THE ROYAL SOCIETY

Creating connections – Research, industry and infrastructure in the North West

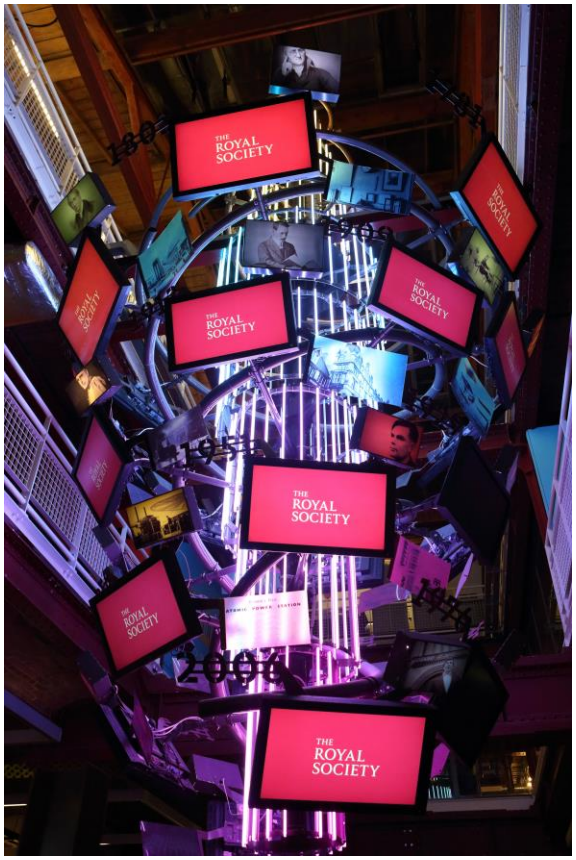
20 November 2017

On 20 November 2017, The Royal Society hosted a conference entitled *Creating connections – Research, industry and infrastructure in the North West*, held at the Museum of Science and Industry in Manchester. This conference explored the scientific and technical challenges to be faced by the North West in the next decade. Speakers from the Royal Society, local government, regional businesses, universities and research organisations shared their perspectives and discussed the role of the North West in driving UK innovation and prosperity.

This event was the first in a new series of *Creating Connections* conferences to be held across the country. They are intended to foster discussion about the scientific and technical challenges of the next decade and how different regions can consolidate and grow their strengths to benefit local people and drive innovation and prosperity across the UK. We hope that the outputs will support strategic decisions at a local level as well as underpinning the Society's work at a national level to reflect regional strengths and best practice as the UK's Industrial Strategy is developed.

A full programme with a list of speakers is available on our website at https://royalsociety.org/science-events-and-lectures/2017/11/creating-connections-manchester/

This document is not a verbatim record, but a summary of the discussions that took place during the day and the key points raised. As such, it reflects the views and opinions of the speakers, not necessarily those of the Royal Society.



Left: The Museum of Science and Industry, Manchester. **Right**: Opening talks from Dame Janet Beer DBE, Vice-Chancellor of the University of Liverpool (top) and Brian Holliday, Managing Director of Siemens Digital Factory.

Introduction

The North West is home to a wide range of companies and institutions with expertise in areas including pharmaceuticals, data and informatics, chemicals, healthcare, materials, technology and energy. The region attracts 9% of total UK investment in R&D (the 5th largest proportion out of the 11 ONS regions),[1] contributing to economic growth and creating jobs and businesses. For example, in 2015 North West businesses employed 17,000 staff in research and development,[2] while universities employed 19,000 in 2015-2016.[3] North West universities commercialised a number of their discoveries, with 1,859 spins-offs created in the region currently active in 2015-2016. These spin-offs generated a collective turnover of £145 million in 2015-2016.[4] Furthermore, 9% of all Research Council funding[5] and 9% of Royal Society grants were awarded to the North West.[6]

A number of priorities emerged from the discussions on the day including action that the North West could take to facilitate and foster greater collaboration between industry and academia, preparing infrastructure and people to enable fast take-up of data-enabled technologies and investing in a number of potential areas of emerging strength that the North West is well-placed to capitalise on. More detailed scientific priorities can be found in the main session summaries of this report.

Regional priorities

- Create spaces for academia and industry to research and develop together, utilising these academic and industrial partnerships to take a national lead in specific areas of innovation.
- Investment in faster data networks.
- Exploitation of Greater Manchester's health and social care budget to ensure the North West is an attractive destination for healthcare innovators.
- More support for local government to harness its data.
- Increased investment in novel antibiotic research.
- Enhanced investment in nuclear energy infrastructure.

Academic priorities

- Develop a better understanding of the range of different ways that UK universities benefit the local and national economy.
- Greater government support for academic collaboration with industry.
- Consistent 'low risk' collaborations with industry allow strong relationships to form which can lead to greater future investment.

Industrial priorities

- Stronger connections and collaboration with universities.
- Clearer signposting to facilitate collaborations with academia.
- In some sectors, short-term collaborations could be desirable, eg in digital technology.
- Simplification of mid-career staff retraining, for adaption to an increasingly digital workplace. Both small and medium enterprises (SMEs) and larger companies need this help.

The conference focused on three research priorities in the North-West: Materials, Human Health and Data.

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[1]Investing in UK R&D, Royal Society. 2017.
[2]Office for National Statistics. 2016 UK Business Enterprise Research and Development.
[3]Higher Education Statistics Agency. 2017. Students by HE provider, level, mode and domicile 2015/16.
[4]Higher Education Funding Council for England. 2016. Higher Education – Business and Community Interaction Survey (data for spin offs and graduate start-ups combined. Number of spin offs represents all firms created from local universities over time which are still in operation).
[5]Research Councils UK. 2015.
[6]Royal Society. 2017.

Data session
Chaired by Professor Steve Furber CBE FREng FRS, University of Manchester.

Speakers:

Professor Christopher Taylor OBE FREng, University of Manchester; Alison Kennedy, Hartree Centre; Professor Sofia Olhede, University College London; Professor Juan Medina-Ariza, University of Manchester; Professor Samia Nefti-Meziani, University of Salford.

Partnerships

- The North West has the three key factors needed to grow AI in the UK: computing capacity, novel algorithms and experts with specific skills.
- The Hartree Centre in Daresbury is the Science and Technology Council's (STFC) high performance computing, big data and cognitive technology centre. It provides businesses and researchers with access to powerful state of the art technologies, facilities and scientific computing expertise. The centre is working with Alder Hey Children's Hospital and Unilever on collaborative projects.
- The Northern Robotics Network aims to provide end users with more efficient access to robotics and AI technologies. It does so by influencing the development of AI technology and reducing costs, eg by delivering a cross-sectoral roadmap for supply chains.

Transforming health and social care

- New technologies can improve the quality of patient care, reduce costs and enhance patient experience. They can also encourage a shift away from treatment and towards prevention.
- The greater combination of data sources in healthcare systems will allow for better characterisation of patient experience and response to treatment in real-time, providing continuous feedback to healthcare professionals.
- AI can be used to build tailored treatments for individuals by using data to predict personal health outcomes. It can also offer predictive power, such that interventions may be possible before episodes of illness, and more targeted care to patients when needed. These approaches will offer 'learning health systems'.
- Healthcare can be further personalised by providing relevant explanations and personalised advice to patients.
- In the long-term, these measures may reduce healthcare costs, despite necessary high upfront investment. As earlier diagnosis becomes more commonplace, demand will likely increase.

AI in our wider society

- AI already pervades our lives by making automated decisions, often based on users' past behaviour.
- As AI develops, the implications of such automation will become more serious. The large volumes of data collected, paired with inherent biases by (lack of) design, mean that unintentional decisions could be made.
- Data can be misused, and as more examples of this become transparent to the public, opinion may shift. Businesses and scientists should be part of this public debate, to ensure AI remains beneficial to society.
- The deployment of machine learning in the criminal justice system is seen as controversial, due to fears that institutional biases (eg social and racial) may be reproduced.
- Such technologies should not be dismissed as they can offer valuable support to the services that are increasingly overworked (eg risk identification models used by police forces).

Health session

Chaired by Professor Janet Hemingway CBE FRS, Liverpool School of Tropical Medicine.

Speakers:

Rory Cameron, Gendius; Professor Niels Peek, University of Manchester; Dr Adam Platt, AstraZeneca; Dr Dave Cook, Blueberry Therapeutics; Dr Samantha Samaras, Unilever; Professor Peter Diggle, Lancaster University.

Health informatics

- 'm-health' (the delivery of medical care and public health supported by mobile devices) helps pharma and biotechnology develop products, assists healthcare professionals with delivering services under increased time pressures and spending cuts, and empowers patients through an increased understanding of their health and treatment.
- Increased connectivity with and monitoring of patients offers a new way to collect data in large volumes (eg from apps and personal health monitors), and may allow for drugs to be trialled alongside other illnesses in 'real time'.
- This technology is somewhat self-regulated as patient needs are driving development.
- The cost of m-health will likely depend on its consumer worth, not regulation.
- Devices must to be accurate if data they collect is to be valuable, especially if related to human health.
- In the future a patient's first point of call will likely not be a clinician, but a digital interface (possibly AI).
- For this to succeed, health and technology will need to work more closely. New tools are required to analyse the changing nature of data collected (eg metadata) and existing data frameworks have to be reassessed.
- Regulators have a responsibility to ensure m-health is accessible to all, especially if there are costs at the point of access.
- Genomics, currently being carried out by AstraZeneca, is being used to understand more about the heritability of many common diseases, to identify new drug targets, identify the right patients for clinical studies, and to launch drugs to the right patients.
- This process generates large amounts of drug response data, therefore success relies on the integration of genomic and clinical data. This is becoming cheaper and easier as technology improves and linked healthcare systems track their patients in greater detail.

Infectious disease

- Antibiotic resistance is a serious societal problem that calls for immediate action, with resistance now being observed as early as clinical trials. Having more active researchers in the field is imperative.
- One cause is the common chemical structure templates of the majority of antibiotics. Chemical innovation in drug synthesis is key in combatting this. Naturally occurring antimicrobials are also an under-utilised source of therapeutics.
- Infectious disease threats can be combatted by better personal healthcare practises. Hand washing remains an effective and low-cost intervention.
- Biostatistics is being applied to global population health research. Data and statistical evidence can be used to inform healthcare treatments and their administration. For example, it is important to know where treatments should be geographically targeted.

The combination of high-detail datasets combined with accessible technology offers great potential, but 'big data' should be used carefully. Large volumes of data are not necessarily valuable, especially if they carry statistical uncertainty.

Materials session

Chaired by Professor Paul O'Brien CBE FREng FRS, University of Manchester.

Speakers:

Professor Andrew Cooper FRS, University of Liverpool; Professor Andrew Sherry, National Nuclear Laboratory; Dr Damian Kelly, Croda; Professor Philip Withers, University of Manchester; Dr Michael Kember, Econic Technologies.

Research centres

- The Material Innovation Factory based in the University of Liverpool is a multi-disciplinary centre for Computer Aided Material Science (CAMS), supported as a public-private partnership between the university, Unilever and HEFCE. This is the largest physical sciences collaboration in the UK and industrial partners are being sought, such as Croda who joined in November 2017.
- The Leverhulme Research Centre for Functional Materials Design sits within this centre. It bridges the current design gap by fusing leading-edge synthesis concepts with ideas from the forefront of computer science.
- The Henry Royce Institute, to be based at the University of Manchester by 2019 (with several satellite partners across the UK), will be a world-leading hub for materials scientists and the UK national centre for research and innovation of advanced materials. The Institute will provide SMEs with access to research labs and work with industry on a range of challenges.

Translating technology

- Econic Technologies has developed catalysts to turn waste CO_2 into valuable chemicals for the plastics industry.
- It was originally a start-up at Imperial College London, and has since moved to Alderley Park, Macclesfield for its 'excellent production facilities', following a £2m grant from the EU.
- The North West gave greater access to industry and offered the chance to prove the science that supported the end application – this was difficult to do in London.

Sustainable future

- Croda is a speciality chemicals company that operates in the areas of personal care, life sciences, industrial chemicals and performance technologies. It has sites in Leek, Hull, Widnes and across the world.
- Croda is working to 'add value to naturally derived materials' by using a range of natural raw materials in its products and as part of its syntheses.
- Future goals include the processing of materials by carbon neutral technology, the production of more biodegradable materials and the utilisation of waste materials.
- The future of the energy sector is trending away from fossil fuels towards renewable and nuclear energy. Cross-sector learning is key for the North West to innovate.
- The North West is energy rich, generating 50% of UK output using a wide variety of energy generation sources. Decarbonising energy supply offers opportunities for alternative sources of power, eg renewables and nuclear.
- Nuclear power, which incurs significant upfront costs, is struggling to keep up with new technologies and innovations in energy that are being championed, such as onshore and offshore wind power.
- Following the lead of wind power, small modular nuclear reactors (SMRs) could realise the greater adoption of nuclear energy.

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Research and innovation in the North West

There is broad consensus across the political spectrum that the UK should set a target of 3% of GDP for combined long-term public and private research and development (R&D) investment. To achieve this, the UK must create a vibrant environment that fosters and encourages research and innovation across public services, universities and business, as well as attracting global investment. But what does delivering this target look like for the North West?

This document provides an insight into the current research and innovation landscape in the North West to inform discussions over how people across the North West can have the opportunity to contribute to and share the benefits of future increases in R&D investment in the UK.

15 universities[1].

2 FTSE 100 business headquarters[2].

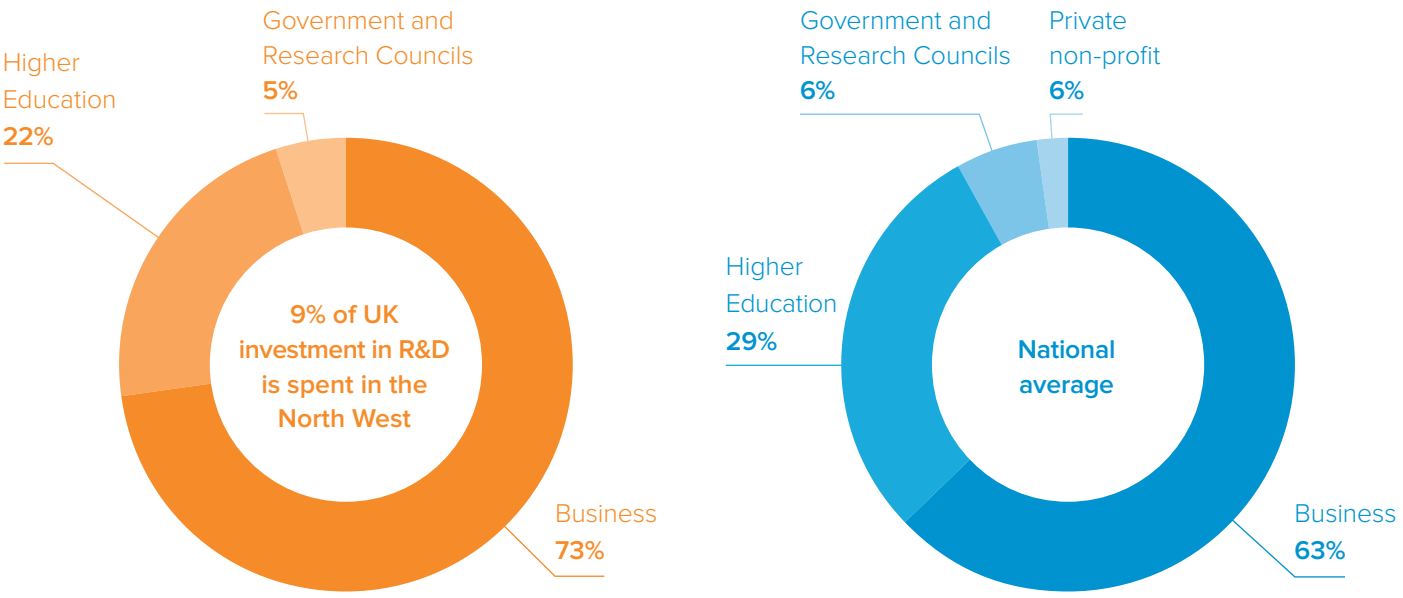
6 science parks[3].

34 business incubators and accelerators[4].

1. Universities UK. 2017 The Industrial Strategy and universities: regional briefings.
2. London Stock Exchange. 2017 FTSE 100 Constituents. Accessed on 25.10.2017.
3. UK Science Parks Association. 2017 List of members.
4. Department for Business, Energy and Industrial Strategy. 2017 Business incubators and accelerators: the national picture.

Who performs R&D in the North West

FIGURE 1



Source: Office for National Statistics. 2015 UK gross domestic expenditure on research and development.

Research funding in the North West

In 2015, Research Councils awarded **£204 million** to the North West, 9% of the UK total – £28 per capita.[5]

The North West has received **£19 million from Innovate UK** in core grant funding in 2016 – 17.

This is 6% of the total given in the UK[6].

€147 million has been awarded to projects in the North West by the EU's Framework Programmes since 2007.

This is 6% of the total given in the UK[7].

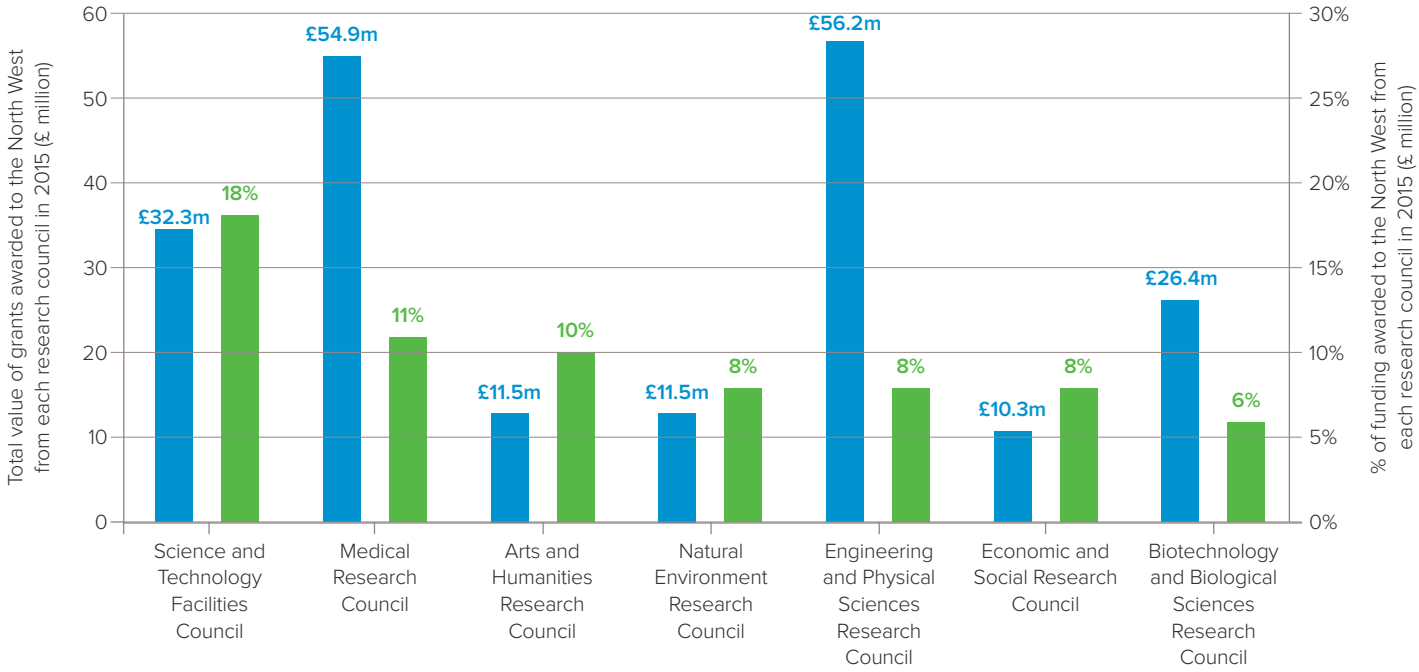
The Royal Society awarded 62 grants to the North West in 2016, totalling **£6 million**.

This is **9%** of the total awards made to the UK that year[8].

5. Research Councils UK. See http://gtr.rcuk.ac.uk/. This graph shows the total value of grants awarded to the North West where funding began in 2015. These may run for several years and the figures do not represent the total amount spent by the research councils in the North West in the 2015 calendar year as this would include funding awarded in previous years. Similarly not all the money awarded in 2015 would be spent in this calendar year.
6. Innovate UK. 2017. Innovate UK's 2016/17 funding reports. See https://innovateuk.blog.gov.uk/2017/08/29/innovate-uks-201617-funding-reports-what-do-they-tell-us/.
7. Technopolis. 2017. Understanding the role of EU funding in UK research and innovation. Data from 2007 to September 2016.
8. Royal Society. 2017.

FIGURE 2

How much did each research council award to the North West in 2015?



Source: Source: Research Councils UK. See http://gtr.rcuk.ac.uk/. This graph shows the total value of grants awarded to the North West where funding began in 2015. These may run for several years and the figures do not represent the total amount spent by the research councils in the North West in the 2015 calendar year as this would include funding awarded in previous years. Similarly not all the money awarded in 2015 would be spent in this calendar year.

How good are North West universities at commercialising their discoveries?[9]

There are **1,859** spin offs created in the North West currently active.

They employed an estimated **4,918** full-time staff in 2015 – 16.

They received **£81 million** in public and private investment in 2015 – 16.

Their total turnover was **£145 million** in 2015 – 16.

9. Higher Education Funding Council for England. 2016 Higher Education – Business and Community Interaction Survey (data for spin offs and graduate start-ups combined. Number of spin offs represents all firms created from local universities over time which are still in operation).

Education and skills

A thriving R&D environment in the North West requires a talented workforce to perform outstanding research and young people in the pipeline who are equipped with the skills they will in the future economy.

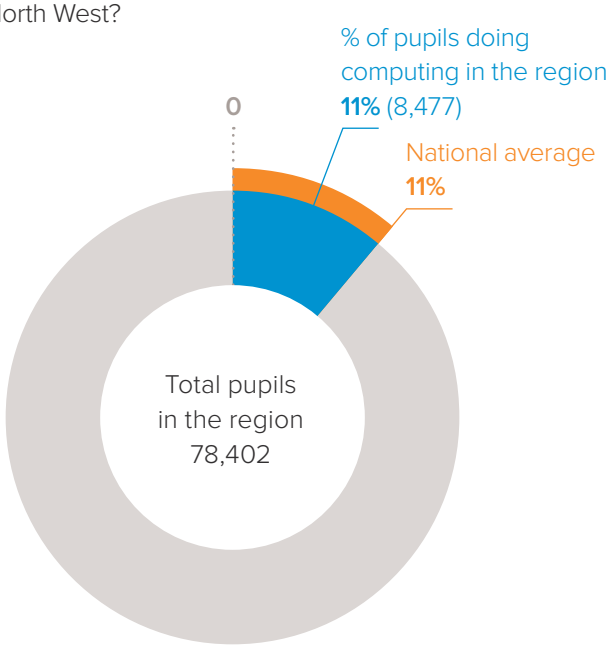
How many people are employed in R&D in the North West?

North West companies had **17,000** staff employed in R&D in 2015[10].

The North West had **18,939** research staff employed in its universities in 2015/16[11].

FIGURE 3

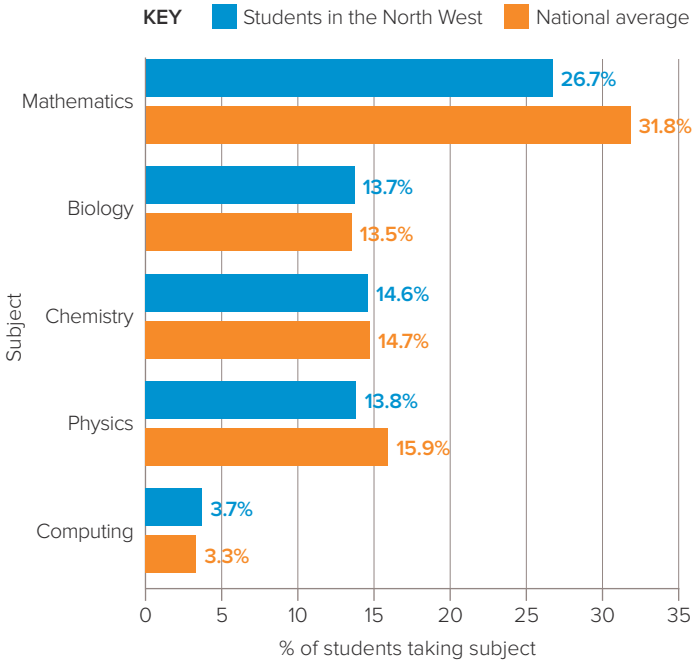
How many young people take Computer Science GCSE in the North West?



Source:
Royal Society. 2017 Royal Society. 2017 After the reboot. Data for 2016 – 17.

FIGURE 4

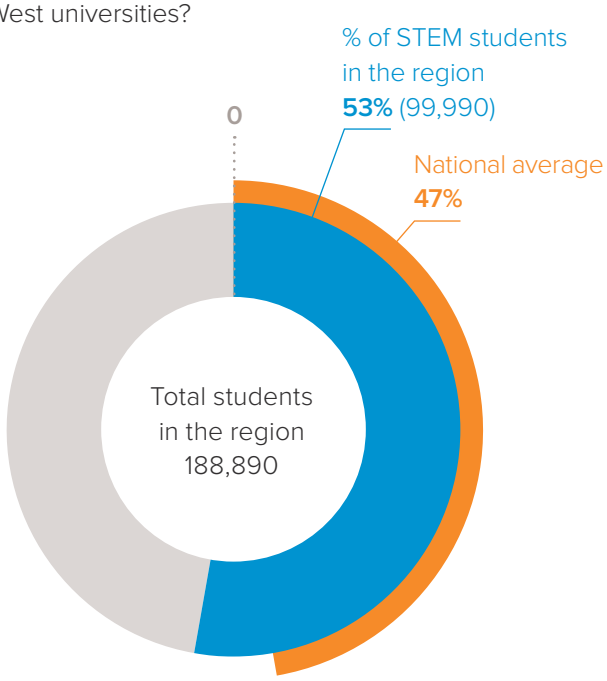
Of the young people taking A-Levels in the North West, what percentage chose to study science subjects in 2015 – 16?



Source: Department for Education. 2017 A level and other level 3 results: 2015 to 2016 (revised).

FIGURE 5

How many undergraduates study science, technology, engineering and mathematics (STEM) subjects at North West universities?



Source: Higher Education Statistics Agency (2017).
Students by HE provider, level, mode and domicile 2015/16.

10. Office for National Statistics. 2016 UK Business Enterprise Research and Development.
11. Higher Education Statistics Agency. 2017 Students by HE provider, level, mode and domicile 2015/16.