁴ The *Scottish Imaging Network: a Platform for Scientific Excellence*, led by the University of Edinburgh, has identified demand for highly skilled personnel and expertise and is training the next generation of brain-imaging researchers. The University of Glasgow-led project *Developing Crystallisation Science Excellence for Manufacturing Technologies: Oscillated not Stirred* partners academics, SMEs and industry together to position Scotland as a global centre of excellence in crystallisation science, delivering the facilities for revolutionising the way drugs are made.

The Beacon for Wales partnership between Cardiff University, the University of Glamorgan, the National Museum of Wales (Amgueddfa Cymru) and BBC Wales is part of one of the UK's largest public engagement initiatives to foster a better public understanding of university research, such as sending researchers from Cardiff University into schools for a series of lectures and interactive activities based on their research in areas as diverse as climate change and ethical issues around genetics. The Climate Change Educational Resource Pack was developed by academics from Cardiff's School of Earth and Ocean Sciences to help secondary schools deliver stimulating lessons and is backed by freely available online material.

Global challenges

- 2.25 Research in leading universities is addressing questions that are facing many countries across the globe, like how to manage climate change; how to feed a growing global population; how to deliver economic growth in a sustainable manner; how to eliminate poverty; how to improve human rights, gender equality and access to education; how to eradicate epidemic disease, decrease mortality and improve quality of life.
- 2.26 Questions such as these are often described as global challenges, important to all nations and cutting across national boundaries. Addressing such enormous topics requires an ambitious approach, drawing on a wide range of expertise from centres of excellence across the UK and globally, understanding the long-term historical context and being able to anticipate the future trends.
- 2.27 Major research-intensive universities offer many of the attributes needed to undertake complex and often expensive research into these global challenges (Case study 12). They have the critical mass and breadth of expertise needed to deliver excellent interdisciplinary programmes; connections to a vast global community of scholars and research users; the infrastructure and technical know-how in place to house state-of-the-art equipment that cannot be replicated in less research-intensive institutions, and where equipment is not on-site, they have access to shared facilities.²⁵
- 2.28 The Royal Society has called for research funding, which it says remains highly discipline-based, to support the collaboration needed to deliver challenge-led research, mixing basic science with near-market innovation.²⁶ Research funders are moving increasingly towards funding interdisciplinary, global studies.²⁷



Case study 12 **Grand Challenges** **University College London**

The UCL Grand Challenges – of Global Health, Sustainable Cities, Intercultural Interaction and Human Wellbeing – are the mechanism through which concentrations of specialist expertise across and beyond UCL can be brought together to address aspects of the world's key problems. The UCL Grand Challenges draw on collective talent in order to generate wise solutions – increasingly, in partnership with external agencies – and disseminate these in a compelling manner through scholarly outputs, education, public engagement, translational research, commercial and social enterprise activity, and influence on public policy and professional practice.

They provide an environment in which researchers are encouraged to think about how their work can intersect with and impact upon global issues. The UCL Grand Challenges both nourish ideas naturally arising from academics' concerns and curiosities, and coordinate institution-wide responses to external agenda. They aim to:

- create networking opportunities – to connect academics across UCL's disciplines and foster networks of experts (e.g. through roundtables, town meetings and centrally seed-funded cross-disciplinary institutes)
- provide spaces for debate – to bring together different expertise, perspectives and methodologies in order to provoke new understanding (e.g. through symposia, workshops and public events)
- facilitate novel research – to stimulate cross-disciplinary activity to generate wisdom and societal debate
- improve policy and practice – to enhance economic performance, public service and policy, quality of life, and social justice and equity.

The challenge of evaluating impact

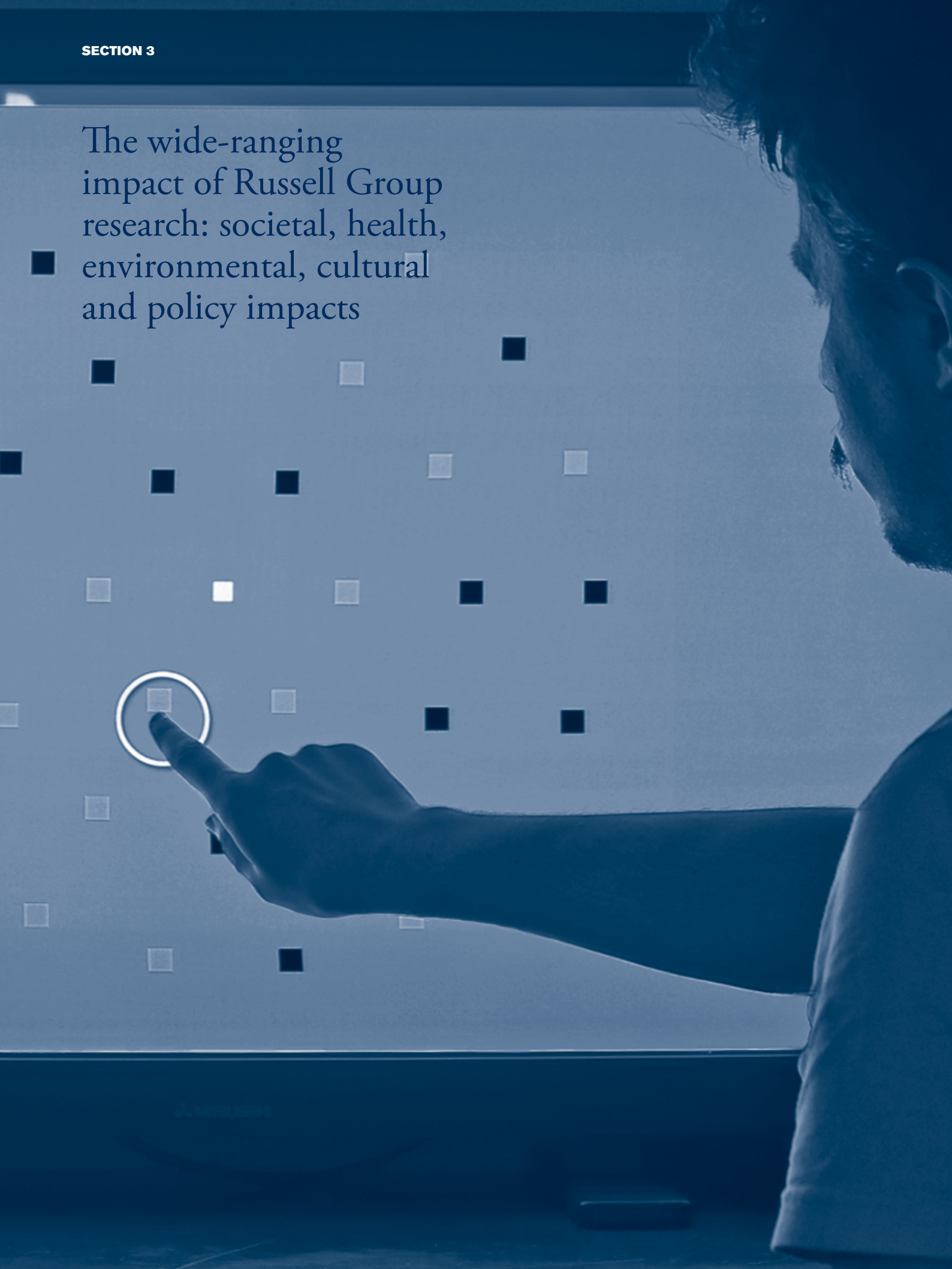
- 2.29 Whilst our universities and researchers pursue research impact of their own volition, as the external funding climate is changing the delivery of research with impact is taking on a new level of significance and there is an additional imperative on universities to articulate the value of their research.²⁸ Whilst it is reasonable to ask universities to explain the benefit of public investment in research, it is essential that measuring impact is undertaken with considerable care. Many attempts to measure research quality have found that there is no one way to articulate, measure and evaluate its impact. Russell Group researchers sit at the heart of the debate about defining and maximising research impact.²⁹
- 2.30 A research team from LSE, Imperial College London and the University of Leeds have undertaken a multi-year project funded by HEFCE that aims to demonstrate how academic research in the social sciences achieves public policy impacts, contributes to economic prosperity and informs public understanding of policy issues and economic and social changes. Recognising that metric indicators such as job creation, patents, or spin-outs are less likely to emerge from social science research, the team are examining and developing methods for measuring impact across varied disciplines. The project is also creating tailored guidance for academics on how to increase their impact and use new technologies such as social media to disseminate their work more widely, including the project's own Impact of the Social Sciences blog which has provided a vibrant arena for challenging, debating, and exploring ways in which to identify, track, and evaluate impact.
- 2.31 It is critical that exercises that assess and incentivise impact take on board the full range of the inter-relationship between research and its benefit. Failure to comprehend the full complexity of the relationship risks driving behaviours that focus on only a small part of the impact spectrum, particularly that which is easily measured and can be delivered within a relatively short time-span.³⁰ As the evidence shows, it is as important to recognise and reward the tacit exchange of knowledge. Effective knowledge exchange demands the capability to apply research knowledge in a way that is relevant to the business context. It is the relationship between the researcher and the 'user' or business partner that allows knowledge to be translated in this way.
- 2.32 In many ways, the UK is well advanced in developing a sophisticated framework for valuing the contribution of higher education to the nation. The introduction of Impact as an element of the Research Excellence Framework (REF) has promoted a lively debate on measuring the benefits of research. Under this new system, discipline-based panels will assess the reach and significance of impact spanning an array of fields encompassing economy, society, culture, public policy and services, health, production, environment, international development, quality of life, commerce, creativity, practitioners and professional services, law, education and public discourse, and impact from engaging the public with research. However, as the Chairs of the panels in a REF Impact pilot exercise noted "the assessment in the first full REF will still be developmental".³¹
- 2.33 In the US investment in science was a critical element of the 2009 economic stimulus package. However, there was hesitancy about measuring the impact of science because of the difficulties in understanding the mechanisms through which research investment and its outcomes interact with society and the economy.³² Thus the methodology developed to demonstrate the value of investment in science, STAR METRICS, has been limited initially to collecting, measuring and assessing metric indicators of job creation.³³ Previously, New Zealand and the Netherlands had seen the most developed attempts to evaluate impact alongside research quality assessment. Still both systems focussed principally on the direct economic impact of research, though the Dutch system did seek data on societal impact and the New Zealand system included contextual descriptors of engagement beyond academia.³⁴
- 2.34 In Australia, efforts to evaluate research impact through the Research Quality Framework (RQF) were the first significant international attempt by a government to extend noticeably the definitions of research impact, categorising research benefit into four areas, social, economic, environmental and cultural, recognising the limitations of more traditional evaluations of research impact. However, the RQF was never implemented, hampered by a failure to agree on definitions and evaluation methodology.³⁵ Its fate is perhaps unsurprising when considering the variety and complexity of relationships between research and impact.
- 2.35 Translating research into impact is complex both in terms of the actual process, and also to account for. Studies show that the pathway from research to innovation to impact is likely to involve a number of inputs from different sources and at different points in time. It is not always possible to attribute impact directly back to a single piece of research or individual input. Impact may arise from a series of factors of which a particular piece of research is only one, intertwined with others.
- 2.36 In some instances, the impact of research may not be highly visible, for example when it prevents a potentially damaging change such as the implementation of a poor policy proposal. In extreme cases, it may even be that the impact of research is buried and can never be credited. An Institute for Government report found that research which was less than flattering to politicians has, in some cases, been played down or suppressed.³⁶ Attributing

SECTION 2 – FROM RESEARCH TO IMPACT

accurately the direct contribution of a particular piece of research to a particular impact is fraught with problems. The Campaign for Science and Engineering (CaSE) has argued that “measures of prior impact or predictions of future impact...should be applied with caution and not used to compare value across sectors. Different time scales, units of measurement, intangible gains, and levels of predictability make it hard to measure past performance, let alone assess the likely success of future work”.³⁷

- 2.37 The importance of taking a long-term view is critical to supporting the nation's research infrastructure. Significant time lags between research and its impact are the norm. It is the nature of research that it is iterative, that it does not stand still, and will continue to push boundaries during its lifespan. A study of research into cardiovascular disease found that it takes on average 17 years for basic research to be translated into treatment benefits.³⁸
- 2.38 Difficulties such as those described above show how vital it is that methods of assessing research impact are fair, accurate and robust. The decision to use case studies in the REF recognises some of the challenges faced in impact evaluation. Using case studies, it has been argued, allows for “a more broadly conceived notion of impact, which probes various dimensions of the economic, social, and environmental returns from research [demonstrating] sensitivity to the definition of impact which varies with the perspectives of...end users”. Studies have shown that case studies are one of the most effective means of explaining the benefits of research, with a particular advantage that they are more suited to demonstrate the complicated pathways between research and its impact. For these very reasons case studies are also used in many fields where a considerable amount of impact evaluation is undertaken, such as international development.³⁹
- 2.39 Case studies are one of the most beneficial methods of capturing the complexities of research impact. The following section of this publication presents a varied selection of examples, exploring some of the many ways in which impact is realised. The nature of impact and the way in which it is delivered, discussed above, is closely related to those who benefit from the value of research. The case studies in this publication show that the UK's major research-intensive universities interact with an extensive population of stakeholders, from the ‘man and woman in the street’ to the highest levels of political influence, and in ways that deliver impact in economic, social and cultural dimensions.

The wide-ranging
impact of Russell Group
research: societal, health,
environmental, cultural
and policy impacts



We live amidst an extraordinarily challenging economic environment and a level of global connections and challenges of an unprecedented scale.

Valuing the broader impact of research

- 3.1 We live amidst an extraordinarily challenging economic environment and a level of global connections and challenges of an unprecedented scale. The Royal Society has described a scientific landscape in which investment in science and innovation is essential to recovery from global economic crisis, in which the UK faces increasing competition from new global players such as China, India and Brazil, and in which enormous challenges of food security, climate change and food inequality will shape the coming century.⁴⁰ This section presents a selection of case studies that demonstrate just some of the many ways in which the research undertaken in Russell Group universities has the potential to make a valuable contribution to tackling these challenges.
- 3.2 Our definition of 'economic impact' includes social and cultural impacts that improve quality of life across many aspects, such as health, education, the environment, social and ethical values, creative production and cultural understanding. In truth much of the impact of university research will have both financial and wider benefits, such as when research leads to new products and services that benefit health or the environment whilst also generating income or savings.
- 3.3 For example, medical research delivers economic as well as health benefits. A report by the Academy of Medical Sciences (AMS) argues that medical research can "create new jobs, catalyse sustained economic growth and restore public finances by improving health and by making the NHS and public services more cost effective".⁴¹ Many OECD countries have sought to quantify the economic impact of their publicly funded healthcare research. Yet the difficulty in linking healthcare developments to discrete lines of research, and the diverse nature of these economic benefits create difficulties in measuring impacts. A report for the WHO summarises much of the literature in this area, and focuses on four broad approaches to understanding the economic impact of health research⁴²:
- savings in treatment costs resulting from new treatments or vaccines
 - economic benefit through improving the productivity of the workforce
 - gains resulting from the development and marketing of new products
 - the intrinsic value associated with human life, and the impact of research upon this.
- 3.4 Our earlier report demonstrated how the UK economy benefits greatly from the fruits of excellent research though elements of wealth creation such as commercialisation of new products, job creation and attracting inward investment. Industry benefits from research in other ways too, such as improvements to business processes that, for example, combine economic and environmental benefits, such as reduction in the use of natural resources and cutting waste, and developing technologies and mechanisms designed for complex and dynamic environments. (Case studies 13-15)
- 3.5 Members of the public may feel that they are far removed from what happens in universities, and that 'science' is something for men and women in white coats, but this is far from the truth. Active participation of user groups helps shape research through direct involvement, ensuring that the outcomes of the research meet their needs. We all benefit from excellent research, for example, from the way policy evidence informs legislation that protects our planet, to individual experiences as NHS patients or by enjoying a national wealth of culture. (Case studies 16 and 17)
- 3.6 Research improves quality of life for all, has an impact on individuals, indirectly and directly, and has an extremely important influence on the development of the policies which shape parts of our economy, our culture and our society. The impact of Russell Group research cuts across all of these spheres, and the case studies presented in this report offer a small selection of the richness and diversity of Russell Group research.



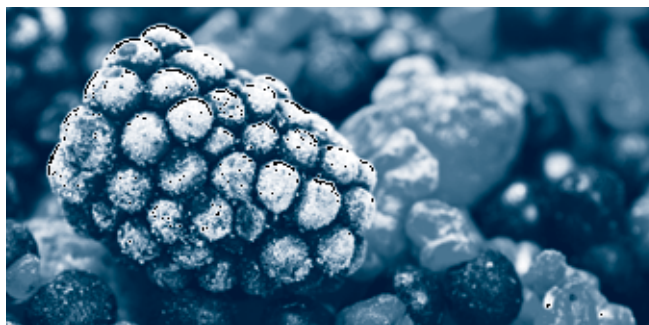
Case study 13 **Water filtration** **University of Liverpool**

In 2000 the EU Water Framework Directive came into force. The directive was aimed at encouraging companies to keep costs down by cleansing and re-using water instead of 'pouring it down the drain'. However, the directive had significant cost implications for companies who discharge large volumes of waste.

Working with the University of Liverpool, Industrial Purification Systems Ltd. (IPS), a Merseyside company has developed filtration equipment with a special turnkey system which is used in industrial processing to remove microscopic matters from high volumes of process effluent. The system creates clean water which can be re-used over and over.

In 2002 IPS became distributor for a US developed filtration system. They realised there was scope to optimise its design and that to achieve this they would need input from specialists in fluid mechanics. This led to a successful Knowledge Transfer Partnership (KTP) bid with the university to fund a research project to design and test a new filtration model. Following the success of the first project, a second KTP award was won to take the research further.

The technology developed through this project is used widely in several countries to re-process sewage either for discharge back into rivers and oceans or to be recycled back into utility systems. The application of this research is enabling companies to control energy consumption and save costs at the same time as reducing environmental impacts on local water systems.



Case study 14 **Food chilling technology** **University of Glasgow**

The UK produces around seven million tonnes of food waste a year, with a large proportion coming from the production and supply chain. Northern Foods, one of the UK's leading food producers, was losing over £0.5 million worth of food during testing. Traditionally, testing food products for safety and quality has been done using probes, which render food products unsuitable for sale. Seeking a non-invasive alternative, Northern Foods turned to the University of Glasgow and Loma Scientific, a leading manufacturer of specialised monitoring and measuring instruments for the food industry.

The Microwave and Astronomy group within the university's School of Physics and Astronomy uses expertise in microwave and high-frequency techniques to research a wide variety of applications in industry, medical research and clinical medicine. One is a non-invasive temperature monitoring technique known as microwave thermography or radiometry, used in medical applications for measuring the temperature of the human body.

The university was able to develop prototype instruments to measure quickly and accurately the microwave temperature of the thermal energy emitted by the food product. These were thoroughly and successfully tested for reliability, stability and accuracy of measurement in a range of food products in realistic production conditions. Loma Scientific then agreed to manufacture and market the technology. Loma Scientific now produce the instrument under the name of 'Celsius' and market it worldwide.

The benefits of reduction in waste, increased safety from continuous monitoring and general cost savings mean Northern Foods no longer spends large amounts of money on traditional temperature testing methods. Other chilled food producers have also adopted the Celsius product, such as Patties Foods Ltd which is the largest pie manufacturer in Australia, producing over 30,000 tonnes of goods each year. As a result they save as much as \$18,000 a year due to waste reduction, while the quicker temperature measurement has also impacted on the efficiency of packaging.

SECTION 3 – THE WIDE-RANGING IMPACT OF RUSSELL GROUP RESEARCH: SOCIETAL, HEALTH, ENVIRONMENTAL, CULTURAL AND POLICY IMPACTS



Case study 15 **ALADDIN** University of Southampton

An award-winning, collaborative project led by the University of Southampton has been using technologies ranging from computer modelling to automated robots to investigate ways to improve the understanding of constantly changing scenarios. The ALADDIN (Autonomous Learning Agents For Decentralised Data and Information Networks) research programme is a multi-million pound multidisciplinary strategic research partnership joint funded by BAE Systems and the Engineering and Physical Sciences Research Council and run in conjunction with researchers from the Universities of Bristol, Oxford, and Imperial College London.

Emergency situations place complex communications systems including multiple agencies, under severe strain. ALADDIN focuses on developing techniques and technology to overcome the challenges facing different agencies involved in an emergency response. For example, it can ensure a more effective response and improve the safety of men and women working in 'danger zones' or aid the safe evacuation of people from dangerous buildings after an earthquake.

The multi-agent toolbox developed by the ALADDIN researchers is applicable across a range of data and information applications, such as networked defence systems. BAE Systems is now integrating ALADDIN technology to improve a range of applications.



Case study 16 **OPAL** Imperial College London

Open Air Laboratories (OPAL) is a research programme that seeks to increase public understanding of the natural environment and the pressures faced from pollution, the loss of biodiversity, and the impacts of climate change. OPAL is led by Imperial College London and involves nine academic partners including six Russell Group members, and five leading environmental organisations.

OPAL employs Community Scientists to work with and train community groups. They have been essential to OPAL's success; it has been the Community Scientists who have built relationships with groups and individuals, including hard-to-reach and disadvantaged groups, and helped them to improve their understanding and develop their skills in biological monitoring and recording. Working together in this way facilitates dialogue, demonstrates research methods and makes research relevant to everyday life, helping to demonstrate the role that universities play both locally and nationally.

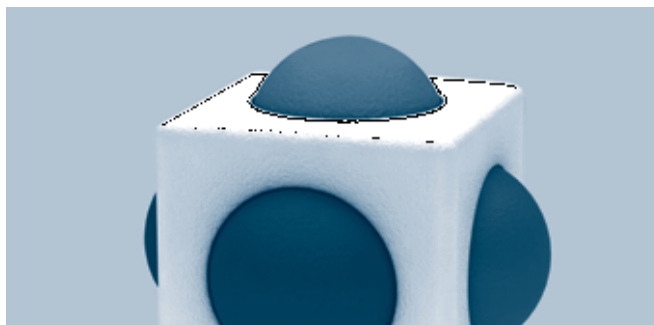
Since beginning in 2007 OPAL has engaged with more than 600,000 members of the public. A further 1.4 million visitors have used OPAL-funded websites. In order to gauge the impact of OPAL's work a range of mechanisms have been employed, from event and web-based questionnaires, focus groups, interviews led by social scientists, case studies, testimonials and online open text boxes.

Initial findings suggest participants appreciate and are encouraged by the fact their efforts will contribute towards 'real' scientific research that may inform policy. Engagement with schools and educators has confirmed a strong desire for outdoor learning activities and children greatly enjoy spending time outside exploring nature using the OPAL field packs and contributing their data to the national database. The OPAL Community Environment Report, detailing the first four years of results and the impact of OPAL's work with communities, will be published in 2012.

Society: the impact of Russell Group research on social cohesion and social infrastructure

- 3.7 Research contributes to our society as a whole, and there are clear examples of the way in which the pursuit of research has an impact on our economic and social welfare. A recent Arts and Humanities Research Council (AHRC) report highlights the role of arts and humanities research in influencing our society's 'civic capital' – the combination of social infrastructure, for example in areas such as health, education and policing, and the tacit knowledge which gives that infrastructure context and value.⁴³ Research from Russell Group universities has provided fundamental understanding which has helped design and drive policy and practice in many of these areas. (Case studies 17 and 18)
- 3.8 Research enhances the knowledge base of our society, introducing new perspectives to cultural and ethical debates. In doing so it reaches beyond the codified knowledge unique to academia, disseminating expert knowledge in ways that are relevant, accessible and of value to a wide audience. The AHRC study found that “arts and humanities research is responsible for the preservation of aspects of UK society and life that its citizens regarded as essential”, and interestingly, the impact of such research is felt not only in a positive aspect, but that “impacts also subsist in preventing the loss or deterioration of something valued”.
- 3.9 The research conducted in our leading universities is unquestionably regarded as world-class by the international scientific community, and, through the activities of Russell Group universities and their academics, it has also had a profound impact upon the knowledge, skill base and behaviour of society as a whole. Our universities' research has improved society's understanding of the consequences of human activities on our climate: the dissemination of this store of knowledge has already raised awareness of climate change issues, and our willingness to reduce our energy use and actively pursue a lower carbon lifestyle. (Case study 19)
- 3.10 The broader contribution which research makes to a 'civilised' society, from exploring questions on the origin of our species and our universe to pondering the models of a successful multi-cultural society, is undoubtedly vast. Through exploring our cultural norms and researching their history, basis and role in society, research has led social debates on our ethical values, making a vital contribution to fundamental shifts in attitudes and policy and promoting a stable and progressive society (Case study 20). Human rights research is one such area that exemplifies links between research and the tenets which underpin a modern democratic society. Research in law, social sciences and philosophy undertaken by the UK's research-intensive universities has been integral to the development of human rights legislation within the UK, Europe and around the world.
- 3.11 Advances in science now go hand-in-hand with research in social science and the humanities – stimulating ethical debate, changing attitudes and increasing acceptance of scientific progress. The significant Government investment and growth of research in this hugely important area of science has been facilitated by a permissive legislative environment, for example on stem cell research an environment which has been determined by an ethical debate informed by leading research from Russell Group universities. Professors of Law at the Universities of Sheffield and Glasgow have acted as special advisers both to the House of Lords select committee enquiry of 2001 and to the more recent joint select committee inquiry on Human Tissues and Embryos, making vital contributions to the debate. (Case study 21)

SECTION 3 – THE WIDE-RANGING IMPACT OF RUSSELL GROUP RESEARCH: SOCIETAL, HEALTH, ENVIRONMENTAL, CULTURAL AND POLICY IMPACTS



Case study 17 **Skoog** **University of Edinburgh**

Learning to play a musical instrument is something many young children enjoy, but for some severely disabled children who may find it difficult to play traditional instruments the developmental benefits that come with creating music would be out of reach. When an extensive grassroots consultation exercise identified music as a tool for improving learning engagement in children with profound physical and learning challenges, a multidisciplinary team of researchers at the University of Edinburgh, collaborating with the National Endowment for Science, Technology and the Arts (NESTA), set about developing an instrument that can be played by anyone.

The instrument they designed, known as Skoog, is a colourful, squeezable cube, sensitive to the slightest touch, yet robust enough to resist strong handling, allowing children who are severely disabled to play music in an expressive way. Technology within the instrument's soft, tactile surface, converts the way the Skoog is touched into the sound of different instruments through links to a computer. As a result, users can play a variety of sounds on the Skoog and alter pitch, timbre and volume using just a very small range of movement. By squeezing, pressing, rolling and pinching the Skoog, children (and others) can easily create notes, chords, musical sounds like the strum of a guitar, the smooth swell of a clarinet or the dance of a flute.

Now, Skoogs can be found in schools, hospitals, care facilities, and concert halls, and are enjoyed by children, adults, musicians, composers, therapists, families and even Special Olympians all around the world.

When a Great Ormond Street Hospital (GOSH) technologist won a Skoog in a prize draw he said: "We are delighted to have a Skoog at GOSH and are sure it will be an invaluable tool in our assessments. We envisage it providing a lot of fun for our children and young people – and probably the staff, too!"⁴⁴



Case study 18 **Addressing sectarianism in early years education** **Queen's University, Belfast**

Researchers at the School of Education at Queen's University Belfast have made a major contribution to early years education in Northern Ireland, and in particular to the way it has been used to counter sectarian thinking among young children.

Professor Paul Connolly co-authored a report in 2002 which provided the first concrete evidence in Northern Ireland that the roots of sectarianism were laid down in the very early years. His research prompted discussion and eventually the formation of a joint working group comprising Queen's academics, practitioners and community relations activists.

The group developed a series of advertisements using cartoon characters designed to treat 'difference' in a positive way. These are reinforced by a resources curriculum package, a special training for early years teachers and resources for parents. Professor Connolly evaluated the impact of the work in 2006, and, such was the success of the programme, that similar interventions have been implemented at all levels of early years education within Northern Ireland. New advertisements, dealing with bullying and the treatment of Irish Travellers, were commissioned by the Children's Commissioners for Northern Ireland and the Republic of Ireland and have been run every year since.



Case study 19 **PURE** University of Glasgow

PURE - PASCAL Universities Regional Engagement - has been running since October 2008 under the auspices of PASCAL, an international observatory aiming to promote the exchange of best practice, ideas and policies about place management, social capital and learning regions, responding to demand for expertise which can be mobilised quickly to respond to a variety of development needs, maintaining some 60 accredited experts around the world.

PURE maps the ways in which the university sector is contributing to community services in different areas around the world, sharing this information with other regions. There are currently 17 participating regions in Europe, Africa, Australia and the US, creating connections that can promote the exchange of ideas.

Experts work with each region, analysing their current methods and then produce an action plan for activities they might wish to engage in. The possibilities for exploitation are far-reaching, making PURE relevant to a remarkably wide range of users. "There's a big interest, for example, in ways in which the university sector can contribute to the green economy," Professor Osborne says. "Green skills for green jobs. For others, it's the challenges that can be presented by geographical isolation in some of our rural areas. Or the role of the university in the cultural development of the city. Once people have decided what they're interested in, we work on creating interactivity between them. That's where technology comes in."

PURE has created its own virtual learning environment which is broken down into thematic areas of interest. All the regions involved are granted access to it. Exchanges can be through traditional text-based material, or via PC-based video conferencing and users can engage in 'cluster-based' discussions between groups. The combination of text, video and audio to deposit and access materials has created an interactive web environment which brings people together to communicate and share common interests, best practice, ideas and policies. More importantly, it allows expertise to be tapped into quickly to meet emerging needs.



Case study 20 **The London living wage: putting an end to working poverty** Queen Mary, University of London

The number of employees receiving a living wage has grown enormously over the last decade thanks to dedicated campaigning from London Citizens. Professor Jane Wills at the School of Geography, Queen Mary, University of London, has worked alongside London Citizens on the living wage campaign since it was launched in the UK in 2001, when she mapped the extent of low pay in east London, and helped to identify targets for the campaign.

Professor Wills' research has charted problems faced by poorly paid workers, and explored the way that pay relates to health, educational achievements, parenting, and family life. The research has shown that significant benefits arise from paying the living wage: employers can expect reduced labour turnover, reduced sickness and better service standards, and workers are found to have better psychological health.

Queen Mary is a founding partner in the new Living Wage Foundation, alongside Save the Children, the Resolution Foundation, Trust for London, Linklaters and KPMG. The Foundation provides strategic advice, financial support and endorsement to the idea of the living wage and runs the Living Wage Week and annual Living Wage Awards, hosted by KPMG and the Mayor of London.

Campaigns from London Citizens, which are underpinned by Wills' research, have led to major corporations such as KPMG, Linklaters, Allen & Overy, Slaughter and May, HSBC and Barclays paying the Living Wage. In addition, many local authorities now make the Living Wage a mandatory element of their procurement policies and all London 2012 Olympic and Paralympic jobs were paid at a Living Wage. London Citizens calculate that the Living Wage campaign has lifted 15,000 low-wage workers out of poverty.

SECTION 3 – THE WIDE-RANGING IMPACT OF RUSSELL GROUP RESEARCH: SOCIETAL, HEALTH, ENVIRONMENTAL, CULTURAL AND POLICY IMPACTS



Case study 21

Russell Group research and bioethics Universities of Liverpool, Newcastle, Bristol

The combination of world-class biological and medicine sciences research, together with leading research in humanities disciplines such as philosophy, history and social sciences, has enabled many Russell Group universities to have a major impact on the social and ethical debates which often occur at the boundaries of these disciplines. Biomedical ethics in particular is an area on which Russell Group institutions have had a major impact, ever since University of Cambridge medics helped create the world's first 'test-tube' baby.

The Institute of Translational Medicine at the University of Liverpool targets schools through awareness-raising for teachers around the ethical and legal considerations of using animals in research, which can include visits to animal housing facilities. In partnership with AstraZeneca, the Department also supports a programme whereby PhD students visit schools to discuss with pupils how and why animals may be used in research.

The Policy, Ethics and Life-Sciences (PEALS) centre at Newcastle draws on research expertise from across the university's biological sciences, social sciences and philosophy research base in order to bring the latest research-informed thinking to a wide audience. The centre's researchers have made significant contributions to the public and political debate on the ethics of stem cells in research, as well as conducting projects with local communities to address other issues in bioethics: for example, the 'How Gay are Your Genes?' project was unique in working with members of Newcastle's Gay, Lesbian and Bi-sexual community to explore issues concerning the genetics of sexuality.

The Centre for Ethics in Medicine (CEM) at the University of Bristol hosted the Young People's Research Ethics Committee (YRec) project, which sought to engage young people in thinking critically

about science and ethics, and help inform the development of effective approaches to incorporating ethical debate within the science curriculum. The project developed teaching materials and methods in conjunction with young people and teachers. It also produced a number of findings which were pertinent to the development of the secondary science curriculum, which were disseminated to teachers, the science education research community and to the Government.

Health: the impact of Russell Group research on wellbeing and medicine

- 3.12 Academic research has long played a role in improving health and increasing longevity, creating advances in medicine and healthcare through a number of mechanisms. Research has underpinned major new treatments and healthcare interventions, such as the discovery and development of penicillin, and the development of in vitro fertilisation and the world's first 'test-tube' baby, both of which originated from research within Russell Group institutions.
- 3.13 Russell Group universities have been at the forefront of major medical innovations such as the development of software to interpret Electrocardiograms in heart disease (at the University of Glasgow); the use of humanised forms of monoclonal antibodies to treat cancer (pioneered by Scientists at the MRC and the University of Cambridge), and the development of MRI scanning (at the University of Nottingham). These and many other innovations have revolutionised healthcare within the NHS and around the world, improving treatment, and saving billions of pounds for the UK taxpayer.
- 3.14 In malaria research it is possible to see how there can be multiple routes to finding solutions to goal-based problems. Research has components which can address the parasite directly, components which address the parasite's habitats, and vaccines which address the host. Any and all of these different pathways can play a critical role in preventing and treating disease, but it is not always possible to predict which will be effective over time, and so researchers will remain open to following new avenues of research. (Case study 22)
- 3.15 The impact of research on improving treatment practices, identifying new targets for further investigation or improving our understanding of the impacts of lifestyle upon disease conditions, improve the health of the nation. Modern healthcare is concerned with identifying, diagnosing and treating disease, and seeking ways to improve the wellbeing of populations, as well as non-medical aspects, where health is less a medical than a social problem. Research that improves our understanding of medical conditions, the impact of lifestyle and diet on human health, and our management of disease creates far-reaching benefits for public health and optimising healthcare delivery. (Case studies 24 and 25)
- 3.16 The discovery of every new treatment and medication comes with a cost attached. Public health research draws together the social, economic and biological determinants of health. This multidisciplinary approach, which uses research from the clinic, the laboratory, the community and the political arena, can help understanding of how social and economic factors determine access to healthcare across the population, or analyse the cost effectiveness and value of health intervention to make sure that finite resources are used to best advantage. (Case studies 26-28)
- 3.17 Research at Russell Group universities plays a key role in shaping public health policy. Research at the University of Cambridge on obesity and nutrition has challenged much of the accepted wisdom on the causes of obesity, including the idea that different rates of metabolism were a primary cause of people becoming overweight. At Cardiff University, research established a link between coal dust and miners' chest disease; University of Liverpool researchers showed that treating postnatal depression improves the lives of children. Russell Group research has improved our understanding of how lifestyle choices, particularly smoking, can increase the risk of conditions such as obesity, type 2 diabetes, heart disease and cancer. (Case study 29)



Case study 22

Malaria

Universities of Liverpool, Oxford, York

Russell Group scientists are making cutting edge discoveries that help tackle health epidemics on a global scale.

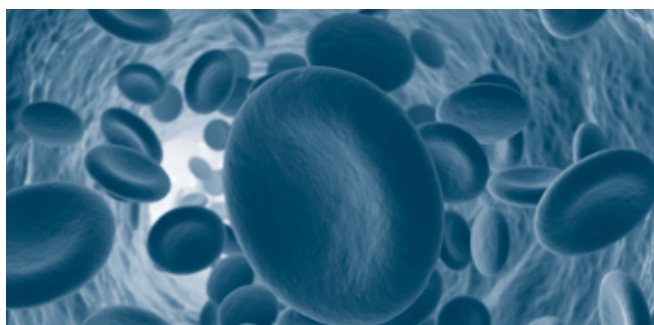
Research conducted at the University of Liverpool has contributed to possible new treatments for malaria by comparing the similarities between malaria and cancer. The malaria parasite is able to develop resistance to drug treatment, including the drug Fansidar, making the disease difficult to treat. Vitamins called folates are essential for cell multiplications, which is why antifolates are used to treat cancer. Comparing the way folates function in malaria and cancer has enabled a better understanding of their role in resistance to antifolate malaria treatment.

Fansidar has been the most widely used antifolate, but it is no longer effective in many parts of Africa because of resistance. Dr Alexis Nzila who is now based at Oxford and the Kenyan Medical Research Institute was awarded the prestigious Royal Society award in 2006 for this research. 20 million Kenyans are regularly exposed to malaria, malaria mortality among the under-fives is estimated at 26,000 deaths a year and an estimated 170 million working days are lost each year in the country [Ref: 2006 data].

At the University of Nottingham scientists have discovered that over a third of the 72 molecular switches that control the three key stages of the malaria parasite can be disrupted.

With the malaria parasite becoming increasingly resistant to existing drugs and vaccines the race to find ways of blocking the transmission of malaria is critical. Using systematic functional studies to broaden understanding of the complex development of the malaria parasite this research offers a rational approach towards drug development, and is a significant breakthrough in the battle to provide cost-effective vaccines to halt the spread of the disease.

The Centre for Novel Agricultural Products (CNAP) at the University of York is developing new, high-yielding varieties of *Artemisia annua*. This medicinal herb is the only source of the main frontline treatment for malaria, artemisinin, but crop yields are low and demand for the drug is soaring. Researchers at CNAP have produced the first genetic map of *A. annua* and used their detailed understanding of how genetics relates to performance to accelerate plant breeding for desirable traits. New varieties have been shown to be competitive in a programme of rigorous field trials and hybrids are now being taken forward by East-West Seed International, CNAP's commercialisation partner.



Case study 23 **Hypertension in the Very Elderly Trial (HYVET)** **Imperial College London**

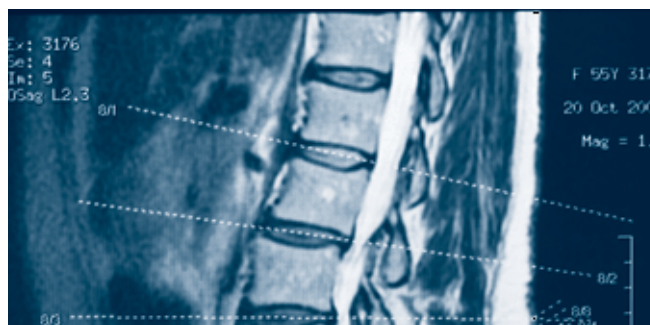
Led by Professor Christopher Bulpitt, HYVET was the largest ever clinical trial to look at the effects of lowering blood pressure solely in those aged 80 and over.

The trial was a multinational academically-led trial sponsored and co-ordinated by Imperial College in partnership with Servier and with funding from the British Heart Foundation but with all aspects of trial design, delivery and dissemination overseen by Imperial staff.

The trial changed the way hypertension is managed in older adults. The results have been incorporated into hypertension guidelines worldwide allowing for specific guidance on how best to manage those aged 80 or more with high blood pressure. Guidelines have been updated in Europe, Canada, Japan, Russia and countries in Latin America. In the UK, the new National Institute for Health and Clinical Excellence (NICE)/British Hypertension Society guidelines for the management of hypertension from August 2011 make specific recommendations for treating those aged 80 or more based on the HYVET results. The new American Guidelines due in 2013 are expected to make similar recommendations.

HYVET was unanimously voted as Trial of the Year in 2009 by the prestigious Project ImpACT (Important Achievements of Clinical Trials) and the Society for Clinical Trials who judged it to be a landmark clinical trial in terms of design, execution, and results. It was designated as one of the best trials of the year by the American Heart Association and Medscape. HYVET has also been identified as exceptional among the 'All time Top 10 list for medicine' compiled by Faculty of 1000 Medicine, an online resource provided by expert researchers and clinicians.

Analyses are ongoing of the data collected and continue to be published. These will help to clarify outstanding issues in how best to manage hypertension in this age group.



Case study 24 **Medic-to-Medic and the Map of Medicine** **University College London**

Researchers at University College London have been able to develop a standardised diagnostic tool which has been implemented across the NHS and healthcare systems in other nations. The experience and expertise which Dr Owen Epstein had amassed through his research and clinical practice at UCL and the Royal Free Hospital London triggered the idea of a universal online tool to help aid diagnosis. He was able to recruit input and expert advice from over 250 clinicians based at the Royal Free Hospital.

The 'Map of Medicine' tool provides an online road-map of common clinical conditions. It uses evidence-based clinical knowledge displayed in an easy-to-use format to help clinicians achieve the optimum diagnosis for their patients, based on the most up-to-date medical knowledge.

By helping clinicians – especially non-specialists, or specialists working outside their field – achieve speedy and accurate diagnoses, the map is achieving significant cost savings for the National Health Service. Key benefits are:

- Improving patient safety: one in 10 patients are unintentionally harmed by their carers, and safety incidents cost the NHS £2 billion a year. Map of Medicine helps treatment plans to be designed based on the latest knowledge and more accurate diagnoses.
- Changing patient care: following evidence-based practice can improve patient care and save costs through reducing hospitalisations, reducing overall hospitalisation time and reducing the need for costly drug treatments.
- Improved planning: by standardising treatment, the Map of Medicine helps managers plan more effectively and achieve more efficient resource allocation.



Case study 25

STORM
University of Manchester

Researchers at the University of Manchester have designed a training package, STORM® (Skills-based Training on Risk Management), for people working with those at risk of suicide and self-harm.

To date, over 500 STORM® Facilitators are delivering training in organisations across health, social care and criminal justice services across the UK, Republic of Ireland, Jersey and Malta. STORM® is also involved in charitable activities delivering free training to mental health workers in Pakistan, Bangladesh and Russia where training is difficult to fund.

STORM® began as a research project in the mid-1990s in response to the need for skills-based suicide risk assessment and management training. The content of the programme, based on what is known of suicide risk, its assessment and management, is delivered through a skills-based model of training underpinned by Adult Learning Theory.

Three studies looked at skills development, effectiveness and feasibility of the training programme. Positive results in skills development for some groups, overall improvements in attitude to suicide prevention and confidence in assessing risk and helping a person stay safe, convinced the researchers that providing this training to organisations was beneficial.

Since 2003 the STORM® Project has offered suicide prevention training packages on a not-for-profit basis for use in the health care, social care, criminal justice and education services. Frontline staff from a range of Adult and Children's services, schools and prisons have benefited from the training with many regarding it highly. Later, the package was developed further with the addition of a self-injury mitigation component and research continues into other areas where STORM® might have benefits such as university staff working with students, occupational health staff with responsibility for mental health and well-being and for others working at the frontline of services across the community.



Case study 26

Liverpool Health Inequalities Research Institute
University of Liverpool

People born in Liverpool can expect to live around three years less than the England average life expectancy; disparities across the city exist too, with differences in life expectancy of around 10 years depending on electoral ward. Responding to these statistics, the University of Liverpool led the Health is Wealth Commission, a body of experts charged with addressing the growing disparity between the city region's economic growth and the long-term poor health of its population.

As one of its principal recommendations, the university established the Liverpool Health Inequalities Research Institute (LivHIR) to provide leadership and excellence in public health research to reduce health inequalities. The LivHIR research programme focuses on the main causes of morbidity and mortality (alcohol, obesity, cancer, mental health and cardiovascular disease) and policies and interventions across the life course (pre-natal through to adulthood). The LivHIR model is to work with research teams, PCT colleagues and other stakeholders to develop research projects and dissemination plans so that findings inform local health strategies and commissioning decisions.

The funding has also allowed research teams to use innovative and multidisciplinary approaches, for example in mental health research where integrating arts and science of the 'Get into Reading' model is becoming more widespread with groups being offered in locations such as care homes, libraries, prisons, mental health drop-in centres, community centres, schools, hostels, refugee centres and workplaces.

Nationally, findings from research funded through LivHIR on children's nutrition in Liverpool daycare settings were included as evidence in recommendations devised by the Advisory Panel of Food and Nutrition in Early Years.



Case study 27

Michael Marmot on social determinants of health University College London

Professor Sir Michael Marmot (UCL Epidemiology and Public Health) chaired the World Health Organization Commission on Social Determinants of Health. In May 2009, the World Health Assembly passed a resolution which charged the World Health Organization to work with countries to follow up the Commission's recommendations, including:

- improve daily living conditions
- tackle the inequitable distribution of power, money, and resources
- measure and understand the problem and assess the impact of action.

Health ministers and senior health officials from 192 countries agreed to:

- call upon the international community to take note of the findings
- collaborate to assess the impacts of policies and programmes on health inequalities
- work together to enhance health equity
- consider health equity as they work toward core global development goals.

A number of countries are now developing national strategies to measure and address social determinants of health inequities. Subsequently, the UK Government commissioned Professor Marmot to carry out a review of health inequalities in England. The report, *Fair Society, Healthy Lives*, found that people living in the most deprived neighbourhoods will on average die seven years earlier than people living in the richest neighbourhoods. Even more disturbing, people living in poorer areas not only die sooner, but spend more of their lives with disability – an average total difference of 17 years. Additionally, the review:

- estimated the cost of health inequalities in England as resulting in productivity losses of £31–33 billion every year
- estimated the cost in lost taxes and higher welfare payments in the range of £20–32 billion per year

- estimated additional NHS healthcare costs well in excess of £5.5 billion per year
- predicted that the cost of treating the various illnesses that result from inequalities in obesity alone will rise from £2 billion per year to nearly £5 billion per year by 2025.

Significantly, the report concluded that, although health inequalities are normally associated with the poor, premature illness and death affects everyone below the wealthiest tier of English society.

The Marmot Review team has worked with local health authorities around the country to help to implement the review's findings. The team also monitors key health inequalities indicators at local authority level. Professor Marmot is now conducting a review of health inequalities and social determinants of health in Europe for the WHO. He has established the Institute for Health Equity at UCL, with support from the Department of Health, UCL and the British Medical Association (BMA).

SECTION 3 – THE WIDE-RANGING IMPACT OF RUSSELL GROUP RESEARCH: SOCIETAL, HEALTH, ENVIRONMENTAL, CULTURAL AND POLICY IMPACTS



Case study 28 **Health economics** **University of York**

Governments spend billions of pounds on healthcare so it is critical that investment translates into improved health, that treatments are effective and safe, that health services are managed efficiently. Researchers at the Centre for Health Economics have developed cost-effectiveness analysis methods that are used worldwide to determine how best to use resources, measuring the costs and benefits of care systematically while taking into account value to patients value and society.

York researchers advised the government on the creation of the National Institute for Health and Clinical Excellence (NICE) and their work is used by similar national agencies across the world. As a result, cost-effective interventions for a number of conditions have been adopted by the NHS.

York health economists have made a central contribution to the measurement of health service performance and productivity, advising the UK government, the WHO and the OECD. York won a Queen's Anniversary Prize in 2007 for its groundbreaking concepts for measuring benefit and productivity, and outstanding contributions to public health policy.

Impact from York health service research has been wide-ranging, from developing guidance which has reduced cancer death rates, to areas such as mental health services, wound care and substance abuse. Research has also led to cost-effective interventions being more widely provided such as the introduction of flu vaccination for all those over 65.



Case study 29 **Smoking** **Universities of Oxford, Liverpool, Edinburgh,** **Cardiff, Bristol, Glasgow, Birmingham,** **University College London**

Smoking remains the single biggest lifestyle factor contributing to increased morbidity and early mortality. It is the biggest single cause of lung cancer, and a major contributor to other life-threatening conditions such as heart disease. Today, we have become accustomed to health warnings and restrictions on smoking in public places as public and commercial policy has become more informed by research. Research at Russell Group universities has made a huge contribution to our understanding of the harmful effects of smoking, and to developing better treatment and public health management in the UK and around the world. The combined effects of this research on reducing smoking-related deaths and morbidity, and improving people's productivity and quality of life, have been enormous.

The dangers of smoking: Seminal studies by Sir Richard Doll and Sir Austin Hill in the early 1950s first established clear links between smoking and lung cancer. More recently, research at the University of Oxford led by Sir Richard Doll and Professor Robert Peto followed up on Doll and Hill's original study, and established unequivocally the major health impacts caused by smoking. They showed that, on average, smoking lowered life expectancy by 10 years, but that life expectancy could be significantly extended by quitting. These and other findings have had a huge impact on smoking-related deaths and ill health: 15,000 people a year continue to die of smoking in the UK, but this is less than half the level in the 1970s, when people were less aware of its dangers.

Smoking and global health: Scientists at the University of Oxford clinical trials unit have helped to coordinate a major international study supported by the Medical Research Council, which has highlighted the public health impacts of smoking in India. The study found that smoking will cause up to a million deaths per year

in India by 2010, and that 61% of men and 62% of women who smoke will die prematurely. The findings will help underpin an important public health message about the dangers of smoking, and may save many lives.

The systematic review at the University of Liverpool was the first meta-analysis to quantify the benefits of smoking cessation for patients with coronary heart disease. Risk of death is rapidly halved. A study by the Universities of Edinburgh and Liverpool showed that despite recent legislation, young people under 18 years still found it easy to access cigarettes and highlighted proxy purchasing as a key source for many young people.

Smoking prevention: Researchers at Cardiff University and the University of Bristol have successfully completed a trial of a peer-led smoking intervention within UK schools, which is already having a significant effect on the way in which smoking education among adolescents is managed. The trial involved almost 11,000 pupils across 59 secondary schools, to study the effect of a novel smoking prevention programme which was led by peers of the target group. The trial found that adolescents were 22% less likely to take up smoking following the new intervention compared with existing interventions. This translates to a 3% reduction in smoking prevalence among 14-to-15-year-olds, or 43,000 fewer smokers if extended UK-wide. The National Assembly for Wales has already invested in the new intervention, and it has also been adopted by Tower Hamlets council and Bristol Primary Care Trust.

Decipher Impact is a 'not-for-profit' spin-out initiative between Cardiff University and the University of Bristol. Established in March 2009, the company is based on intellectual property generated by Professor Laurence Moore (School of Social Sciences, Cardiff University) and Professor Rona Campbell (University of Bristol) during the successful MRC funded (£1.5 million)

ASSIST (A Stop Smoking in Schools Trial) Study which took place in 59 schools across Western England and Wales. The company has generated interest across the UK and since incorporation granted Primary Care Trusts (PCTs) three year sub-licences to deliver the ASSIST training. The whole of Wales is currently rolling out ASSIST as well as 15 English PCTs which have already acquired licenses and have been implementing ASSIST in schools since September 2010.

Informing smoking legislation: Scientists at Russell Group universities have also helped to highlight the public health benefits associated with the smoking bans across the UK. Researchers from the University of Glasgow, the University of Edinburgh and the University of Birmingham all contributed to a series of studies demonstrating the improvements in air quality and health benefits following the ban. Professor John Ayres of the University of Birmingham led a study supported by NHS Scotland which showed that the ban had provided significant health benefits to smokers and non-smokers; University of Edinburgh researchers were able to show that the ban had not harmed children through an increase in smoking in the home. Research by the Universities of Edinburgh and Liverpool found that many parents and carers of young children had successfully introduced home smoking restrictions and influenced friends and family to do the same; a University of Glasgow study showed a 17% reduction in hospital admissions for heart attacks since the ban came into force.

A study by scientists at University College London has also highlighted the significant impact which the ban in England has had on people giving up smoking. The study, led by Professor Robert West at the Health Behaviour Research Unit at UCL, found that smoking levels had dropped by 5.5% since the ban, compared with a 1.6% drop over the previous year.

SECTION 3 – THE WIDE-RANGING IMPACT OF RUSSELL GROUP RESEARCH: SOCIETAL, HEALTH, ENVIRONMENTAL, CULTURAL AND POLICY IMPACTS

Environment: the impact of Russell Group research on climate change, sustainability and agriculture

- 3.18 Just a few decades ago interest in the environment was restricted to a small proportion of the population and some very foresighted scientists. Now efforts by individuals, governments and industry to limit damage to our natural environment have become commonplace (Case study 30). For example, it is becoming the norm for manufacturers to seek innovative technology to cut environmentally damaging practice (Case study 36). And we have started to recognise that providing clean water and food for the world's ever-growing populations is going to be a major challenge for the years ahead. (Case study 31)
- 3.19 Our earlier impact publication highlighted some of the ingenious ways researchers at Russell Group universities have demonstrated success in developing workable solutions to environmental problems.⁴⁵ This report looks at how Russell Group research is having impact by improving our understanding of the environment, and the environmental consequences of human activities – through changing the attitudes of governments and the public toward environmental issues, it has had an even more profound and long lasting impact on our economy and society. (Case study 32)
- 3.20 Ensuring the sustainability of our economic growth, whilst protecting the environment for future generations, is a global challenge. Climate change – changes to the atmosphere as a result of human behaviour or natural phenomena – has the potential to utterly change the world in which we live; understanding its effects and reducing its impact are key strategic priorities for governments around the world. The steps that people and societies can take to prevent further change and to reduce damaging behaviours are one of the foremost challenges to be addressed, as recognised by the Research Councils' cross-disciplinary research programmes. Research has made an enormous contribution to our understanding of the challenges we face and to developing the responses that will help us overcome them. Russell Group universities are at the cutting edge of this research, and lead the world in the effort to combat climate change. (Case study 33)
- 3.21 At the same time, we must meet the needs of today's societies without compromising the needs of future generations. It is critical to understand our natural resources and our biodiversity, when pursuing economic growth. So, for example, reduction in consumption of unsustainable resources through new technologies and improved efficiencies are some of the necessary tools to generate that growth without mortgaging the prospects of future generations. Advancement against environmental benchmarks requires scientific understanding, technological innovation and changes in human and societal behaviours. Through this understanding research can create solutions to key environmental challenges, and disseminate knowledge that alters behaviour, influences policy and provides a base for future innovation (Case study 34).
- 3.22 A PricewaterhouseCoopers study, conducted on behalf of the Natural Environment Research Council (NERC) highlights the significance of environmental research, such as is undertaken in our leading universities, on policy development, on changing public attitudes and in aiding decision-making on environmental issues. It finds that indirect impacts, together with the wider economic benefits, are notably far more frequent than more direct economic benefits.⁴⁵ (Case study 35)



Case study 30
Co\$ting nature
King's College London

Researchers within the Department of Geography at King's College London have developed 'Co\$ting Nature', a tool which places an economic value on natural resources.

The tool was devised in collaboration with the United Nations Environment Programme and is delivered through a web interface, making it easily accessible and allowing policy makers and others to analyse the intrinsic value and benefits of the world's ecosystems which are critical to the delivery of food, water and energy needed to sustain life.

Ecosystems services are critical to delivering the food, water and energy which sustain life, but often go unquantified and unrecognised in decision-making. By using satellite-derived data the tool is able to measure the worth of 'ecosystem services' such as carbon capture, clean water and tourism benefits. Co\$ting Nature allows policymakers to understand where priority areas lie and is used by conservation and development organisations to better understand the value of ecosystem services and the implications of conserving or losing them.



Case study 31
Defending crops with maths
University of Cambridge

In today's multidisciplinary research environment, the protection of the world's food crops does not rely just on the application of basic agricultural and biological sciences. At the University of Cambridge mathematicians and statisticians developed a toolkit to reduce dramatically crop losses from pests and pathogens.

Amidst pressures of population growth and climate-related changes, food security has become one of the 21st century's global challenges. Any significant expansion of productive land is not a credible option, so other methods must be used to increase yields from existing land, and one way of doing so is by minimising current losses of up to a quarter of the global crop production. Outbreaks of disease can sometimes reach epidemic proportions, wiping out entire crops, often with substantial social and economic consequences.

Working in collaboration with the UK Department for Environment, Food and Rural Affairs and the United States Department of Agriculture, the group has successfully integrated fundamental biological understanding of how certain diseases spread into epidemiological models that incorporate data from geographic information systems about landscape and weather. The result is a toolkit that enables end-users to identify the risks and hazards of disease detection, spread and control.

Modelling the uncertainties in crop behaviours is a complex undertaking, but the toolkit allows for these uncertainties to be incorporated into developing models of how disease spreads and, by constantly updating the models as new information becomes available, it is possible to predict the future spread of hazards. What is more, the toolkit generates intelligence on cost-effective management and control of threats enabling strategic and effective use of resources.

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Case study 32 **Centre for Business Relationships, Accountability, Sustainability and Society Cardiff University**

The Centre for Business Relationships, Accountability, Sustainability and Society (BRASS) at Cardiff University has made an important contribution to helping governments and societies to live in a more sustainable fashion.

Research by Professors Terry Marsden and Bob Lee of BRASS analysed the major food supply, modelling trends over the next few decades and demonstrating how the UK in particular can take steps to ensure its food supply remains resilient, sustainable, competitive and able to meet consumer expectations. Their report generated widespread media coverage throughout the UK and, during 2008, BRASS researchers also worked with the Welsh Assembly Government to produce a Local Sourcing Action Plan, 'Food and Drink for Wales'.

BRASS research has also made an important contribution to improving our understanding of the social impacts of climate change: helping to communicate to a wide public audience the way in which behavioural change can help protect against its damaging effects. The 'Climate Change and the Future of Brands' project studied the impact climate change was having on the perceptions and behaviours of consumers. The resulting report from NESTA is entitled 'Selling Sustainability – Seven lessons from advertising and marketing to sell low-carbon living'. Launched in June 2008 to an audience including representatives from government, educators, consultants and organisations working in climate change, it has made significant inroads into the marketing and advertising community. BRASS climate change research work was also presented at one of the 2008 AEA/Wolfson College Oxford seminar series on 'Responding to Climate Change'; and the findings of the future of brands project were delivered to the 2008 Prince of Wales' Business and Environment Programme, attended by managers from some 50 leading UK businesses.



Case study 33 **The impact of Russell Group research on our understanding of climate change**

Russell Group researchers have had a huge impact on our understanding of climate change. Their research has made an important contribution to establishing an international consensus on climate change linked to human activity, and in doing so has helped influence public and political attitudes to the impact of human activity on the environment.

Russell Group universities are at the forefront of climate change research. Research undertaken at partner centres the Grantham Research Institute for Climate Change and the Environment (LSE) and the Grantham Institute for Climate Change (Imperial College) is driving forward research, advancing both scientific and technical knowledge and policy-related advice, and promoting awareness of climate change issues across a broad spectrum of academics and policymakers. Lord Nicholas Stern, founder of the LSE Grantham Research Institute, undertook the most comprehensive and widely known and discussed reviews of the economics of climate change whilst adviser to the UK Government in 2006.

The Tyndall Centre, named after the British scientist who first established a basis for human impact on global warming, is a centre of excellence for British climate science which has made significant contributions to the Inter-Governmental Panel on Climate Change (IPCC) assessments on climate change adaptation and mitigation. Russell Group universities comprise five of the centre's seven academic partners, which include the University of Cambridge, the University of Manchester, Newcastle University, the University of Oxford and the University of Southampton. The contributions of Russell Group researchers associated with the centre to the IPCC reports have helped demonstrate unequivocally that human activities are contributing to global warming.

Russell Group university researchers based at the Tyndall Centre have also contributed to the ADAM

(Adaptation and Mitigation Strategies) report, which will support EU policy development and develop strategies for adaptation to and mitigation of climate change in the EU.

The Climate Leadership programme is based at the University of Cambridge. Established by Al Gore, the programme aims to educate business leaders about climate change, and the risks and opportunities associated with mitigating its effects through their business practices. The programme draws on the research and expertise of senior University of Cambridge academics, as well as a number of external contributors. 75 delegates from businesses based within 17 different countries have so far attended the course, with the potential for significant benefits through the implementation of climate change mitigation strategies across UK and international businesses.

The Environmental Change Institute, based at the University of Oxford, is one of the foremost agencies in the UK's efforts to understand and to raise awareness of climate change and its impacts. As well as conducting leading international research, which has made the institute a major partner in the Tyndall Centre and international climate change consortiums including the IPCC, the institute also plays an important role in understanding the impacts of climate change and disseminating this understanding to the UK public. The institute is host to the UK Climate Impacts programme, which aims to coordinate scientific research on the impact of climate change, and to work with businesses and public sector organisations to help them adapt to and mitigate those impacts. The institute has also initiated a number of other outreach programmes on the back of its research, including Climate-X-change – a campaign to tackle climate change issues in the local community of Oxfordshire, and a scientific briefing on climate

change for over 70 artists. Research at the institute is therefore enabled to have profound impact on public attitudes and those of business to climate change, and their awareness of and willingness to adopt solutions to its challenges.

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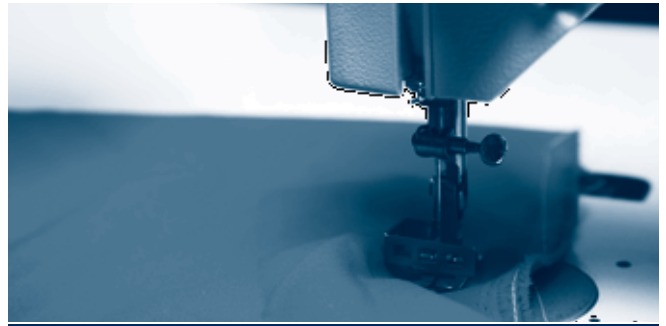
Case study 34 **ROBUST: Regeneration Of Brownfield Using Sustainable Technology** **Durham University**

ROBUST is a project engaging with local communities to develop a sustainable methodology to regenerate low-value brownfield spaces to improve their local environment and quality of life.

Low-value brownfield is land that is of no interest to developers; it is commonly unsightly and often unhealthy because of pollutants left in the soil. Such brownfield 'grotspots' attract crime and, as the interdisciplinary ROBUST team have demonstrated, have a strong association with poorer public health and wellbeing particularly in deprived areas. The team's finding opens up new research opportunities for a previously unidentified health inequality since there is often a prevalence of brownfield in lower socio-economic communities, with important implications for community health policy.

The primary objective of ROBUST is to develop low-cost, effective and sustainable contaminated land remediation methodologies for improving soil health, allowing these blight spots to be tackled through communities accessing ward-level community funding. The greening involves adding recycled minerals (free from the water industry) to the soil in conjunction with compost (green waste available from councils) to unhealthy soil. These minerals are naturally present in the soil and form part of the soil's defence mechanism against man-made pollution, immobilising potentially toxic elements and breaking down organic contaminants like petrol to regenerate the land.

Initial results suggest that these minerals have the ability to sequester carbon, making the technology carbon negative. ROBUST has led to new research ideas on how to engineer the soil by adding different combinations of these recycled minerals in order to afford us more control over this valuable resource in this age of unpredictable climate.



Case study 35 **Wonderland** **University of Sheffield**

Art and science combined in extraordinary fashion at the University of Sheffield, to create a novel and compelling environmental message.

Professor Tony Ryan from Sheffield's Chemistry Department collaborated with Professor Helen Storey from the London College of Fashion and textile experts at the University of Ulster to create a remarkable exhibition of fashion and materials that challenges people's concepts of sustainable consumption.

The exhibition used novel materials developed by Professor Ryan's research, and featured dissolvable dresses and disappearing bottles. The bottles are made of specially developed polymers which transform into a fertile gel when dissolved in hot water in which seeds can grow. The exhibition also includes a personal water purification device, which Professor Ryan hopes will be used to help people with limited access to water, such as during the aftermath of a natural disaster.

The aim of the exhibition, which both toured live and had an online presence, was to help communicate the importance of operating in sustainable fashion, and to challenge people to re-consider the impacts of their consumption on the environment by challenging audiences to think about waste. As Professor Ryan noted:

"Not only do we hope the products we have created can provide practical solutions to live issues, but that the conversation we've started about re-thinking our current behaviour can continue and gather momentum."



Case study 36 Carbon-negative construction University of Leeds

Developing fully sustainable and carbon-negative construction materials is the goal at Encos Ltd, a University of Leeds spin-off company. The company's patented method for manufacturing carbon-negative masonry products from waste materials is the result of research carried out by Dr John Forth and his team in the School of Civil Engineering.

The process uses a combination of vegetable oil-based binders mixed with graded waste aggregates. The mixture is then shaped into bricks and blocks and cured using low temperature heat. During the curing process the oil undergoes a number of complex chemical reactions which transforms it from a viscous liquid into a solid binding matrix. Producing the products uses no water and creates no waste.

A third-party report produced by Best Foot Forward Ltd estimates manufacture of the Encos masonry blocks and bricks would result in a reduction of 160% and 120% respectively in greenhouse gas emissions, compared to traditional clay bricks and concrete blocks.

The process could significantly reduce the environmental impact of the construction industry and greatly reduce the amount of waste going to landfill. "We've got a revolutionary product, we use very little energy in making our products and use a binder which actually stores CO₂ as opposed to emitting it," says Encos chief executive, Mark Nichols. "Not only does every tonne of bricks we create prevent about the same weight of waste material going to landfill, it also prevents an equivalent amount of primary resource being used."

Companies such as Yorkshire Water are already enthusiastic:

"Partnering with Encos may allow us to beneficially utilise a waste stream formed when producing high quality drinking water and treating waste water on behalf of our customers, moving us toward our zero waste aspiration," notes Jon Brigg, at Yorkshire Water.

Policy: the impact of Russell Group research on public policy

3.23 Robust evidence is critical to the development of sound policy and for that reason independent academic research is valued highly by policymakers. The Government spends around £1.6 billion a year on research and development to support its policymaking, and improve the delivery of public services.⁴⁷ The role of independent challenge in government policymaking has been well served by departmental Chief Scientific Advisers (CSAs), many of whom, including the most recent Government CSAs, Sir Mark Walport and Sir John Beddington, built their career in Russell Group universities. A report on the role of CSAs concluded that the standing and authority of CSAs within the scientific community both nationally and internationally was the single most important personal characteristic. The Royal Society supports a greater understanding of science through its 'Pairing Scheme', which between 2001 and 2011 has paired 144 research scientists in Russell Group universities with MPs and civil servants.

3.24 Research can influence policy in a number of ways. It builds the capacity of policymakers enabling them to be better informed, broadens the policy agenda allowing new ideas and knowledge to be considered, and opens up processes and procedures facilitating better decision-making. Whilst research impact on policy can be directly instrumental, contextual influence is far more prevalent, and research often 'informs' policy, rather than exerts a clear influence or steer. Publicly funded research within Russell Group universities has made an important contribution to policymaking both in the UK and internationally.

3.25 The impact of academic research upon public policy can be realised through a number of mechanisms. Court and Young (2003) found that research influenced policy through codified research reports and papers, as well as through the tacit knowledge of researchers which was disseminated by face-to-face exchanges and ongoing dialogue with policymakers. A British Academy report from 2008 adds further detail to these broad modes of interaction, identifying eight routes by which policymakers engage with research and researchers. They provide a useful summary of the ways in which publicly funded research within universities can influence public policy⁴⁸:

- Published literature: academic research adds to the knowledge base through published research within academic journals, conferences or books. Government departments can access this knowledge when developing policy. (Case studies 37 and 38)
- Commissioned research/consultancy: the UK Government regularly commissions research from experts within universities in order to inform a particular area of policy. The Government has established links with academics and centres of expertise. (Case studies 39-41)

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- Contributions to government consultations and committees: expert academics provide evidence to public consultations and enquiries, through responses to consultations, or through participation on committees or steering groups.
 - Secondments: academics undertake secondments to government departments, contributing to the development of policies. (Case study 42)
 - Training and development: academics provide expert training and advice to government officials and other public sector workers.
- 3.26 Policy is an essential common element to putting research into practice, whether it is through scientific and technological advances or greater understanding of individual, organisational or societal behaviours which shape our daily lives. It is not surprising, therefore, that the examples of policy impact presented below are diverse, ranging from climate change to crime prevention.
- 3.27 The impact of Russell Group research upon public policy extends across many sectors, for example in influencing public health, environmental and economic policy. A study funded by the Economic and Social Research Council (ESRC) on the research outputs of two of its research centres – the Centre for Economic Performance and the Centre on Skills, Knowledge and Organisational Performance, both hosted by Russell Group universities – found the impact on the UK economy of initiatives such as the National Minimum Wage, and skills policies in England and Scotland was highly significant.
- 3.28 The direct financial returns from Russell Group research which has influenced policy have in some cases been truly spectacular, as seen, for example, in the role of researchers from University College London in helping to secure over £22 billion for the public purse in what has been called ‘the biggest auction ever’.⁴⁹
- 3.29 Russell Group universities are host to two thirds of the research centres supported by the ESRC, which have often been highly influential in informing government policy on a wide range of issues; the ESRC itself selected the Centre for Economic Performance at LSE and the Centre on Skills, Knowledge and Organisational Performance based at the Universities of Oxford and Warwick as exemplars of the influence its sponsored research had had on UK policy.



Case study 37

Happiness in economic policy

London School of Economics and Political Science

Research at the London School of Economics and Political Science has been at the forefront of recent policy drives to increase ‘happiness’ and ‘wellbeing’. In 2005, Richard Layard published a seminal book, *Happiness: Lessons from a New Science*. It showed, among many other things, that ‘happiness’ was not related to the acquisition of wealth, so much as relative wealth and status. Increasing inequality meant that people were less happy in 2000 than they had been during the 1950s, despite an overall increase in income.

Professor Layard’s work, along with that of many other researchers in this area, has had a profound impact on government policy and priorities. In 2002, the Prime Minister’s Strategy Unit held a seminar to discuss the ways in which happiness might feature in government policy, and since then, ‘happiness’ and ‘wellbeing’ have been afforded an increasingly important place within the priorities of the current government and the opposition: the Treasury has now included ‘quality of life’ as one of its stated aims and in 2010 David Cameron announced the introduction of a wellbeing index which will be supported by measures developed by the Office for National Statistics.

Professor Layard was also the founding director of the Centre for Economic Performance (CEP) at the LSE. Funded by the ESRC, in 2003 the centre was awarded the Queen’s Anniversary Prize in recognition of its ‘significant impact on government policy in the UK and more widely’. Research at the centre has influenced policy innovations such as the New Deal Programme, the Working Families Tax Credit Scheme, the European Union’s employment policy and major initiatives in UK mental health care.



Case study 38
Edinburgh Study of Youth Transitions and Crime
University of Edinburgh

The Edinburgh Study of Youth Transitions and Crime (ESYTC) is a longitudinal programme of research into pathways of offending amongst a cohort of 4,300 young people which began in 1998. The research, funded by ESRC, the Nuffield Foundation and Scottish Government, has filled significant gaps in knowledge about factors associated with youth offending.

The ESYTC has an exceptionally strong public policy focus and impact has developed gradually since 2003 through targeted knowledge exchange activities and establishing connections with policy and practice communities. Impact has been enhanced by the high quality of the research evidence published (quantitative and qualitative) and clear presentation of theory and policy implications to key audiences. Three recent policy changes are all heavily informed by this study:

- Key in the recent Scottish Government reform to youth justice is the 'Whole System Approach' to prevent offending by young people, developed based on ESYTC findings. This was piloted in 2010-11 and, following evaluation, formally rolled out across Scotland in September 2011.
- Findings on patterns of desistance from offending and critical moments in the teenage years informed the development of a Scottish Government policy document 'Reducing Re-offending' and informed Scottish Government strategic objectives and national outcomes on crime and communities.
- ESYTC data informed Scottish Government policy on gangs and knife crime and to develop the No Knives Better Lives campaign in Edinburgh in 2010-2011. This work also led to a play called Split//Second which has been performed to secondary school pupils across Edinburgh and highlights the dangers of carrying a knife.

The study has also informed policy debate elsewhere in the UK, feeding into the Northern Ireland Youth Justice Review 2011 and England/Wales Youth Justice Commission 2010.



Case study 39
Reducing radicalisation through policing
Cardiff University

Research conducted by Professor Martin Innes and colleagues at the Universities' Police Science Institute, Cardiff University, has had an important influence on policing policies both in the UK and internationally.

Professor Innes was commissioned to conduct research into the causes of violent radicalisation, and what the role of policing might be in preventing it. His findings have had a major influence on UK Government policy, informing in particular revisions to the Government's Counter Terrorism strategy, CONTEST, and the later reconfiguration of its Prevent Strategy.

The research has also gained wide traction internationally, being requested by a number of overseas non-governmental and governmental organisations, including the chair of the US Senate Committee on Homeland Security and Government Affairs. The research therefore stands to result in significant impact on policing practice and ultimately on domestic security both in the UK and around the world.



Case study 40

**UCL Constitution Unit
University College London**

The UCL Constitution Unit has undertaken research which has helped to involve legislation and policy on: the Human Rights Act; devolution; reform of the House of Lords; referendums; new voting systems; the new Supreme Court; Church and State; constitutional watchdogs; freedom of information; and parliamentary reform. Senior members of the Unit regularly act as advisers to parliamentary committees, public commissions, and give evidence in public to such bodies. The Unit's work is regularly cited in government documents, parliamentary debates and the media.

More recently, the Constitution Unit provided valuable analysis on the UK General Election during April and May 2010, offering guides and forecasts during the General Election campaign and commentary on its potential implications. In particular, a draft report on Hung Parliaments was sent to the Cabinet Office and led them to produce a new Cabinet Manual, which:

- codified for the first time the conventions on how the Sovereign invites the person most likely to command the confidence of the House to serve as Prime Minister and form a government and determined how the transition after the 2010 General Election was managed, and
- recommended that the civil service supported the opposition parties in their negotiations, thus ensuring that the subsequent process of government formation went much more smoothly than might otherwise have happened.

Professor Robert Hazell, Director of the Constitution Unit, was also at the forefront of commentary on the workings and implications of a hung Parliament, with multiple media appearances.

The Unit has also influenced House of Commons reform – research by Dr Meg Russell was specifically cited in proposing the establishment of a new committee to look at wide-ranging Commons reform

to help restore public confidence in parliament, and Dr Russell was subsequently appointed as the specialist adviser to the new Select Committee on Reform of the House of Commons. The Committee's report led to:

- chairs of its select committees being elected for the first time in cross-party secret ballots (as originally recommended in Russell's report)
- select committee members in party ballots, weakening the control of party whips, and potentially greatly strengthening the select committees
- the establishment of a 'Backbench Business Committee' to manage a newly created slot of 'backbench business' allowing backbench MPs to collectively set the Commons agenda and forcing votes, if necessary, on the topics of their choosing.

Collectively this package of Commons reforms has been cited by *The Times* as the most important since the creation of departmental select committees more than 30 years ago.



Case study 41

Alcohol Pricing Policy

University of Sheffield

A multidisciplinary research team from the University of Sheffield played a key role in shaping the current debate over alcohol pricing policy. Researchers in the School of Health and Related Research (ScHARR), Department of Economics and Department of Automatic Control and Systems Engineering collaborated to model the impact of potential alcohol policies on individuals and society.

The initial study, an Independent Review of the Effects of Alcohol Pricing and Promotion commissioned by the UK Department of Health in 2008, showed policy options such as minimum unit pricing or banning price-based promotions reduce alcohol consumption and can have significant effects on reducing alcohol-related harm. These findings have been used by senior decision-making bodies such as the House of Commons Health Select Committee, the UK Chief Medical Officer and the WHO alcohol strategy group.

The research produced the Sheffield Alcohol Policy Model, which draws on data from large-scale surveys to form a key evidence base. The model has since been adapted for use by the Scottish Government, and work is underway to provide further international adaptations. In 2009, it was extended to cover other significant policy areas, such as alcohol screening and brief interventions in primary care, to help the development of NICE guidance. In early 2010, the University of Sheffield team was commissioned by the Home Office to draft one of three independent research reviews on alcohol pricing.

The model and its findings have made a strong contribution to the public debate on alcohol pricing, with members of the research team making regular appearances in the national broadcast media.

Sheffield's contribution to this key policy area is set to continue, with ScHARR being chosen to host and lead the Capacity Development for Alcohol Policy

Effectiveness Research (CAPER) research cluster, a team of international experts from diverse fields such as sociology, economics, psychology, criminology and policy modelling funded by the MRC to inform strategic decisions about UK alcohol policies and their local, national and international implementation.



Case study 42

Influencing social policy – Julian Le Grand London School of Economics and Political Sciences

During the course of more than 30 years of research into social policy, Julian Le Grand, now Richard Titmuss Professor of Social Policy at the London School of Economics, has become a major influence on social and economic policy in the UK.

Beginning with a paper on the social class distribution of health spending in the late 1970s, Professor Le Grand has consistently conducted research which has resulted in key social and political reforms in the UK. He has advised the World Bank, the WHO, HM Treasury, and the BBC, and has chaired several government committees and working groups. Perhaps most notably, he was a Senior Policy Adviser at No. 10 Downing Street between 2003 and 2005.

Research which Professor Le Grand conducted whilst at LSE was one of the principal drivers for the wide-ranging reforms that introduced 'quasi-markets' (i.e. elements of competition between agencies) into public sector organisations, most notably within the NHS. His work has also underpinned specific policy innovations that have directly impacted on people's everyday lives, including the Child Trust Fund, the Pupil Premium for less well off and for looked after children, the Partnership Scheme for funding long-term care, which was endorsed by the Wanless report in 2005, and social work practices now being piloted by the Department for Education.

The profound influence which Professor Le Grand's research has had on our society and economy has been widely recognised: he was listed by Prospect and the Guardian as one of Britain's top public intellectuals, and by the ESRC as one of its 10 'heroes of dissemination'.

Culture: the impact of Russell Group research on cultural production and cultural understanding of society

- 3.30 The creative industries are one of the most significant sectors of the UK economy, for example they create significant export earnings comprising 10.6% of the UK's economy.⁵⁰ They are a key part of the economy showing consistent growth over recent years,⁵¹ and a significant contributor to the UK's attractiveness to international visitors and business. The University of Edinburgh campus provides numerous venues for the world-renowned Edinburgh Festival, an event that puts Scotland on the international map, when the city teems with tourists.
- 3.31 It is frequently noted that university research has a close relationship with and major impact upon important UK industries. The video gaming industry, for example, is known to draw frequently upon research, where arts and humanities research and expertise has become increasingly important, alongside technical expertise in computing. Reports by UUK and Universities Scotland found universities to be the primary source of talent, skills and entrepreneurship for the creative economy. Not only does university research contribute to the economy through avenues that can be commercialised, but also in areas that develop "creative practice, evidence-based policy making and new ways of working in the creative industries".⁵²
- 3.32 The AHRC describes arts and humanities research as a driving-force behind a UK 'culture ecosystem' where elements of a rich cultural heritage, popular engagement with that heritage, and both popular and professional reflection on our heritage and culture all interlock (Case study 43).⁵³ Public investment in such research has developed the knowledge base which underpins popular cultural exploration through museums, documentary television, books, films, recordings and performances (Case study 44).
- 3.33 Participation in the arts enriches lives, and research at Russell Group universities facilitates that participation both through its vast knowledge base and through practice-based research. Russell Group researchers are innovative and imaginative in translating research into installations that the public can engage with directly. Research can offer new perspectives and interpretations of a wide range of art, allowing it to be constantly re-defined and often updated for a modern audience. Research can develop innovative approaches and artistic methods, allowing cultural and creative arts to be brought to wider audiences or presented in novel ways, in person or even digitally. (Case studies 45-48)



Case study 43
Digital Heritage
University of York

Researchers at the University of York, located in a city that resonates with heritage, store and exploit cultural and heritage resources in formats that make information useful and accessible to wide-reaching audiences.

The Centre for the Study of Christianity and Culture (C&C) has created a series of highly acclaimed interactive DVD-ROMs, featuring the work of over 300 scholars, as well as a book series, training courses and international conferences for students unfamiliar with Christian thought and its influence on western culture. Over 12,000 copies of the interactive DVD-ROMs are now in use in universities and schools and their popularity and use has spread to the general public. The success of the DVDs has led to numerous commissions from important historic churches and cathedrals to bring recent research to life through interpretation projects and schemes which help people of all ages and backgrounds understand and enjoy these remarkable buildings and the stories they hold. C&C's expertise in new media has meant these interpretation schemes can include complex 3D models of the evolution of buildings and their use, as well as reaching out beyond the buildings to newer audiences through mobile phone Apps and web-based resources.

For more than 15 years York's Archaeology Data Service (ADS) has pioneered approaches to digital preservation, providing open and free access to a wide range of data. Examples of deposits range from the archaeology reports for the Channel Tunnel rail link and Heathrow Terminal 5 to animal remains from the Neolithic and Early Bronze age of Southern Britain. The ADS regularly deals with data and data requests from academic archaeologists, local and national government archaeologists, the commercial sector, the community archaeology sector and, being an open archive, the general public. There are now over 17,000 unpublished fieldwork reports and over 500 data-rich digital archives, and the ADS receives around

250,000 visits per year, 23% of which are from outside the UK. As well as researchers, national and local government, non-professional archaeologists and members of the public are frequent users of the ADS, and data are used for commercial research and heritage management projects.

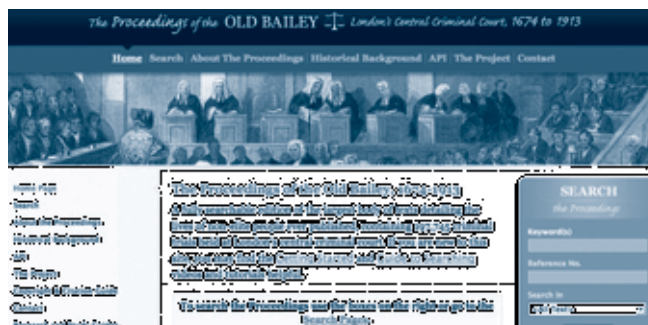
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Case study 44 **Biblical texts, archaeology, and their implications for modern religious beliefs** **University of Exeter**

Professor Francesca Stavrakopoulou's research at the University of Exeter on the ancient religious traditions reflected in biblical texts has had significant impact upon many critically acclaimed television programmes; it has increased public awareness of the historical study of biblical texts and recent archaeological discoveries. Stavrakopoulou, who has been called 'the BBC's new face of religion', has written and presented television documentaries, served as an expert consultant, engaged in broadcast discussions and collaborated with a museum, resulting in her research attracting exceptional media attention and generating on-going public debate.

In 2009 Stavrakopoulou was appointed as an academic expert for Channel 4's *The Bible: A History* documentary series which explored the religious significance and impact of the Bible. She advised on the content of and appeared in two episodes, fronted by Rageh Omaar and Ann Widdecombe. She was subsequently invited to write and present three hour-long documentary programmes for BBC2. *Bible's Buried Secrets* raised questions about the biblical portrayal of religion which challenge beliefs central to Judaism and Christianity. Stavrakopoulou's collaboration with BBC staff allowed her knowledge and expertise to shape both the content and format of the programmes. The documentaries were screened in a primetime slot in March 2011, achieving viewing figures in excess of a million per episode and were franchised to BBC Worldwide.



Case study 45 **Online publications** **University of Sheffield**

The HRI Online Publications at the Humanities Research Institute of the University of Sheffield has published a fully searchable edition of the largest body of texts detailing the lives of ordinary people ever published. The Old Bailey online project, a collaboration between the Universities of Sheffield and Hertfordshire and the Open University, contains all surviving editions of the Old Bailey Proceedings from 1674 to 1913, and of the Ordinary of Newgate's Accounts between 1676 and 1772 and allows access to over 197,000 trials and biographical details of approximately 2,500 men and women executed at Tyburn, free of charge for non-commercial use.

The project has had over 10 million visitors since its completion in 2005. Not only does it provide a range of advanced search tools for individuals with an interest in local or family history, it also incorporates learning packages for school and university students and for specific communities, such as black, traveller, gay and Irish.

This unique resource has proved inspirational, leading to two further online historical resources (Locating London's Past and London Lives) and serving as the basis for *Data mining with criminal intent* a project looking into new tools for electronic research to revolutionise the way people can extract information from digital resources. It also provided the inspiration (and the plots) for award-winning BBC drama *Garrow's Law* about the life of an 18th century defence barrister. The drama ran to three series and attracted over 5.6 million viewers at its peak, spreading knowledge of the history of the English criminal justice system to a wide and varied audience.

The website was overall winner of the 2003 Cybrarian Project Awards and (together with the London Lives project) won the project's co-directors the Longman History Today Trustees Award in 2011.

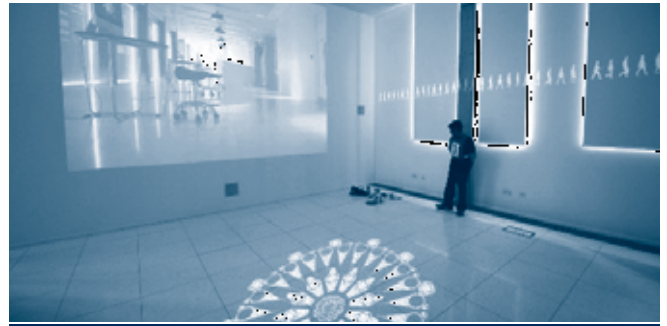


Case study 46 **Global People** **University of Warwick**

The Centre for Applied Linguistics Research at the University of Warwick is leading the 'Global People' project, funded by HEFCE. The project, which formed the third phase of HEFCE's eChina-UK e-learning programme, explores how to promote intercultural effectiveness in wider international contexts, with a particular focus on managing international education projects.

The project has developed a large web-based resource, which includes models and a competency toolkit to help people who want to become more efficient at working with others across different cultures (<http://www.globalpeople.org.uk/>).

The project will have an important impact on improving international relationships, managing miscommunication, and developing more effective working relationships; enhancing the UK's international competitiveness in business and education. It has received numerous endorsements. For example, John Knagg, Senior Adviser Learning and Teaching at the British Council said: "Warwick University's 'Global People' website and resources make a substantial contribution to thinking and practice in the area of intercultural working. As a professional in international cultural relations, I will be referring partners that we work with, both in UK and overseas, to this site."



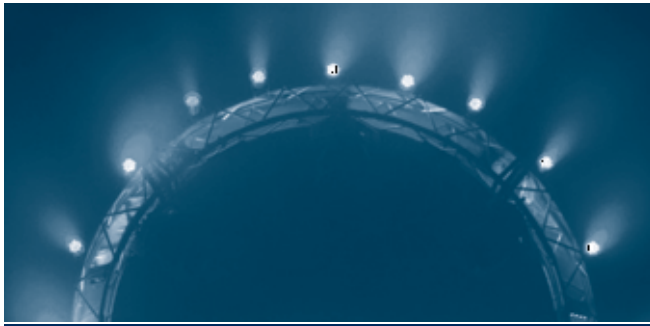
Case study 47 **Inspace** **University of Edinburgh**

Inspace is a public research space exploring the cultural significance of informatics.

On first inspection, Inspace appears to be a public gallery, albeit one with a very interactive programme. But a closer look shows that it is in fact a functional laboratory which is exploring the cultural significance of informatics – the study of the structure, the behaviour, and the interactions of natural and engineered computational systems – and new media practice by transforming into a gallery, studio, cinema, workshop or lecture space where the exhibits are part of the research itself. Inspace was created as an agile resource for the research, exploration and presentation of digital culture, and welcomes collaborative projects which have the potential to take technology, audiences and expertise in new and dynamic directions.

A joint research partnership between the School of Informatics and New Media Scotland, Inspace increases public awareness and understanding of the role of computation in modern biology, security, learning and other areas of life by providing a focus for visitors, researchers and the general public to learn more about research and its many practical uses.

As an official venue for the Edinburgh International Science Festival, Edinburgh International Film Festival and Edinburgh Art Festival and with its city centre location, Inspace is able to open its doors to a large international audience as well as serving its local community.



Case study 48
Dancing in the Streets
University of Leeds

A small consultancy project undertaken by the University of Leeds has led to an extended research collaboration with creative media design company, KMA.

KMA first approached researchers at the University's School of Performance and Cultural Industries to act as consultants on its design project 'Dancing in the Streets' a lighting installation which allows passers-by to control projected lights through their own movement. It was first performed in York city centre in 2005, and proved an enormous success with the public and in 2006 travelled to the Esterni Festival in Italy.

Following the success of Dancing in the Streets KMA has continued to work with Dr Sita Popat, Senior Lecturer in Dance, and Scott Palmer, Lecturer in Scenography, and has gone on to develop further projects using interactions between people and projected lights in public spaces. These have included commissions for public installations in Trafalgar Square and in Dublin.

The partnership between KMA and University of Leeds also highlighted opportunities for further collaboration, including an 18-month long collaborative research project, focused on the choreographic and scenographic exchange between dancers and projected digital images within a theatrical context. The project received funding from the Arts and Humanities Research Council (AHRC), and enabled KMA's future productions to be informed by a better understanding of the interaction between performance and technologists.

- 3.34 The academics who founded the formal study of culture saw in it the importance of interpreting the values and attitudes of societies. When the discipline of 'cultural studies' first emerged it challenged perceptions that culture was about high-brow arts and raised the visibility of parts of society, such as northern working-classes and the new immigrant communities, that had hitherto been 'hidden' to mainstream academic work. Fast-forward a few decades, and the multi-cultural, globalised and digitised society we now inhabit has an ever evolving set of cultural values for society to absorb. (Case study 49)
- 3.35 Sometimes that means challenging the received wisdom of individuals and groups' perceptions of the world they live in and their place within it. Academic research plays a crucial role in advancing our understanding of different cultures, religions and social groups. In the increasingly multi-cultural environment of modern Britain, this understanding is crucial to cross-cultural integration, and a tolerant and peaceful society.
- 3.36 Russell Group research is at the forefront of foreign cultural and linguistic scholarship in the UK. Russell Group universities demonstrate particular expertise relating to strategically important regions such as China, the Arab world and Russia. HEFCE currently funds five specialist centres in partnership with the Scottish Funding Council, the AHRC and the ESRC, which focus on expanding the UK's research capacity in relation to the Arab world, China and Japan, Eastern Europe and the former Soviet Union. Each of these five specialist centres involves a collaboration incorporating one or more Russell Group universities.
- 3.37 Languages and cultural understanding help the UK to do business on a global scale, and inform understanding of behaviours and norms that can inform policymakers and public bodies who must interact with a multicultural society (Case study 50). The impact of Russell Group research on our understanding of foreign languages and different cultures – both foreign and domestic – makes an immeasurable contribution to promoting social and cultural integration, and to promoting global security. In addition, a strong foreign languages research base is vital to underpinning the UK's business and trading success within the global economy.



Case study 49
The Culture Capital Exchange
King's College London

King's College London, in partnership with other London-based institutions, established a forum to maximise the impact of its research on the arts and cultural sector.

The Culture Capital Exchange (TCCE), formally the London Centre for Arts and Cultural Exchange (LCACE), evolved from an original collaboration of eight London universities, led by King's College London, and now grown to 11 founder members as TCCE. TCCE fosters collaborations between academics and the arts and cultural industries. It supports networking, communication and information exchange events both within the arts and humanities disciplines and in the sciences. As LCACE the collaboration supported over 140 events with a total audience of 20,000, including 22 new works of art, 20 publications, and links formed with private and public sector bodies such as museums, galleries and publishing agencies.

Through these programmes, the LCACE ensured that the research expertise of its partners is disseminated to business, helping to drive success in the creative and cultural industries. In its new guise, the Centre generates significant impact through informing and enhancing the development of many of the UK's fastest growing and important economic sectors, such as media, music, design and fashion, retail, finance, mobile and social enterprise.



Case study 50
Impacts 08 and the Institute of Cultural Capital
University of Liverpool

Researchers from the University of Liverpool and Liverpool John Moores University undertook a five-year longitudinal research programme evaluating the social, cultural, economic and image effects of Liverpool's reign as European Capital of Culture in 2008. The 'Impacts 08' programme found that Liverpool's historic stereotypical image, often associated with social deprivation, was replaced by a renewed emphasis on the city's contemporary culture and creative assets as a result of its year as European Capital of Culture. The programme was funded initially by Liverpool City Council with additional provided by AHRC, ESRC and Arts Council England (ACE).

The programme has had a significant impact within cultural policy circles in the UK and in Europe as well as within cultural practitioner circles locally, nationally and internationally. By the end of this programme in 2010, the research framework proposed by Impacts 08 had been adopted and is regularly referred to within key policy documents, seminars, and strategic or planning documents produced by key stakeholders in the UK and Europe.

The lead researcher, Dr Beatriz Garcia, now acts as the Head of Research, Cultural Policy and Impact at the Institute of Cultural Capital, which builds on the success of Impacts 08, and has been awarded the contract to evaluate the impact and legacy of the London 2012 Cultural Olympiad.

Conclusion



The economic crisis of 2008 that swept the globe brought into sharp focus tough spending decisions for governments.

- 4.1 In the shadow of economic gloom, nations worldwide have recognised the need to invest in research as a platform for economic growth and broad social benefit.
- 4.2 Science and research can at times appear difficult to understand and that can make it challenging for governments to explain the importance of funding research when there are so many immediate pressures on the public purse. But governments neglect science and research at their peril. The UK is one of the world's most productive centres of excellent research in the world and the research undertaken by our world-class universities has been shown to make a real difference.
- 4.3 The impacts of research in this report were made possible by invaluable investments from charities and business. But mostly they rely on many years of clear commitment by successive governments to sustained public investment in research. That commitment is vital to allow our world-class universities to conduct the fundamental research that is so essential to new discoveries and innovations that change all our lives – years, perhaps even decades, before those benefits have even been imagined.

Glossary of terms

ACE Arts Council England

AHRC Arts and Humanities Research Council

AHSCs Academic Health Science Centres

AHSP Academic Health Science Partnership

AMS Academy of Medical Sciences

BBSRC Biotechnology and Biological Sciences Research Council

BMA British Medical Association

CaSE The Campaign for Science and Engineering

CEP Centre for Economic Performance

CRF Clinical Research Facility

CSAs Chief Scientific Advisers

EPSRC Engineering and Physical Sciences Research Council

ESRC Economic and Social Research Council

GDP Gross Domestic Product

GOSH Great Ormond Street Hospital

GSK GlaxoSmithKline

HEFCE Higher Education Funding Council for England

HESA Higher Education Statistics Agency

IP Intellectual Property

IPCC Inter-Governmental Panel on Climate Change

JISC Joint Information Systems Committee

KTP Knowledge Transfer Partnership

MRC Medical Research Council

NERC Natural Environment Research Council

NESTA National Endowment for Science, Technology and the Arts

NICE National Institute for Health and Clinical Excellence

NITC Northern Ireland Technology Centre

OECD The Organisation for Economic Co-operation and Development

PCT Primary Care Trust

RCUK Research Council UK

R&D Research and Development

REF Research Excellence Framework

RQF Research Quality Framework

UUK Universities UK

WHO World Health Organization

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- 10 RCUK has issued the following definition of economic and societal impacts; (<http://www.rcuk.ac.uk/kei/impacts/Pages/meanbyimpact.aspx>):

The demonstrable contribution that excellent research makes to society and the economy. Economic and societal impacts embrace all the extremely diverse ways in which research-related knowledge and skills benefit individuals, organisations and nations by:

– fostering global economic performance, and specifically the economic competitiveness of the United Kingdom,

– increasing the effectiveness of public services and policy,

– enhancing quality of life, health and creative output.
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 - Ceres Power, a spin-out company from Imperial College London, is developing fuel cells which will provide low CO₂ power generation within homes and offices
 - Oxford Catalysts, a spin-out company from the University of Oxford, has developed new organic catalysts that facilitate low carbon power through instant steam production
 - Electrokinetic Geosynthetic, is a process developed by researchers at Newcastle University which allows more environmentally friendly sewage treatment; consuming less CO₂ and producing less waste.
 - Envirogen is a company spun out from the University of Nottingham, which uses DNA technology to trace industrial pollutants in rivers, streams and lakes
 - CASTEP is a spin-out company from the University of Cambridge which markets software to help companies

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select more environmentally friendly materials to support their business.

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