MANCHESTER 1824

The University of Manchester

GLOBAL CHALLENGES, MANCHESTER SOLUTIONS

Contents

Research at Manchester

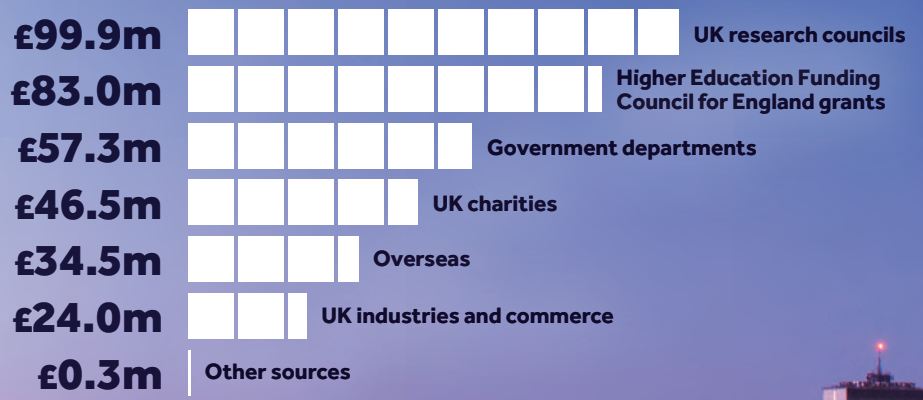
Research is fundamental to The University of Manchester. We're committed to both the discovery of new knowledge and its application for social and economic value.

Our place as one of the UK's top research universities was confirmed in the results of the 2014 Research Excellence Framework, where 83% of our research activity was judged to be "world-leading" (4*) or "internationally excellent" (3*).

We have a range of high-quality research that is rivalled by few other institutions. Our size and breadth affords us excellent opportunities to combine expertise from across disciplines, bringing the best minds together to find new ways forward in many fields.

Our five research beacons exemplify this unique capability.

In 2014/15 we attracted more than £345 million in external research funding.



TOTAL £345.5m

Global challenges, Manchester solutions

Manchester's research beacons are exemplars of interdisciplinary collaboration and cross-sector partnerships that are distinctive to our University, making pioneering discoveries and improving the lives of people around the world.

Researchers in our beacon areas are at the forefront of the search for innovative solutions to some of the biggest challenges facing the planet today.

Working together, we're advancing knowledge for a better future.

Our research beacons

- **Addressing global inequalities**
- **Advanced materials**
- **Cancer**
- **Energy**
- **Industrial biotechnology**

Addressing global inequalities

There are pronounced inequalities across the world. Food, infrastructure, health care, resources and opportunities remain plentiful for some, scarce for others. Social injustice, discrimination and constraints on social mobility heavily impact on some communities by gender, ethnicity, educational background and other characteristics.

For almost two centuries The University of Manchester has been leading the way in tackling global inequalities. From poverty to social justice, from living conditions to equality in the workplace, we seek to understand our world – and change it for the better.

"The University has much to contribute to shaping research, ideas and policies across the world. The international nature of our students and researchers helps us to make this happen."

Armando Barrientos
Professor of Poverty and Social Justice

Why Manchester?

- **335** academic staff and PhD students at Manchester are working to address global inequalities.
- Specialist hubs of expertise include our **Centre for Global Women's Health**, **Fairness at Work Research Centre** and our **Centre on Dynamics of Ethnicity**.
- At the forefront of development studies for **more than 60 years**, we're currently ranked **first for impact** in development studies in the UK, with many researchers deemed to be **"world leading"**.[1]
- Our Humanitarian and Conflict Response Institute is an **internationally leading training centre** for humanitarian practitioners, and unites medicine and the humanities to facilitate **improvements in global crisis response**.
- Our Global Development Institute is **Europe's largest dedicated development research and teaching institute** and contains the world's first doctoral college for international development: **The Rory and Elizabeth Brooks Doctoral College**.

[1] Research Excellence Framework 2014

Global challenges

Addressing global inequalities

20%

15%

10%

In the US, **the wealthiest 1% of the population takes 20% of all income before tax**; in the UK they take **15%** and in Sweden, **10%**.[1]

Ethnic minorities identifying as African, Arab, Bangladeshi, Caribbean and Pakistani are more than twice as likely as the white British ethnic group to live in **England's most deprived neighbourhoods**.[2]

1,400 women die every day from treatable illnesses related to pregnancy and childbirth.[4]

1,400

800 MILLION

Around **800 million** people go hungry in the world every day.[5]

29,000 children will die today, most from easily preventable health problems.[3]

29,000

[1] The World Top Incomes Database, 2012

[2] The Dynamics of Diversity: Evidence from the 2011 Census

[3] Unicef

[4] World Health Organization

[5] International Federation of Red Cross and Red Crescent Societies

Manchester solutions

Our employment expertise has informed the **European Commission**, the **European Parliament** and the **United Nations' International Labour Office**.

£45m

Our research led **Cadbury** to switch to **Fairtrade** cocoa and invest **£45 million** in cocoa-growing communities.

We've worked with **The UK International Emergency Trauma Register** and **UK-Med** to deploy medical teams to some of the most significant global humanitarian crisis responses of recent times, **Typhoon Haiyan** in the Philippines, the 2014 **Israeli-Gaza conflict** in Gaza, and the **Ebola** virus epidemic in Sierra Leone.

Our insight into humanitarian efforts and technologies has influenced **Médecins Sans Frontières**, **Save the Children**, **Handicap International** and the **International Federation of Red Cross and Red Crescent Societies** – and has been recognised by the **British Academy**.

We work with **Age Concern UK** and **local governments** to inform policy and service delivery for ageing societies.

Advanced materials

As the modern global age evolves, we need new, transformational materials that allow us to work in the harshest, most demanding environments: on the frontiers of the energy sector, or inside the human body. Advanced materials have the power to transform almost every industrial sector and every aspect of our lives.

The birthplace of graphene research, The University of Manchester is today a world-leading hub for advanced materials expertise. We work with dozens of international industrial and academic partners to turn discoveries from the lab into revolutionary applications to improve the lives of people across the globe.

"You cannot help but wonder what else graphene has in store for us."

Sir Andre Geim
Professor of Condensed Matter Physics

Why Manchester?

- We have more than **£248 million** invested in live advanced materials research projects.
- We're home to the **BP International Centre for Advanced Materials** and the **National Graphene Institute**, and will soon welcome the upcoming **Graphene Engineering Innovation Centre**.
- We **lead the world in characterisation of materials**: measuring and exploring materials to help us fully understand and exploit their properties and potential.
- We're soon to be home to the **£235 million Sir Henry Royce Institute for Advanced Materials**, playing a crucial role in making advanced materials a catalyst for economic growth and industrial innovation.
- **Tailored facilities** include cleanrooms and state-of-the-art laser, optical, metrology and chemical labs and equipment.

Global challenges

Globally, corrosion costs more than **£1.5 trillion a year**.[1]

Every two minutes a child dies somewhere in the world from a diarrhoeal disease caused by dirty water and poor sanitation.[2]

Advanced materials

10km

Deep-sea platforms are drilling ever deeper for oil. Increasingly they need to be able to operate at depths of up to **10km** below the seabed where pressures can be as high as **20,000psi**.

Just **7%** of UK energy consumption in 2014 was provided by renewable sources.[3]

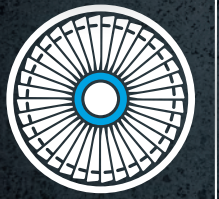
Transport accounts for **one-fifth (21%)** of the UK's carbon emissions.[4]

21%

[1] World Corrosion Organization 2012
[2] WHO/UNICEF 2014, 2015
[3] Digest of United Kingdom Energy Statistics 2014
[4] Transport Statistics Great Britain 2015

Manchester solutions

25%



An aero engine developed by Rolls-Royce with the University is **25% more fuel-efficient** than its closest competitor.

Our world-leading **3D characterisation capability** enables us to study the properties of new protective coatings for materials such as aluminium used in aeroplanes.

The BP International Centre for Advanced Materials works on projects at the University that aim to **improve the safety, reliability and performance** of materials across the oil and gas industry.

We're working on **'accident-tolerant' fuels** that can survive much higher temperatures, providing improved safety; and **extended lifetime fuels** with better thermal conductivity, offering improved economic performance.

Two Manchester scientists first isolated graphene in 2004; now **Nobel laureates**, they work alongside **more than 230 researchers** on graphene and 2D materials – set to revolutionise global health care, water supplies and consumer electronics.

Cancer

One in two of us will be diagnosed with some form of cancer in our lifetime.[1] The disease can have a devastating impact on the lives of patients and on their friends and family who feel its emotional and economic fallout.

The University of Manchester has a rich history of cancer research, stretching back to the early 20th-century research of Sir Arthur Schuster into x-radiography and radium. Today we're working on the full range of ways to reduce cancer's impact on our patients, our health services and our society.

"There aren't many other places where researchers, clinicians, charities and patients mingle so freely. By working together in the same space, we deliver results faster and more effectively."

Professor Sir Salvador Moncada
Director, Institute of Cancer Sciences

[1] Cancer Research UK

Why Manchester?

- We're home to the **Manchester Cancer Research Centre (MCRC)**, a unique collaboration between the University, Cancer Research UK and The Christie NHS Foundation Trust, and the research arm of the **Manchester Academic Health Science Centre (MAHSC)**.
- Our **Centre for Genomic Diagnostics and Innovation**, based at the University and the Central Manchester Trust, handles 8% of England's complex single gene diagnostics.
- We opened a **£28.5 million** new MCRC building in 2015 to house an additional **150 scientists** and **100 clinical trials support staff**, plus new and advanced equipment.
- We've invested **£30 million** into attracting internationally leading investigators to the MCRC.
- We collaborate with **six NHS organisations** as part of MAHSC, and partner with companies such as **AstraZeneca** and **GlaxoSmithKline** to bring new drugs to the market.

Global challenges

Cancer

14m

14.1 million new cases of cancer

There were **14.1 million** new cases of cancer, **8.2 million** cancer deaths and **32.6 million** people living with cancer worldwide in 2012.[1]

33%

Around **33% of cancer deaths** are due to behavioural and dietary risks: high body mass index, low fruit and vegetable intake, lack of physical activity, and tobacco and alcohol use.[2]

70%

Around **70%** of all cancer deaths occur in low and middle-income countries.[1]

Cancer rates are predicted to **increase by 70%** in two decades, from 14 million in 2012 to 22 million in 2020.[1]

£870bn

The financial costs of cancer are estimated at **£870 billion** a year, as of 2010.[1]

[1] World Cancer Report 2014, World Health Organization

[2] World Health Organization Factsheet no 297

Manchester solutions

1.5m

1.5 million women with breast cancer across the world are now benefiting from endocrine therapy approaches developed at Manchester.

Our academics and medics are helping to roll out a national programme of cervical cancer screening in **Uganda**.

25% of people with lung cancer live for **two or more years** after diagnosis thanks to groundbreaking treatments developed at Manchester.

25%

We've contributed substantially to government initiatives that have helped the **90,000 working people a year** diagnosed with cancer **return to work** after treatment.

100,000 patients a year benefit from **better nutrition** before and after cancer treatment, thanks to our enhanced use of the malnutrition universal screening tool.

100,000

Energy

As the world develops, we're using more and more energy in our everyday lives, raising big questions about where energy comes from, how smartly we use it, how accessible it is and what impact there is on the environment.

Researchers at The University of Manchester are seeking solutions to some of the biggest energy challenges we face – from the sustainability of sources to the social factors that stand in the way of equal access to power. We're looking at the whole energy system in order to produce technologies and approaches to secure the world's energy future.

"The size of the University and the sheer range of knowledge here allows us to bring people together from a huge range of research areas. This helps us to find innovative ways to tackle some of the world's biggest energy challenges."

Ian Cotton
Professor of High Voltage Technology and Director, Manchester Energy

Why Manchester?

- We're home to the **Dalton Nuclear Institute**, a world-leading centre of expertise delivering applied research across the nuclear fuel cycle.
- We've invested **£75 million** into projects covering energy generation, systems and usage, involving more than **600 academics and researchers**.
- We're working on a **€9 million** project with partners in the UK and Europe to develop the smart energy systems of the future.
- Our leading energy research facilities include **the world's highest energy dual-beam accelerator system** at our Dalton Cumbrian Facility, a **1MW energy storage test bed**, one of the largest combined wave-current flumes in the UK and the only **400kV-capable HV lab** of any UK university.
- Our strategic partnerships include **Amec Foster Wheeler**, **Arup**, **BP**, **EDF Energy**, **Electricity North West**, **National Grid**, **National Nuclear Laboratory**, **Rolls-Royce** and **Siemens**.

Global challenges

Energy

The average growth rate for global electricity demand is about 3% a year, meaning **global electricity use could double** by 2038 compared to 2015 levels.[1]

CO_2 ↓

The UK is legally required to reduce greenhouse gas emissions by **80%** of 1990 levels by 2050, meaning a reduction in our reliance upon fossil fuels.[2]

Bioenergy use in the EU is estimated to increase **2.5 times** by 2020 from 2010 levels; further increases in demand worldwide could impact on the availability and sustainability of this energy source.[3]

Globally, the share of **renewable energy** in total final energy consumption is expected to **double** to 35% by 2030, from 18% in 2010.[4]

Every year a typical large coal-fired power station produces around **10 million tonnes** of CO_2, **200,000 tonnes** of gases associated with acid rain and **4,000 tonnes** of fly ash.[5]

[1] BP Statistical Review of World Energy
[2] 2008 UK Climate Change Act
[3] EURELECTRIC Renewables Action Plan (RESAP)
[4] International Renewable Energy Association
[5] International Energy Agency

Manchester solutions

We're working closely with industry to deliver projects such as VISOR, a **£7.4 million** initiative to demonstrate the role of **measurement and monitoring technologies in electrical power systems** – an essential step in ensuring the success of a low-carbon future.

£7.4m

We're helping the hydrocarbon sector to extract bridging fuels **more efficiently** from conventional reserves – and we're investigating the **technical and social implications** of extracting from unconventional reserves using techniques such as fracking.

We're designing an amphibious remote-operated vehicle that can easily access nuclear facilities, carry neutron detection and navigation equipment, and withstand radioactive environments for **safely decommissioning** sites such as Sellafield.

We're developing a solution that uses quantum dots to **increase the efficiency of solar cells** – and we've found that combining graphene with similar materials can create extremely sensitive photovoltaic devices.

We found that the UK could generate **44%** of its energy needs from biomass by 2050[1] – and we're finding ways to produce **fuel from algae**, engineering bacterial enzymes and hacking metabolic pathways to turn carbon into gases such as propane.

[1] 'Securing a Bioenergy Future Without Imports', Energy Policy Volume 86

Industrial biotechnology

In a century where society seeks sustainability alongside efficiency, industrial biotechnology offers an attractive alternative to traditional oil and gas technologies, using biological resources such as plants, algae, fungi, marine life and micro-organisms to create cleaner, sustainable chemicals, materials and energy.

The University of Manchester is leading the way across Europe towards a bio-industrial revolution. Our multiskilled, interdisciplinary teams give us unique capabilities, making us ideally placed to translate knowledge into application in areas from agriculture to medicine.

"There is no industry better positioned than industrial biotechnology to respond to society's grand challenges as we tackle an ageing and ever-increasing population, affordability of health care, resource efficiency, food security, climate change and energy shortages."

Professor Nigel Scrutton
Director, Manchester Institute of Biotechnology

Why Manchester?

- We're home to the **Manchester Institute of Biotechnology (MIB)**, one of Europe's leading industry-facing research facilities driving bio-based chemicals synthesis in the UK
- A hub for **EU- and industry-funded** programmes, we also have a strong record in forging **industry and stakeholder collaborations** in the fine chemicals sectors, including with GlaxoSmithKline, Shell and Pfizer
- Our flagship **€26.4 million** CHEM21 project brings together six pharmaceutical companies, 13 universities and four SMEs from across Europe
- **52** lead MIB investigators collaborate with many more colleagues across our University, while **30%** of MIB's research portfolio involves overseas partners
- We lead **four** national Biotechnology and Biological Sciences Research Council networks in Industrial Biotechnology and Bioenergy

Global challenges

Industrial biotechnology

The chemical industry is the UK's largest manufacturing sector, worth **£50 billion** in exports every year.[1]

Hepatitis C affects approximately **150 million** people worldwide.[2]

150m

Pravastatin, a leading drug that lowers cholesterol levels in order to decrease the risk of **cardiovascular disease**, is currently produced via a costly dual-step fermentation and biotransformation process.

Around **20 million tonnes** of propane gas is used each year to fuel motor vehicles across the globe.[3]

Industry accounts for nearly **two-thirds** of EU chemicals consumption.[4]

[1] Chemical Industries Association
[2] The World Health Organization
[3] World LP Gas Association
[4] The European Chemical Industry Council

Manchester solutions

Our **£10.2 million** SYNBIOCHEM centre is developing new products and methods for drug discovery and production, focusing on new antibiotics and agricultural chemicals, as well as new materials for sustainable manufacturing.

We've helped to devise an efficient synthesis of **telaprevir**, ensuring that this leading medicine in the treatment of hepatitis C will become more **widely available** and **affordable**.

We've helped to create a **synthetic pathway** for biosynthesising propane gas, bringing us one step closer to the commercial production of **renewable propane**.

We're developing **faster and greener** routes to fine and speciality chemical production, partnering with GlaxoSmithKline to engineer bacterial strains to produce flavours and fragrances, enhancing their market value and **reducing the environmental impact** associated with traditional chemical synthesis.

We've developed a superior biocatalyst that will allow **efficient**, **industrial-scale production** of pravastatin.

Addressing global inequalities

Advanced materials

Cancer

Energy

Industrial biotechnology

The University of Manchester
Oxford Road
Manchester
M13 9PL

+44 (0)161 306 6000
www.manchester.ac.uk

Created by the Division of
Communications and Marketing

Royal Charter Number RC000797
M1555 07.16