



Department  
for Business  
Innovation & Skills

**SIR ANDREW WITTY'S  
INDEPENDENT REVIEW OF  
UNIVERSITIES AND GROWTH**

Preliminary findings

JULY 2013

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# Introduction

1. In the spring the Government invited me to undertake an independent review to explore how universities can support growth by working with organisations such as Local Enterprise Partnerships (LEPs), as the local bodies responsible for setting strategies to drive economic growth across the country<sup>1</sup>.

2. In these preliminary findings I outline the themes which have emerged from the evidence-gathering phase of the Review, and which I intend to develop in the final report of the Review at the end of the summer. I also set out in more detail the implications of these for the production of Strategic Economic Plans by LEPs, on which the Government is shortly to issue guidance. In addition, to assist LEPs in developing their plans I am presenting over forty heat maps showing locations of economic activity in the sectors in the Government's Industrial Strategy, UK universities ranked in the top 200 in the world in Science, Technology, Engineering and Mathematics, and centres undertaking research on aspects of the Industrial Strategy "Eight Great Technologies". These are useful, but also only as good as the publicly available data sources on which they are based: in particular, the classifications used to produce them cannot do justice to the granularity of economic and research activities. The maps will benefit greatly from input from academic and commercial experts, so that improved versions can be included in the final report of the Review<sup>2</sup>.

3. One hundred and fifty one responses to the Review's Call for Evidence have been received. I am very grateful to everyone who responded, as I am to all those who have given up their time to attend one of the six meetings I have had with stakeholders from universities and LEPs across the country, or to join one of the meetings with members of the Review team. I would also like to thank Universities UK for their help in analysing and summarising responses from universities. The final report of the Review will give details of the responses to the Call for Evidence and meetings with stakeholders.

## Part 1: Emerging Themes

***Sectoral strengths and clusters are a sound starting point for creating regional growth, and this implies collaboration between LEPS and Universities across the country...***

4. In the Call for Evidence I put forward the hypothesis that the strongest basis for regional economic growth is activity rooted in a sound understanding of a locality's economic advantage.

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<sup>1</sup> As in the Call for Evidence I use the term "university" broadly, including eg publicly funded research taking place on Science and Innovation Campuses and other Research Institutes.

<sup>2</sup> Comments on the heat maps should be sent to the Review mailbox (universitiesandgrowth@bis.gsi.gov.uk), by 26 July 2013.

*"Hypothesis 1: The strongest basis.... locality's comparative economic advantage. The local economic partners within the Plymouth area have increasingly come to recognise this fact in more recent years..."* Plymouth Manufacturers' Group

5. Many respondents endorsed this hypothesis. In work since then and in discussion with stakeholders this has crystallised into the proposition that understanding of sectoral strengths, including clusters of associated activity is the right starting point for development of regional or local growth policy. The challenge then is to identify the sectoral strengths which offer opportunities to a given region, what are the local implications and how best to maximise the resulting benefits – which will probably involve working in partnership with other localities. I contrast this with regional growth policy in recent decades which has tended to take this or that particular geographical unit as a starting point.

6. This is more than an academic distinction. Place is important because economic activity has to happen somewhere. However administrative geographical units do not necessarily fit with economic activity linked to sectors. A number of responses to the Call for Evidence and our own work have highlighted this and the fact that sectoral strength is usually distributed across a number of locations. The maps at Annex A which show locations for research centres and industrial activity in the nuclear sector provide an illustration of this.

7. This underlines the importance of collaboration between universities and LEPs in different parts of the country. There are many examples of this sort of collaboration already, and more should be possible – England is smaller than the areas covered by some sectoral clusters in the USA. In the final report of the Review I will set out ideas on how such collaborations might work including how they might be supported by relevant national agencies. I make some suggestions below, in relation to the LEPs' preparation of economic plans during the summer.

In Yorkshire universities have a single contact point for the four LEPs in the area and a specific resource to encourage, co-ordinate and deliver such interaction. This allows LEPs to source expert information and the appropriate contact easily for each higher education institution. This is facilitated by Yorkshire Universities, a regional association of 11 higher education institutions.

8. In the Call for Evidence I drew attention to the Government's Industrial Strategy. I would not expect this collaboration to be confined to the sectors and technologies in the Industrial Strategy. We should not assume that we know what the technologies and sectors of the future will be, or that the propositions in this document are not applicable to other existing sectors such as the creative industries, for example. The Industrial Strategy must not be a means of setting in permafrost a 2012-13 perception of key future sectors and technologies. Indeed, I hope that as the Industrial Strategy is developed further more thought will be given to how it can offer support to tomorrow's technologies – those which are yet to come clearly over the horizon, and often where our most innovative SMEs are to be found.

***Universities can play a stronger role in realising the economic benefits of research insights for localities and the Industrial Strategy...***

*“We feel it is important to consider mechanisms to support growth opportunities that are of a greater scale than one single LEP area, for example those highlighted in the Industrial Strategy. The capacity, focus and capability of each LEP is variable... given the number of organisations working in this space... there is potential for fragmentation and duplication.”*  
The N8 Research Partnership

9. Evidence to the Review has emphasised the heterogeneity of both universities and LEPs (and LEP strategies), and of the LEP areas. These differing circumstances will need different models of university-LEP interaction. I do however agree with those respondents who stressed that for many LEPs producing a robust economic development plan which can be given practical effect represents a very demanding challenge.

10. LEPs were established in England as locally-developed, voluntary partnerships. They are business-led, which is an important asset in effectively catalysing local partners to progress economic growth and distinguishes them from previous models. There are 39 and their resourcing is modest (£500,000 pa each for staff etc). Many have no inherited experience or established ways of working. They are having to fill these gaps, create networks, etc afresh. Many of the LEPs I met explained how they need to find others to help them meet the demands placed on them by government departments, which have continued to grow since they were originally established. A great deal of hard work has been done and many have made substantial progress, but others have further to go. Several told me that more is being asked of them than they are equipped to deliver.

11. In my view a clear understanding of how LEPs can best operate is yet to develop, and a mechanism for LEPs to be able to adopt best practice and establish an operating model that supports greater collaboration not only with universities but also with other LEPs is still to appear. The success of LEPs will depend in part on continuing thoughtfulness about their resourcing and the number of tasks they are asked to deliver, and about their role. Successful LEPs will be able to work with and through others such as local authorities to devise sound economic strategies. However in general LEPs are neither designed nor resourced to implement such strategies, and so should not be accountable for their implementation.

12. On the other hand universities are among the largest, and sometimes the largest, economic entities in the LEPs' areas. Moreover they will frequently be very important sources of economic advantage – through research insights, provision of a vibrant technology base, international reach which can support exports and help attract inward investment, supply of skills, support and advice to local businesses – so that they will be central to Strategic Economic Plans. They have a strength and weight that LEPs lack. They have an international reach through their overseas presence, alumni, business engagement etc that offers an under-utilised resource. Many of the evidence submissions have described the contribution universities have already made, from sitting on LEP boards – which should be the norm in my view – to drafting LEP plans.

*"We are working with HE partners on the development of 'smart specialisation' plans for our world-class growth sectors; this work will underpin our local European Investment Strategy that we will deliver to Government at the end of September 2013." Enterprise M3, the Local Enterprise Partnership for mid and north Hampshire and southwest Surrey*

13. The Review will examine further the role that universities can play, both in helping to formulate LEP plans and as cornerstones of those plans for regional growth. But there is also an implied role for universities on the wider stage of the Industrial Strategy that needs to be considered.

14. The Industrial Strategy implies investigating opportunities to enhance the role of universities in contributing to growth. Universities should be central to most of the sectoral strategies because continuing innovation derived from research insights (alongside other university inputs to innovation) will be a prerequisite for the success of these sectors, as it will for all the technologies in the Industrial Strategy.

15. Universities generating cutting edge research and resulting insights may be likened to the tip of an arrow, with the arrowhead behind it representing the economic activity enabled by research-led innovation. Maximising the size of these arrowheads and their economic benefit to the UK, specifically, is fundamental to both sectoral and local growth strategies.

16. Some stakeholders have suggested to me that there is a policy tension between the "top down Industrial Strategy" and "bottom up local growth plans". There is certainly a coordination challenge in achieving the common overall goal of economic growth. Universities, rooted in localities but engaging nationally and internationally, and central to local and sectoral growth offer a means of bringing these different approaches together.

17. In the next phase of the Review I intend to examine further the scope to enhance the role of universities in relation to local economic growth and the Industrial Strategy. I am mindful that key questions will include how far universities are fitted to an enhanced role, and the importance of avoiding any adverse impact on their research and teaching functions.

***There is room to improve SME benefit from universities in terms of talent and know how...***

18. During the Review's evidence-gathering phase I have seen a wide range of examples of very successful practice in making university research and advice accessible to SMEs. Benefits to SMEs come in various forms including enabling entrepreneurs to launch businesses, consultancies, student internships, year long student placements, access to facilities, joint working on business and technological problems, running of business focussed networks, and brokering facilities. Since the Review was launched the Higher Education Funding Council for England (HEFCE) has published analysis showing an 11%

increase in activity benefitting SMEs which gain a competitive advantage from their association with universities<sup>3</sup>.

19. I have also seen evidence that SMEs find universities difficult to engage with, often because SMEs lack the time to work out how they can make effective contact. It has also been put to me that universities may be able to help medium-sized firms with the potential to enter or grow their export markets to overcome some of the distinct difficulties they face.

20. Since the Review started Lord Young has published *Growing Your Business*, the second part of his report on small firms<sup>4</sup>. One of his findings is that business schools could do more to help small firms to grow, and he describes an initiative the Association of Business Schools is to lead to help bring this about. Lord Young's finding chimes with what I have heard during meetings with stakeholders, where I heard examples of university business schools having a transformative effect on SMEs through practical advice and support on running and developing the business.

*"The Goldman Sachs 10,000 Small Businesses programme has shown that tremendous growth can be achieved by companies in any sector with good leadership skills."* Aston University

21. This is an important subject. Strengthening our innovative SMEs is one of the ways in which we may be able to meet a challenge I posed in the Call for Evidence, namely how to raise our game in securing more of the commercial benefits of breakthroughs in UK universities for the UK. In the next phase of the Review I intend to explore this further, including the work of university business engagement units and also whether there are opportunities to increase the contribution made by business schools, recognising that many business schools are largely self-funded and thus financially independent.

***Incentives, and national organisations supporting research, innovation and growth, can be better aligned to deliver to their full potential for the Industrial Strategy and for local growth...***

22. There are several government or government-funded organisations whose roles make them central to the Review. These include the Research Councils and HEFCE, who between them provide the great majority of public money for universities. The Technology Strategy Board and UK Trade and Investment (UKTI) have critical roles in realising the economic potential of research and sectoral strengths and clusters around the country.

23. Apart from UKTI these bodies are important funders of research and innovation. During meetings with stakeholders I have heard concerns about the fragmentation and complexity of funding arrangements. Sometimes this has focused on the requirements attached to European funding sources, but it has not been confined to this. Concerns include the time involved in preparing applications for funding and the number of funding streams. It has been suggested to me that for research-based SMEs demonstrating

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<sup>3</sup> Analysis by HEFCE of the twelfth annual Higher Education – Business and Community Interaction (HE-BCI) survey <http://www.hefce.ac.uk/news/newsarchive/2013/name.81928,en.html>

<sup>4</sup> *Growing your Business: a Report on Growing Micro Businesses – the Second Part of the Report on Small Firms*. Lord Young, May 2013.

compliance with requirements to access funding intended to benefit such companies can be a material hurdle in its own right.

*“In this country you don’t just have to be an entrepreneur: you have to be an endurance entrepreneur.”* Meeting with universities and LEPs, Newcastle, April 2013

24. Streamlining of funding, while continuing to ensure quality of funding decisions, is an issue I will examine in the next phase of the Review. I am also concerned that funding should give aligned and optimal incentives to recipients. Alignment of incentives goes to the alignment of the objectives of the funding organisations, and measurement of performance against metrics which express the outcomes that matter. I would expect the objectives of these organisations to reflect the Government’s Industrial Strategy and its policy of supporting local growth so that, allowing for the differences arising from their distinct functions, there is an overarching commonality of purpose in relation to supporting growth through the Industrial Strategy and local growth. These considerations about metrics and objectives are not particular to funding functions and apply to UKTI too, although it is not a funding body.

*“While innovation and industrial strategy are – rightly – retained as national-level functions, the difficulty is...the confused space between national and local levels.”* Liverpool City Region Innovation Board.

25. In my meetings with stakeholders I have also heard concerns that national bodies are insufficiently connected to localities and their priorities. How are national organisations adjusting to reflect these local dimensions, or the regional centres of activities within the Industrial Strategy? This is a question I will examine in the next phase of the Review.

### Emerging Themes: Next Steps

26. In a number of places I have indicated where I intend to develop these emerging themes for the final report of the Review. I am very much looking forward to producing that report: the evidence-gathering phase of the Review has only reinforced my belief that this is a moment of opportunity in this field – partly because of contextual factors such as the development of the Industrial Strategy, but also because of the enthusiasm and sense of opportunity displayed by so many of those I have met since the Review began.

*“While the UK’s Universities are of extraordinary quality and are definitely open for business, there is a sense that we have only just started to unleash the potential.”* The Technology Strategy Board.

## Part 2: LEPs’ Preparation of Strategic Economic Plans

27. LEPs are currently developing their strategic plans. The Government is to issue guidance on their plans for spending the Single Local Growth Fund, and the European Structural and Investment (ESI) funds 2014-20.

28. Approximately €6bn of ESI funds is to be allocated to English LEPs in June 2013 for the period 2014-2020. A further €3.5bn will be allocated to the rest of the UK. Up to €1bn

of this will be prioritised for innovation and the commercialisation of Research and Development (R&D). The European Commission requires that the plans to spend this money should conform to a methodology called “Smart Specialisation.”

### **Smart Specialisation.**

Smart Specialisation seeks to ensure that proposed actions are based upon sound evidence that properly reflects the comparative advantages of the physical and human assets of particular places in the global economy. It emphasises the need to ensure that activities are fully integrated in the local economy and its supply and value chains. It helps to build connections of ideas, finance and trade with similar activities elsewhere. It promotes also the use of enabling technologies that can transfer and add value between related sectors.

### ***A sound local economic plan must be informed by a national evidence base...***

29. I welcome Smart Specialisation, which reflects my own proposition that regional growth may best be rooted in sound understanding of a locality's comparative advantage. This understanding must be based in a clear-eyed and rigorous analysis which is benchmarked against other localities so that it exposes genuine local advantages and, where markets are global, tests these against global criteria. In life science, for example, a case for investment will need to show potential to be among the best in the world, not merely the best in a region of England. In addition a sound assessment of local comparative advantage requires awareness of others' strengths to inform comparison and to identify opportunities for collaboration. I would expect LEPs to identify a small number of priorities for local investment strategies for innovation in line with the genuine potential for growth. These priorities will be the areas in which local places can realistically hope to excel.

30. LEPs need an overview of the whole country if their plans are to be both individually sound and collectively coherent, and thereby deliver best value for their investment of public money in R&D and innovation. For these reasons I commissioned the production of heat maps with the aim of giving LEPs a starting point for conducting an informed assessment of local comparative advantage, including where there are centres of research strength and also of associated economic activity in the sectors and technologies in the Industrial Strategy.

31. The maps presented in the annex at the end of this document show locations of economic activity in the sectors in the Industrial Strategy. They show UK universities ranked in the top 200 in the world in Science, Technology, Engineering and Mathematics. They also show centres undertaking research on aspects of the Industrial Strategy “Eight Great Technologies”.

32. It has not been possible to find a methodology (other than collecting opinions) to identify centres where there is excellent research relevant to most sectors in the Industrial Strategy, and so this is not mapped. I find it unsatisfactory in principle that research centres relevant to Industrial Strategy sectors cannot be presented on a robust and accepted basis. For LEPs and SMEs this lack of transparency will make things more difficult in practice too. In addition there is a sense in which it is misleading: maps based in academic classifications (such as the attached STEM subject maps) do not do justice to centres which excel in some specific, often applied, forms of research. I think it important

to overcome these difficulties as far as that is possible, in order to establish a robust basis for identifying these centres, and also those excelling in more focussed subject areas. I would welcome views on what might be a robust basis for identifying these research centres<sup>5</sup>.

33. The annexed note which introduces the heat maps explains the methodologies used. At this stage the maps are a work-in-progress because they have been produced in a limited time, without the opportunity to consult on them. They will benefit from the comments of all those with relevant knowledge, and I would welcome views on their content and methodology so that improved versions can be produced<sup>6</sup>. In the final report of the Review I aim not only to present refined versions of these maps, but also heat maps showing all clusters, i.e. whether or not the activities are related to the Industrial Strategy.

34. LEPs will want to seek to understand the quality and type of employment revealed by the heat maps, and to keep in mind that the maps have had to draw on two different kinds of categorisation: academic subject classifications, and Industrial Sector sectors and technologies. Nonetheless I believe that, used in conjunction with other available evidence (for example, local knowledge of university strengths), they will be a useful resource for LEPs in identifying sectoral priorities for their economic strategies.

***European Structural and Investments funds are an opportunity for Local Enterprise Partnerships to make the most of what universities can do....***

*"There is no doubt that, when carefully managed, European funds can be a major enabler of productive collaborations between industry and universities, particularly in regions where SMEs tend to have limited resources for investment and R&D." Million+*

35. I have already commented on enhancing the role of universities in contributing to growth, and on the expertise they may be able to offer LEPs. ESI funds (and any other funds which may have an innovation or R&D component) offer LEPs an opportunity to invite universities to play this enhanced role.

*"Any plans that LEPs are required to produce should include in their guidance the need to engage with universities as key economic partners." Universities UK.*

36. LEP plans could achieve this by directing a large share of innovation money towards excellent universities and research centres, but within a framework which includes development of new infrastructure where university/business interactions can be maximised and economic outcome metrics, and which ties the future flow of funds to these measured outcomes. I envisage outcomes expressing the goal of maximising the economic benefit from the research being supported, such as numbers and value of jobs, underpinned by a plan indicating how these will be achieved, addressing questions such as supply of skills, support for supply chain SMEs, increasing business levels of business investment in R&D and intangible assets, etc. These outcomes underline the breadth of

<sup>5</sup> Comments on the heat maps should be sent to the Review mailbox (universitiesandgrowth@bis.gsi.gov.uk), by 26 July 2013.

<sup>6</sup> Comments on the heat maps should be sent to the Review mailbox (universitiesandgrowth@bis.gsi.gov.uk), by 26 July 2013.

the contributions that universities can make – realising the economic potential of what I have called “arrow tip research” will engage functions such as providing skilled people, supporting local businesses, running business focussed networks, etc.

37. LEPs have few resources, and I would expect most to look to universities to write this sort of plan. In addition ESI Funds are subject to complex procedural requirements which impose an appreciable compliance burden. More broadly, I would expect universities to want to own preparation of plans that they would have a central responsibility for delivering.

***Collaboration is essential...***

*“It is essential that we provide LEPs with the ability to foster connections with networks of universities with the right specialisms to support their growth plans. Collaborations between universities to ensure broad coverage where it benefits the local economy are important, so a university in a particular LEP area should not focus exclusively on that area and equally allow other universities from out of the area to transfer their expertise into that area too”. Buckinghamshire Thames Valley LEP.*

38. There are 39 LEPs, all tasked with producing local economic plans. This creates risks of sub-optimal duplication on the one hand, and missed opportunities on the other.

39. The duplication risk arose repeatedly during my meetings with stakeholders. England should not have twenty or thirty bioscience parks. The mitigation of both risks is the same: the creation of mechanisms to enable LEPs to consider the characteristics of other LEP areas too, and facilitation of collaboration between LEPs (and between universities).

40. The heat maps show very clearly that sectors are typically characterised by centres of economic activity in a number of locations around the country, and the same is true of centres of excellent research. I would encourage LEPs to connect with others who have research or economic centres in the same fields, drawing on the annexed maps and other evidence to identify where in the country activities should be joined up to establish networks that maximise the economic benefits of funding.

41. I would expect some LEPs to have several separate sector-centred collaborations with different sets of partners according to the geographical characteristics of each sector. These connections should involve universities as well as LEPs and universities may often be best-placed to take the lead in bringing parties together.

42. Multi-party collaborations of different sorts of institution in different parts of the country are a significant organisational challenge. There is often likely to be a good case for agreeing that one institution should lead the collaboration, and make the running in producing a plan for agreement by all.

43. I have heard suggestions to establish an oversight forum of national experts to guide LEP investment decisions in R&D commercialisation, in order to help LEPs to set the best priorities and pull through the right proposals. Thought is needed as to how this might work, including whether it should simply be a resource available to LEPs who wish to use it or something a little more formal. It is an idea I will explore it further in the next phase of the Review.

## ANNEX

### Heat Maps for the Industrial Strategy Sectors and Eight Great Technologies

1. Most of the attached heat maps show numbers of local units and employment Location Quotients (LQs) by local authority in the Industrial Strategy sectors (explained in paragraph 10). (Maps for Nuclear, Oil and Gas, Agri-tech and Offshore Wind have different bases, which are explained below in each case.) Maps have also been provided showing universities and other institutions which have received Research Council funding in the Eight Great Technologies (explained in paragraph 6). Analysis by Aston University for this Review looking at the QS World University Rankings<sup>7</sup> shows that the UK ranks second behind the US in terms of the number of universities included in the world top-200 list in fields relevant to the Industrial Strategy and Eight Great Technologies. Maps have been provided showing the UK universities appearing in the QS World University Rankings in the relevant academic fields identified by Aston University and other STEM<sup>8</sup> subjects. More information is available in paragraph 22.

2. LEPs will want to seek to understand the quality and type of employment revealed by the heat maps, and to keep in mind that the maps have had to draw on two different kinds of categorisation: academic subject classifications, and Industrial Sector sectors and technologies. Nonetheless the Review believes that used in conjunction with other available evidence (for example, local knowledge of university strengths), they will be a useful resource for LEPs in identifying sectoral priorities for their economic strategies.

3. The Review will be carrying out further work to identify where sectors are located in the UK, and to identify key universities and other research institutions carrying out research relevant to the Industrial Strategy sectors, and looks forward to comments on the maps presented here<sup>9</sup>. The intention is to publish updated maps with the final report of the Review at the end of the summer.

4. Information is provided below about the definitions of the Industrial Strategy sectors and the data sources used.

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<sup>7</sup> <http://www.topuniversities.com/subject-rankings>

<sup>8</sup> Science, Technology, Engineering and Mathematics

<sup>9</sup> Comments on the heat maps should be sent to the Review mailbox ([universitiesandgrowth@bis.gsi.gov.uk](mailto:universitiesandgrowth@bis.gsi.gov.uk)), by 26 July 2013.

## What the Industrial Strategy sector maps show

5. It is important to note that the size of the enterprise bands vary with the overall size of the sector, and colours are not comparable between different sectors. Local unit counts reveal where there are large numbers of businesses, but do not distinguish between businesses of different sizes, so users cannot tell whether the cluster is responsible for significant levels of employment, or whether the sector is particularly concentrated in an area. For this purpose the LQ maps should be used. Sector information is based on the industry category (the "SIC code") reported by the businesses in question to government, and in some sectors the wider supply chain will not therefore be shown, where supply chain businesses have reported themselves as part of another sector classification.

## What the Eight Great Technology maps show

6. These maps show universities and other research institutions which have received grants from the Research Councils related to the Eight Great Technologies. The information covers recipients of Research Council funding in the current rounds: it is likely that excellent research in any of these areas is also being funded through general unclassified funds that cannot be allocated to one or another of the Eight Great Technologies. The Review will explore whether it is possible to identify other funding sources (eg industry, charities, EU funds) to extend the information base from which these maps are derived. We would welcome views on this<sup>10</sup>.

### Data

#### Businesses

7. Information on the number of local units and employment by local authority has been extracted from the Inter-departmental Business Register (IDBR)<sup>11</sup>. This register is

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<sup>10</sup> Comments on the heat maps should be sent to the Review mailbox (universitiesandgrowth@bis.gsi.gov.uk), by 26 July 2013.

<sup>11</sup> <http://www.ons.gov.uk/ons/about-ons/who-we-are/services/unpublished-data/business-data/idbr/index.html>

compiled and maintained by the Office for National Statistics for the purposes of statistical surveys and analysis, and includes all UK enterprises registered for VAT and/or PAYE. Enterprises are classified according to the Standard Industrial Classification 2007 (SIC2007)<sup>12</sup>.

8. For most of the sectors the maps show local unit counts and local unit employment LQs. A local unit is an individual site (factory, shop, office, etc.) at which an enterprise conducts its business. It might be an individual business or a branch of a large business, so this measure provides detailed geographic information. Employment figures are the sum of the employees plus any working proprietors (owners directly involved in the business).

9. Local unit counts reveal where there are clusters of businesses, but do not distinguish between businesses of different sizes, so users cannot tell whether the cluster is responsible for significant levels of employment.

10. For the employment maps Location Quotients have been calculated. Location Quotients are a way of quantifying how concentrated a particular industry, cluster, occupation, or demographic group is in a region as compared to the nation. It can reveal what makes a particular region “unique” in comparison to the national average<sup>13</sup>.

11. In the maps we have only shown those areas which have an LQ greater than one – that is, those areas with a higher than the national average proportion of employment in the relevant sector.

The equation is:

$$LQ = \frac{e_i / e}{E_i / E}$$

Where:

$e_i$  is sector employment in an area

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<sup>12</sup> <http://www.ons.gov.uk/ons/guide-method/classifications/current-standard-classifications/standard-industrial-classification/index.html>

<sup>13</sup> <http://www.economicmodeling.com/2011/10/14/understanding-location-quotient-2/>

$e$  is total employment in an area

$E_i$  is national sector employment

$E$  is national total employment

12. For some sectors – nuclear, offshore wind, and agri-tech – information was not available from the IDBR as these sectors are not identified in the SIC2007. Although the oil and gas sector can be identified in the SIC2007, this gives a very limited picture of the sector as it excludes the majority of the supply chain. Alternative information has been used to produce the maps, and the sources are outlined in the relevant sector section below.

## Universities

13. While information on UK universities identified as world-leading does exist, it is not available by Industrial Strategy sector – however maps have been provided showing UK universities in the QS World Top 200 by research field in STEM subjects.

14. There are several sources of international university rankings, with different strengths. The Review has chosen to use the QS World University Rankings<sup>14</sup>. These rankings combine the results of academic and employer reputation surveys with information from Scopus<sup>15</sup> on citations to produce an overall ranking by subject area. While this does introduce an element of perception, a strength of this source is that it provides a more detailed breakdown of subject areas. Even so it is not sufficiently granular necessarily to convey world class performance. A more specific research capability may not be captured. The rankings identify the top 50 universities globally in order, and then group universities into rank bands, e.g. 51-100. Within bands, universities are shown alphabetically by full title. The maps show the UK universities included in the Top 200, with their world rank given in brackets.

15. The subject areas included within STEM are:

- Agriculture and Forestry

<sup>14</sup> <http://www.topuniversities.com/subject-rankings>

<sup>15</sup> <http://www.info.sciverse.com/scopus>

- Biological Sciences
- Chemical Engineering
- Chemistry
- Civil and Structural Engineering
- Computer Science
- Earth and Marine Sciences
- Electrical and Electronic Engineering
- Environmental Science
- Materials Sciences
- Mathematics
- Mechanical, Aeronautical and Manufacturing Engineering
- Medicine
- Pharmacy and Pharmacology
- Physics
- Psychology

16. The Eight Great Technologies maps show the locations of universities which have received grants from the UK Research Councils related to the technologies. There are some caveats to this data:

- Disciplines and departments do not match with industrial sectors of activity. In order to provide real but partial information on the location of some of the excellent research activity in each of the Eight Great Technologies, the Research Councils reported on universities and research institutions that receive funding under the technologies.
- These technologies and the associated funding were launched in 2013 and thus recipients listed cover only the partial funding dedicated to these particular technologies.
- The list covers recipients of funding in the current rounds: it is likely that excellent research in any of these areas is also being funded through general unclassified funds that cannot be allocated to one or another of the technologies.
- For agri-science and big data a cut-off of £1m funding per recipient has been applied to restrict the map to showing the most significant recipients of funding.
- As indicated above, research funded from other sources also takes place, and the Review will explore whether it is possible to identify other funding sources to extend the information base from which these maps are derived. We would welcome views on this.<sup>16</sup>

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<sup>16</sup> Comments on the heat maps should be sent to the Review mailbox (universitiesand[growth@bis.gsi.gov.uk](mailto:growth@bis.gsi.gov.uk)) by 26 July 2013

## Industrial Strategy sectors

17. The Secretary of State for Business, Innovation and Skills, Vince Cable, set out the Government's approach to industrial strategy<sup>17</sup> in September 2012. BIS subsequently published an analysis<sup>18</sup> of industry sectors outlining the factors considered when choosing the sectors in the Industrial Strategy.

18. Strategies are being produced for each of these sectors, and will be published by summer 2013. Links to those strategies already published are provided in the footnotes. The sectors are:

### Advanced Manufacturing

- Aerospace<sup>19</sup>
- Automotive
- Life Sciences<sup>20,21</sup>
- Agri-tech

### Knowledge Services

- Education (NB the Review is not looking at this sector)
- Information economy<sup>22</sup>
- Professional and business services

### Enabling sectors

- Nuclear<sup>23</sup>
- Oil and gas<sup>24</sup>

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<sup>17</sup> <https://www.gov.uk/government/speeches/industrial-strategy-cable-outlines-vision-for-future-of-british-industry>

<sup>18</sup> <https://www.gov.uk/government/publications/industrial-strategy-uk-sector-analysis>

<sup>19</sup> <https://www.gov.uk/government/publications/lifting-off-implementing-the-strategic-vision-for-uk-aerospace>

<sup>20</sup> <https://www.gov.uk/government/publications/uk-life-sciences-strategy>

<sup>21</sup> <https://www.gov.uk/government/publications/strategy-for-uk-life-sciences-one-year-on>

<sup>22</sup> <https://www.gov.uk/government/publications/information-economy-strategy>

<sup>23</sup> <https://www.gov.uk/government/organisations/department-for-business-innovation-skills/series/nuclear-industrial-strategy>

- Offshore wind
- Construction<sup>25</sup>

19. The Review has not looked at the Education Industrial Strategy sector as it is a different type of sector, focusing on education exports rather than domestic education activity, in particular the economic impact of overseas students. The following descriptions explain what is included in each of the remaining 10 sectors.

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<sup>24</sup> <https://www.gov.uk/government/publications/uk-oil-and-gas-industrial-strategy-business-and-government-action-plan>

<sup>25</sup> <https://www.gov.uk/government/publications/construction-2025-strategy>

## Aerospace

In SIC2007 terms (see paragraph 5 above) the aerospace sector is here defined as:

- 30300          Manufacture of air and spacecraft and related machinery
- 33160          Repair and maintenance of aircraft and spacecraft

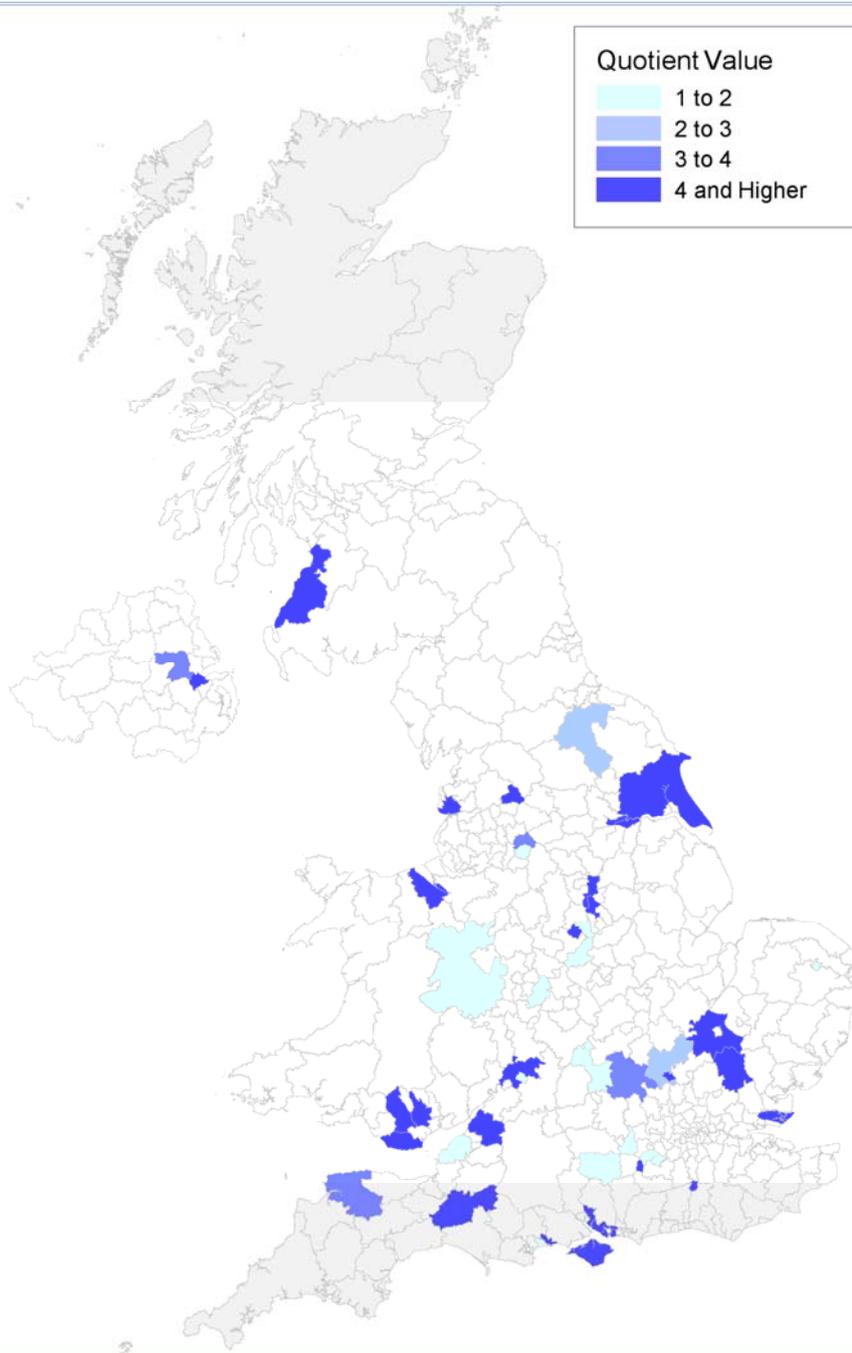
The UK's aerospace industry spans most of the UK, with large geographical clusters mainly centred around companies in the North West, Midlands, South West, and South East of England; in Wales (Broughton); in Scotland (Prestwick and Glasgow); and in Northern Ireland (Belfast). These clusters benefit from the availability of large and sufficiently skilled labour forces, easy access to suppliers, and knowledge spill-overs.

Recent investments by industry have created world-class facilities such as the new Airbus A350 wing factory at Broughton in North Wales, GKN's advanced wing component facility near Bristol, Rolls-Royce's new engine-blade casting facility at Rotherham, Bombardier's composite wing facility in Belfast and Spirit AeroSystems's new composite development centre in Prestwick.



Department for Business, Innovation & Skills

### Employment Location Quotient - Aerospace



Quotient Value	
1 to 2	Lightest Blue
2 to 3	Light Blue
3 to 4	Medium Blue
4 and Higher	Darkest Blue

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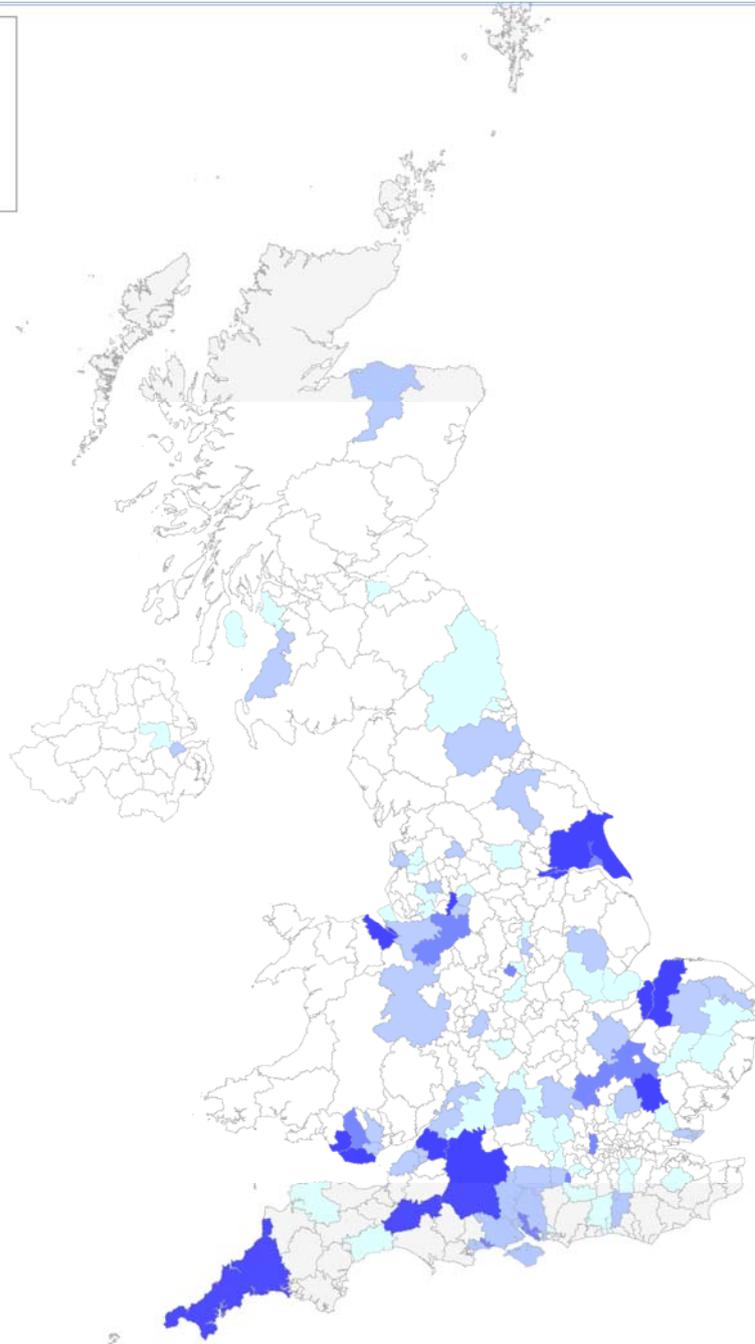


Department for Business, Innovation & Skills

### Aerospace

Enterprise Count

- 5 to 10
- 10 to 15
- 15 to 20
- 20 to 50



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## Automotive

It should be noted that this sector covers a range of activity including the large scale manufacture of vehicles for general use and the manufacture of parts and accessories, as well as motorsport. In SIC2007 (see paragraph 5 above) terms the automotive sector is here defined as:

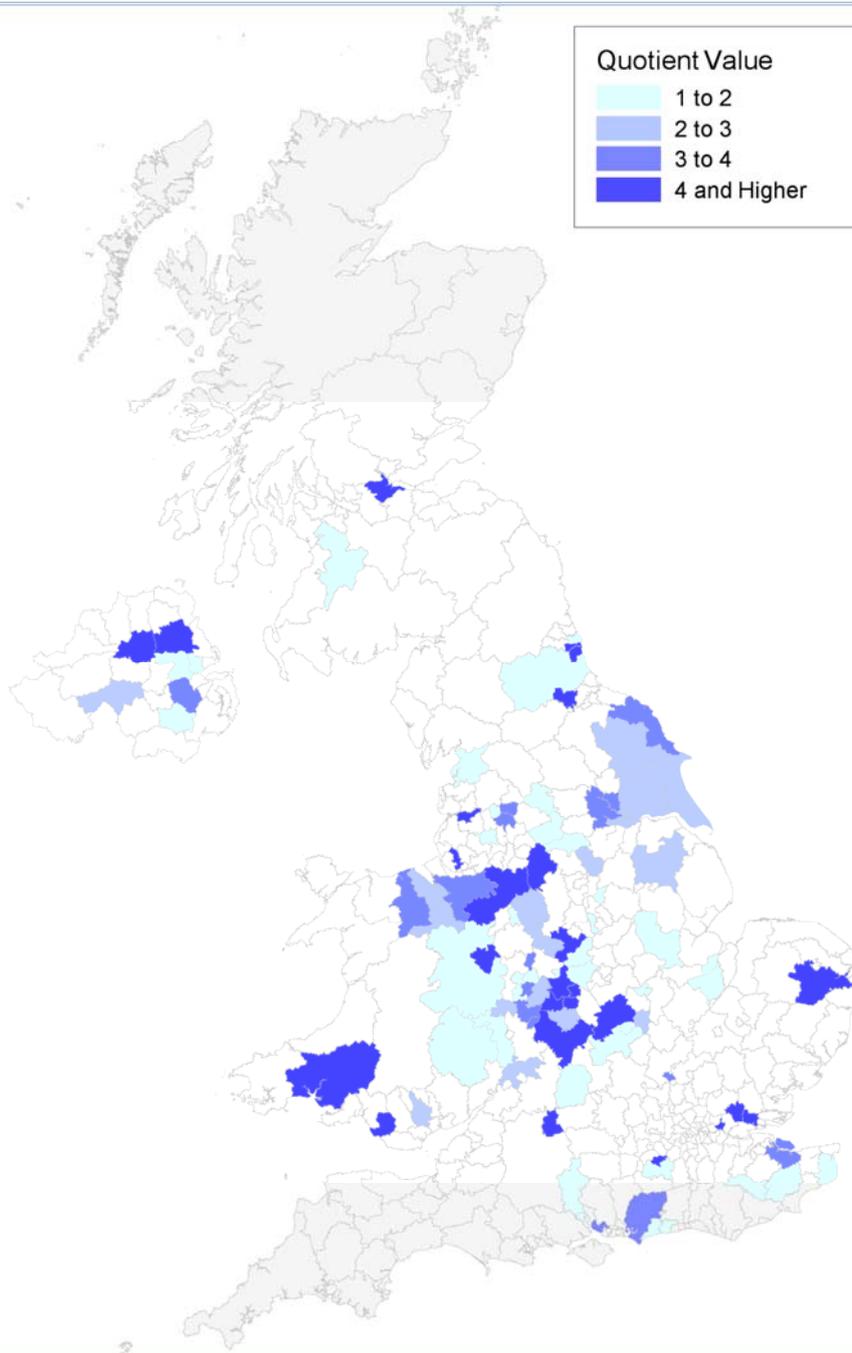
29100	Manufacture of motor vehicles
29201	Manufacture of bodies (coachwork) for motor vehicles (except caravans)
29202	Manufacture of trailers and semi-trailers
29203	Manufacture of caravans
29310	Manufacture of electrical and electronic equipment for motor vehicles and their engines
29320	Manufacture of other parts and accessories for motor vehicles

- The UK automotive industry is mostly clustered around the major vehicle plants
- The largest concentrations are in West Midlands (JLR), North West (JLR, GM, Bentley, Leyland) and North East (Nissan)
- South Wales also has a cluster around Bridgend (Ford), also East Midlands (Toyota), Swindon (Honda) and Norfolk (Lotus)
- Other regions also have manufacturing clusters that initially grew around other industries, that do not have a large vehicle maker in the immediate vicinity, but now count the automotive sector amongst their customers. This particularly includes Yorkshire and Manchester, and also parts of the South East.
- Caravan manufacturing is captured within the automotive sector statistics, and this has a particular concentration around Hull
- Motorsport activities are widespread around UK, but with much of the high-end industry (especially F1) located in the area between Oxford and Cambridge (so-called 'motorsport valley')



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### Employment Location Quotient - Automotive



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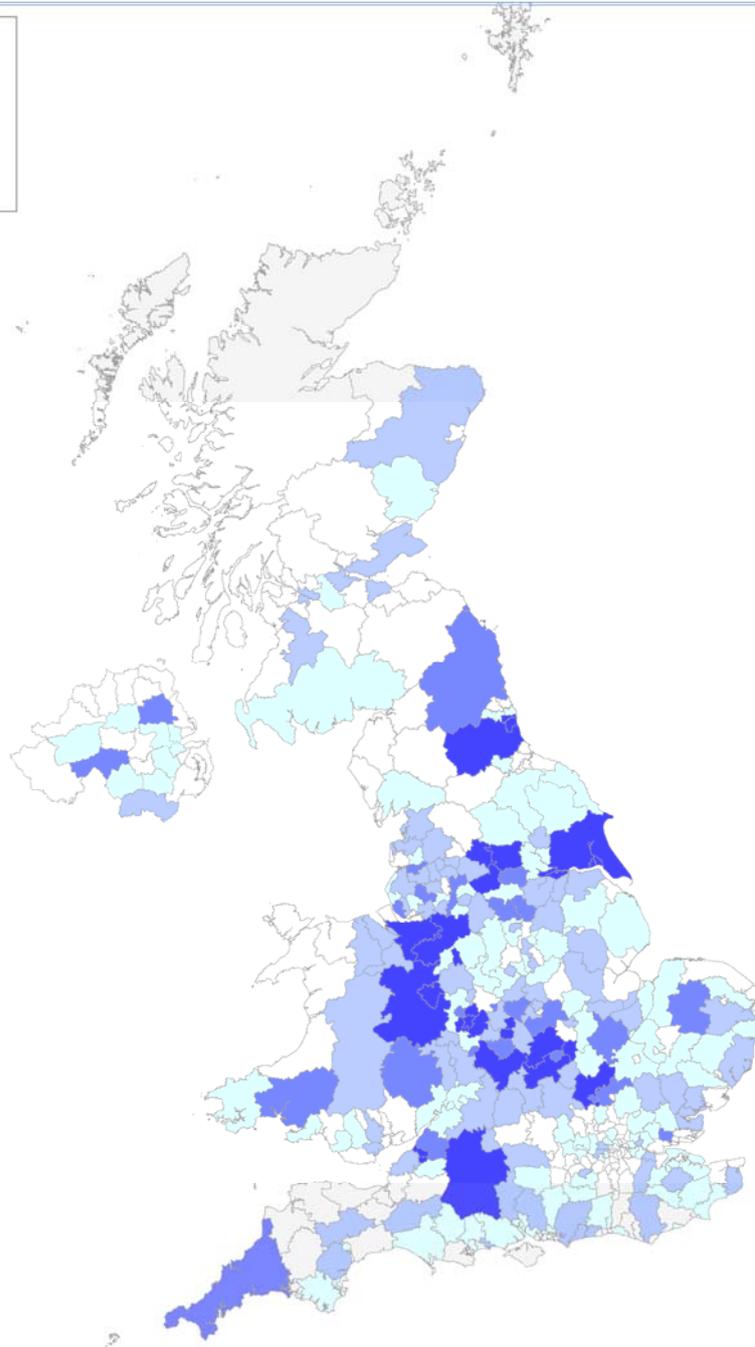


Department for Business, Innovation & Skills

### Automotive

Enterprise Count

- 5 to 10
- 10 to 15
- 15 to 20
- 20 to 70



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## Life Sciences

22. The life sciences sector includes pharmaceuticals, medical technologies, diagnostics and medical biotechnologies. In SIC 2007 (see paragraph 5 above) terms it is here defined as:

21 Manufacture of basic pharmaceutical products and pharmaceutical preparations

26.6 Manufacture of irradiation, electromedical and electrotherapeutic equipment

32.5 Manufacture of medical and dental instruments and supplies

72.11 Research and experimental development on biotechnology

This last sub-sector is also included in the Professional & Business Services sector. The SIC codes selected do not exactly match the definition of this sector but are the closest available. We have therefore also reproduced maps of the medical technology, medical biotechnology and pharmaceutical sectors from *Strength and Opportunity 2012*<sup>26</sup>, produced using the BIS Bioscience and Health Technology Database.

- The life science (drug discovery and development) sector has particular clusters around academic centres which are strong in health life sciences especially the Cambridge/Oxford/London triangle, and also around Manchester and Edinburgh/Glasgow.
- Manufacturing of pharmaceutical products is widely dispersed but there is a growing cluster of speciality pharmaceutical manufacturing on Teesside and Tyneside in the North East and Speke (Merseyside) is home to commercial scale manufacturing of both biologic products and vaccine manufacturing.
- The life science (medical device and diagnostics) sector is a very diverse industry in terms of products. It is widely dispersed but strong in the Midlands, both West and East, where it has built on engineering and materials science strengths as well as academic centres. There are particular regional strengths in the following medical technology sub-sectors :
  - Orthopaedic devices: Yorkshire

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<sup>26</sup> [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/36736/12-p90-strength-and-opportunity-2012.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/36736/12-p90-strength-and-opportunity-2012.pdf)

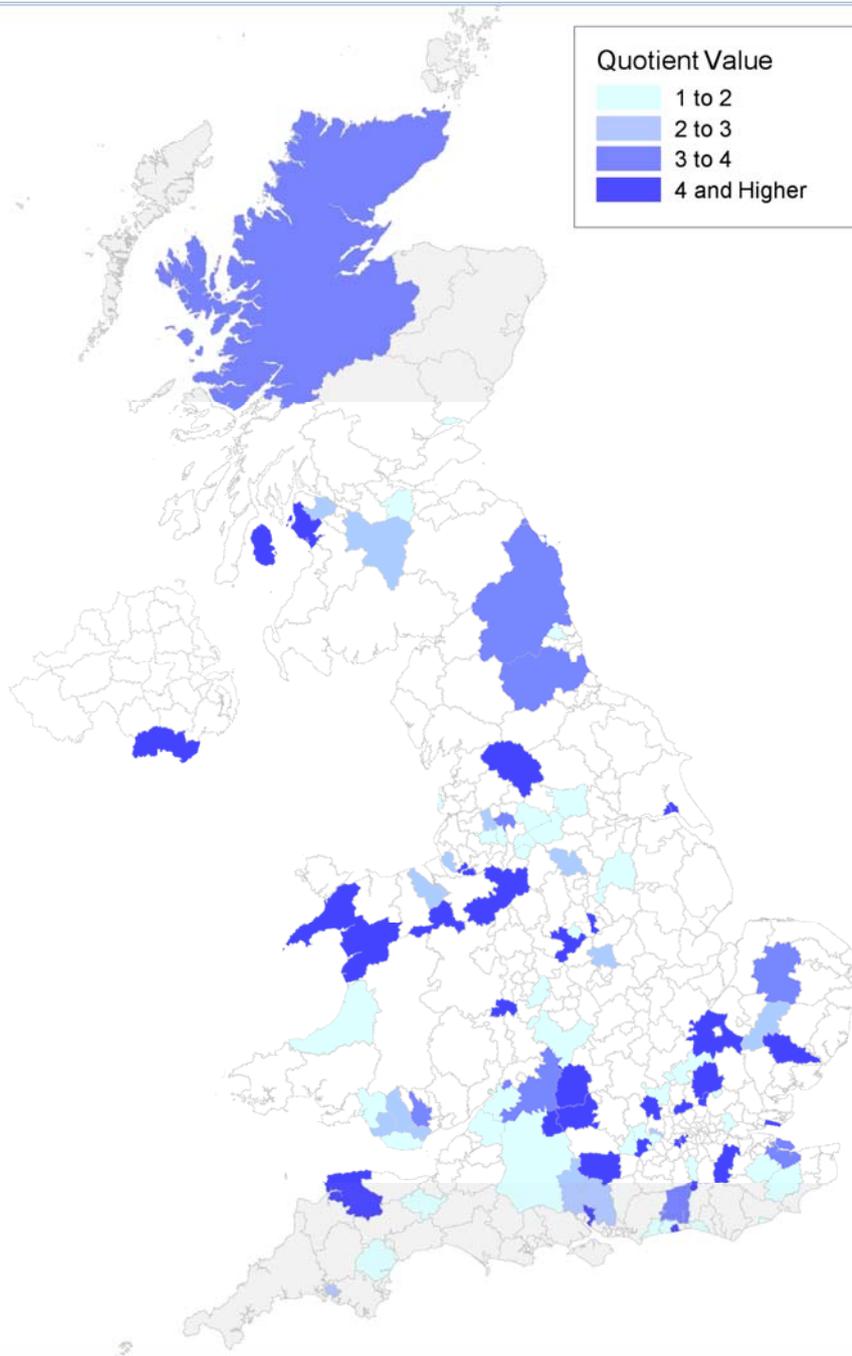
- In vitro diagnostics: South East and East England
- Wound care: Midlands and Yorkshire/Humberside

Note - these are comments on the database maps rather than the Enterprise Count and Employment Location Quotient maps due to the fact that the SIC classification system doesn't identify some major life science sectors.



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### Employment Location Quotient - Health Life Sciences



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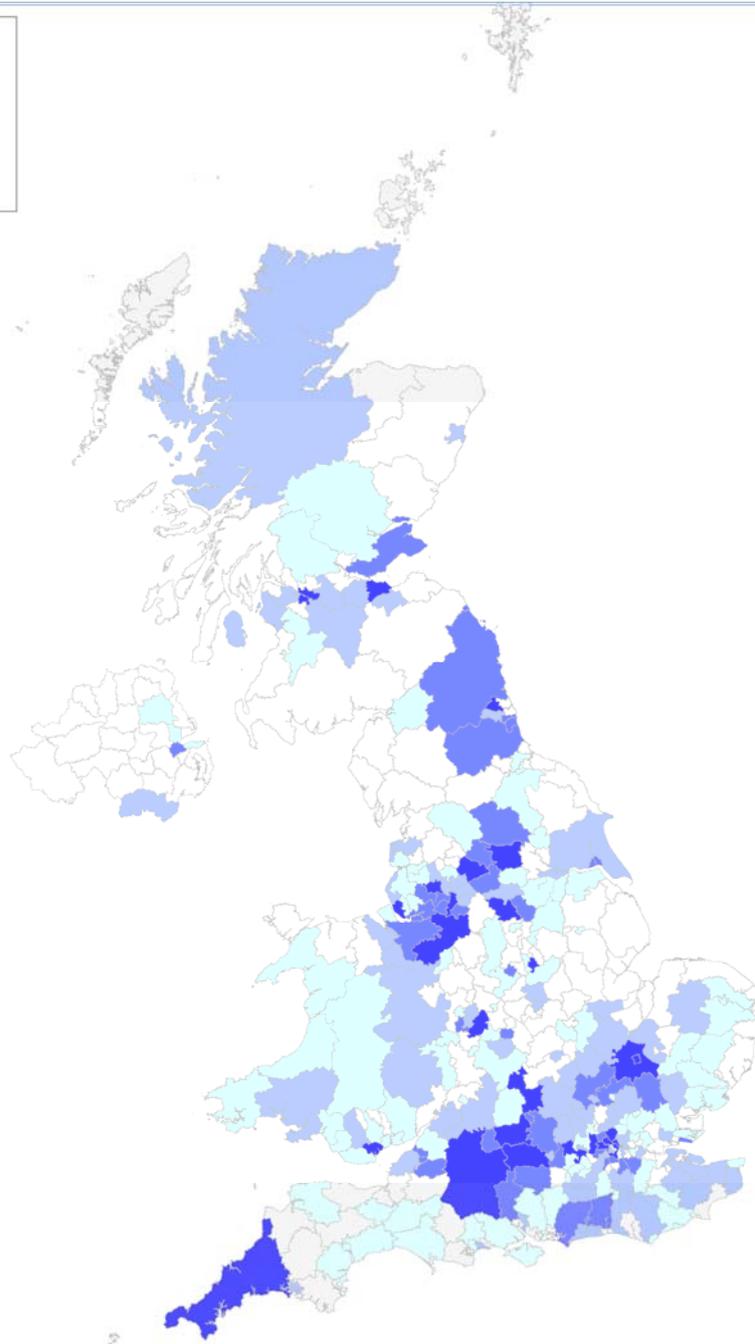


Department for Business, Innovation & Skills

### Life Sciences

Enterprise Count

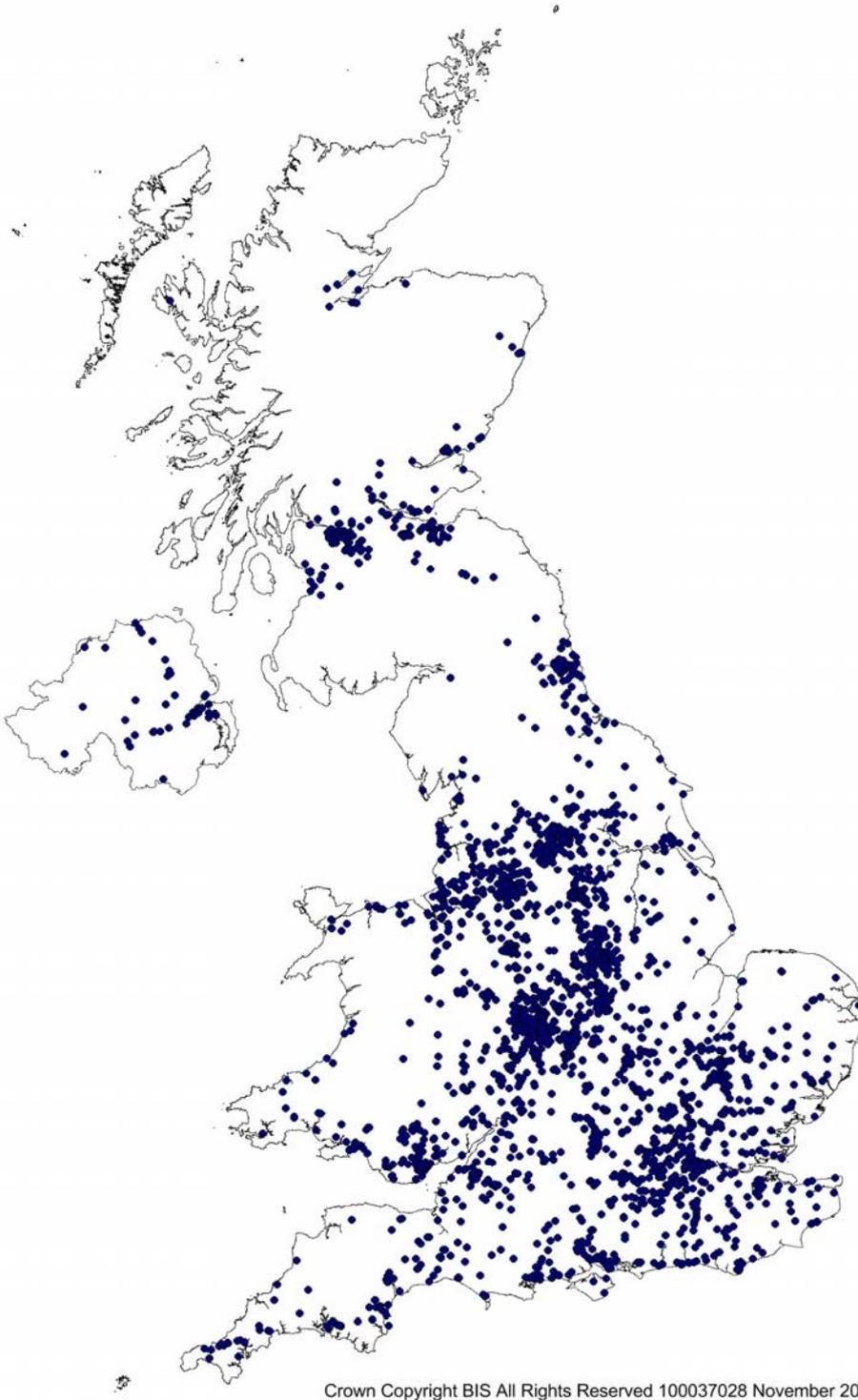
- 5 to 10
- 10 to 15
- 15 to 20
- 20 to 60



Produced by Statistical Analysis Directorate  
Source: Inter-Departmental Business Register

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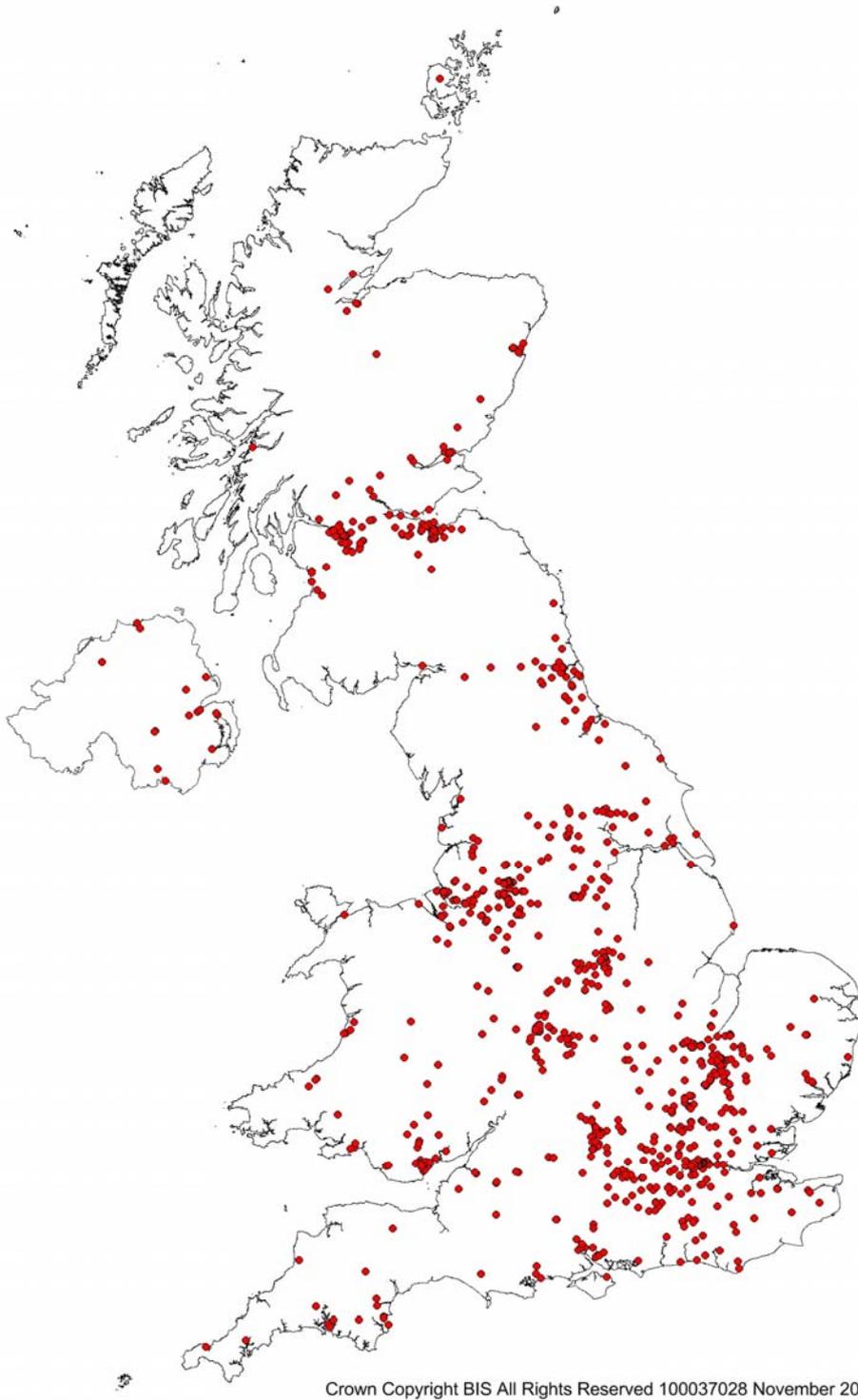
## Life Sciences: geographical distribution of medical technology companies



Source: *Strength and Opportunity 2012* (BIS Bioscience and Health Technology Database)

Contains Ordnance Survey data © Crown Copyright and database right [2012]

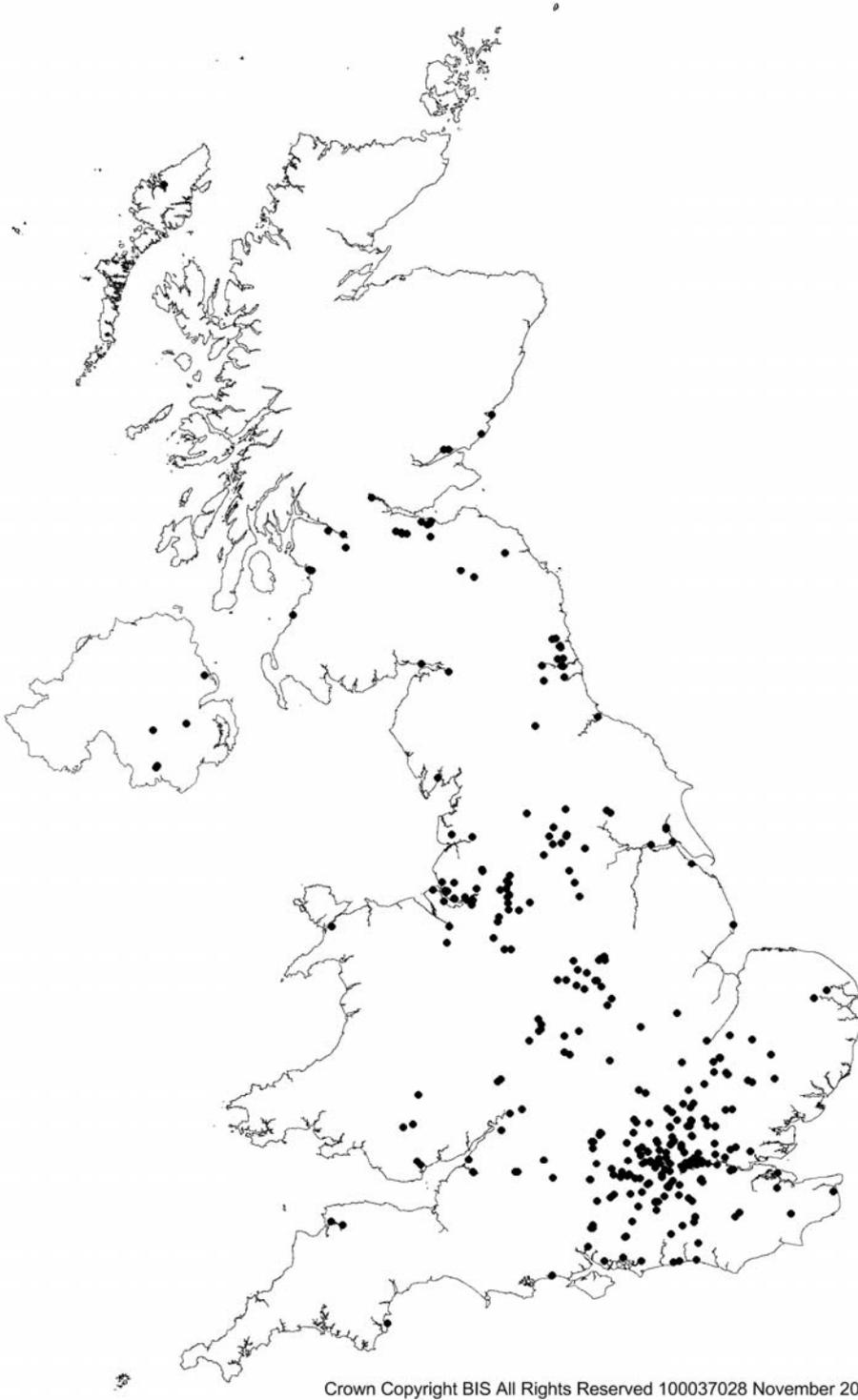
## Life Sciences: geographical distribution of medical biotechnology companies



Source: *Strength and Opportunity 2012* (BIS Bioscience and Health Technology Database)

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## Life Sciences: geographical distribution of pharmaceutical companies



Source: *Strength and Opportunity 2012* (BIS Bioscience and Health Technology Database)

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## Agri-tech

The agri-tech sector includes a broad set of technologies that contribute to environmental sustainability and improvements in agricultural productivity. In addition to the agriculture sector, agri-tech also includes the R&D and manufacturing of new technologies that provide benefits to the agriculture sector (e.g. plant breeding, animal breeding, agricultural machinery, precision farming).

- Around a quarter of Syngenta's research collaborations are in the UK, which includes recent investments in a £2m glasshouse and a £3.5m facility for the automated formulation of agri-chemicals. Syngenta's main research site is at Jealott's Hill, and the company also has manufacturing facilities at Huddersfield.
- Many international pharmaceutical companies that also have animal health activities have manufacturing operations in the UK, including Lilly (Elanco Animal Health), Sanofi (Merial), Novartis (Novartis Animal Health), and Merck/MSD (MSD Animal Health).

It is not possible to provide official data for the sector because it does not fit within existing SIC codes (see paragraph 12 above) and instead we have mapped company information provided by UKTI. Advice on how this gap might be filled would be welcomed, for inclusion in the final report of the Review<sup>27</sup>.

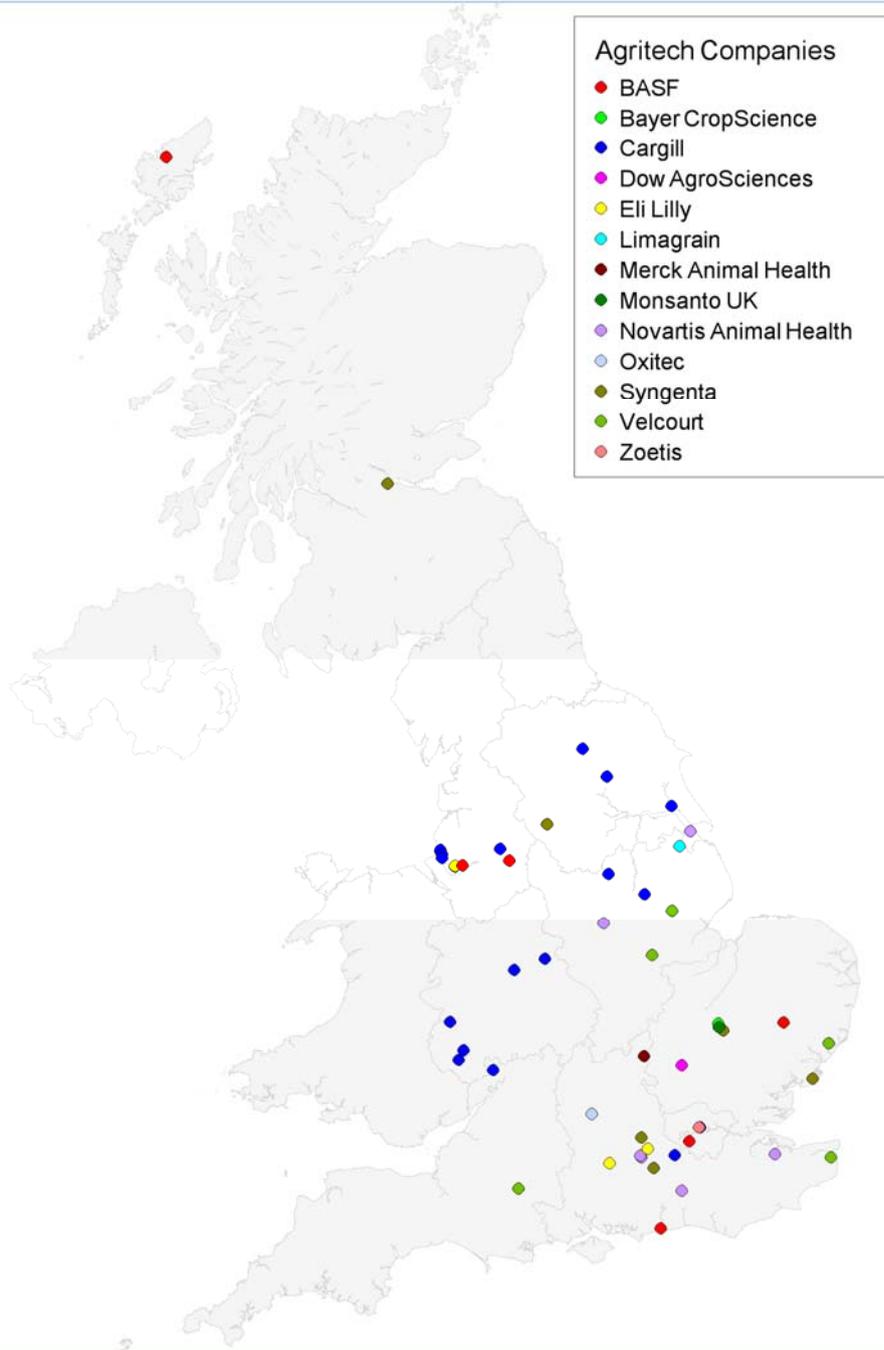
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<sup>27</sup> Comments on the heat maps should be sent to the Review mailbox (universitiesandgrowth@bis.gsi.gov.uk), by 26 July 2013.



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### Agritech



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Source: UKTI

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## Information Economy

In SIC 2007 terms (see paragraph 5 above), the information economy sector is here defined as:

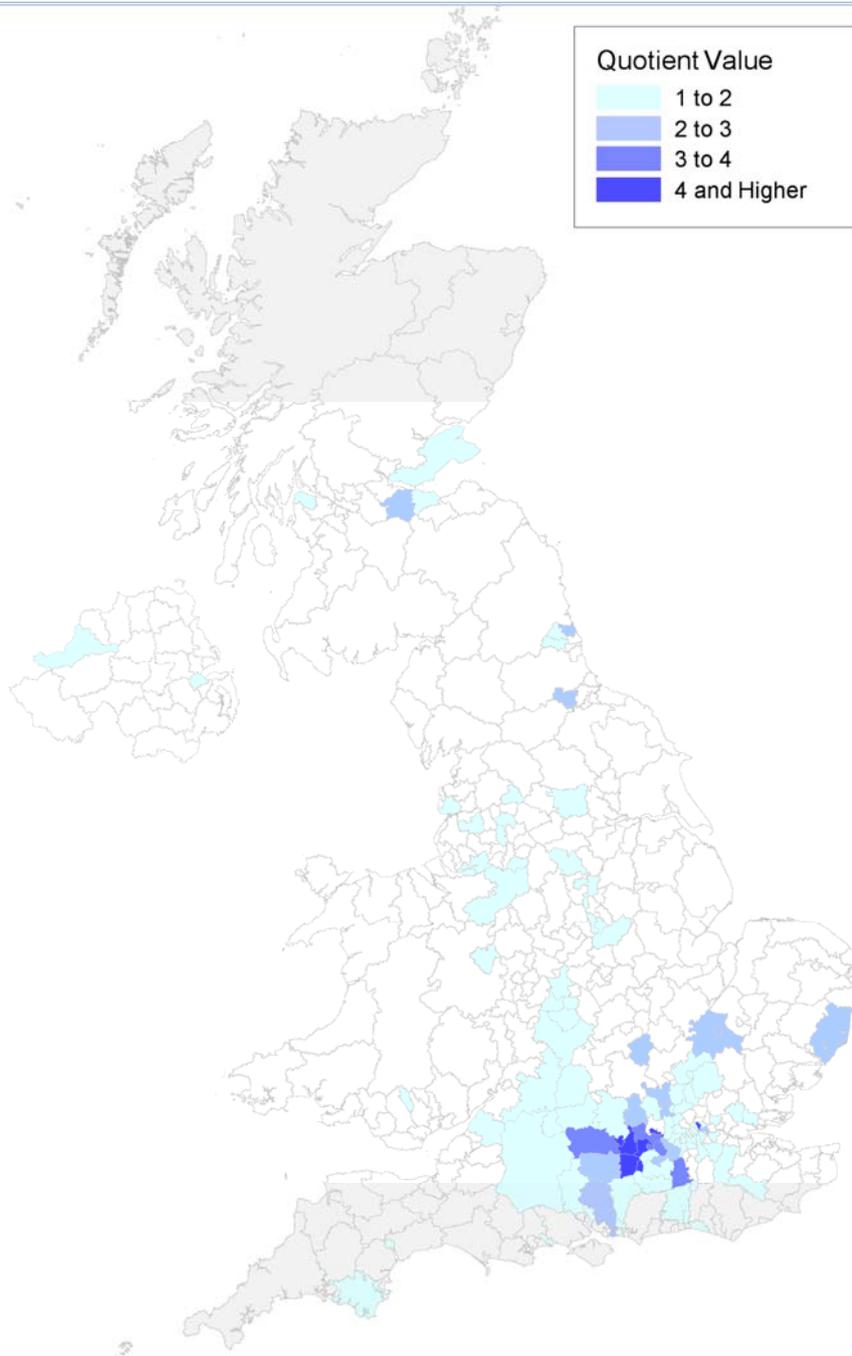
- 58.2 Software publishing
- 61 Telecommunications
- 62 Computer programming, consultancy and related activities
- 63 Information service activities

The nature of the information economy sector, covering telecoms, software and IT services is such that it is a broadly dispersed industry. It consists predominantly of small businesses and of a small number of large companies that operate on a multi-national basis. Whilst services such as software development and other IT services can effectively be offered from any location with adequate connectivity, there are some information economy clusters in the UK. These include London (Tech City), Cambridge, Sunderland (Software City), Manchester (Media City), Bristol, much of the M4 corridor and Malvern.



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### Employment Location Quotient - Information Economy



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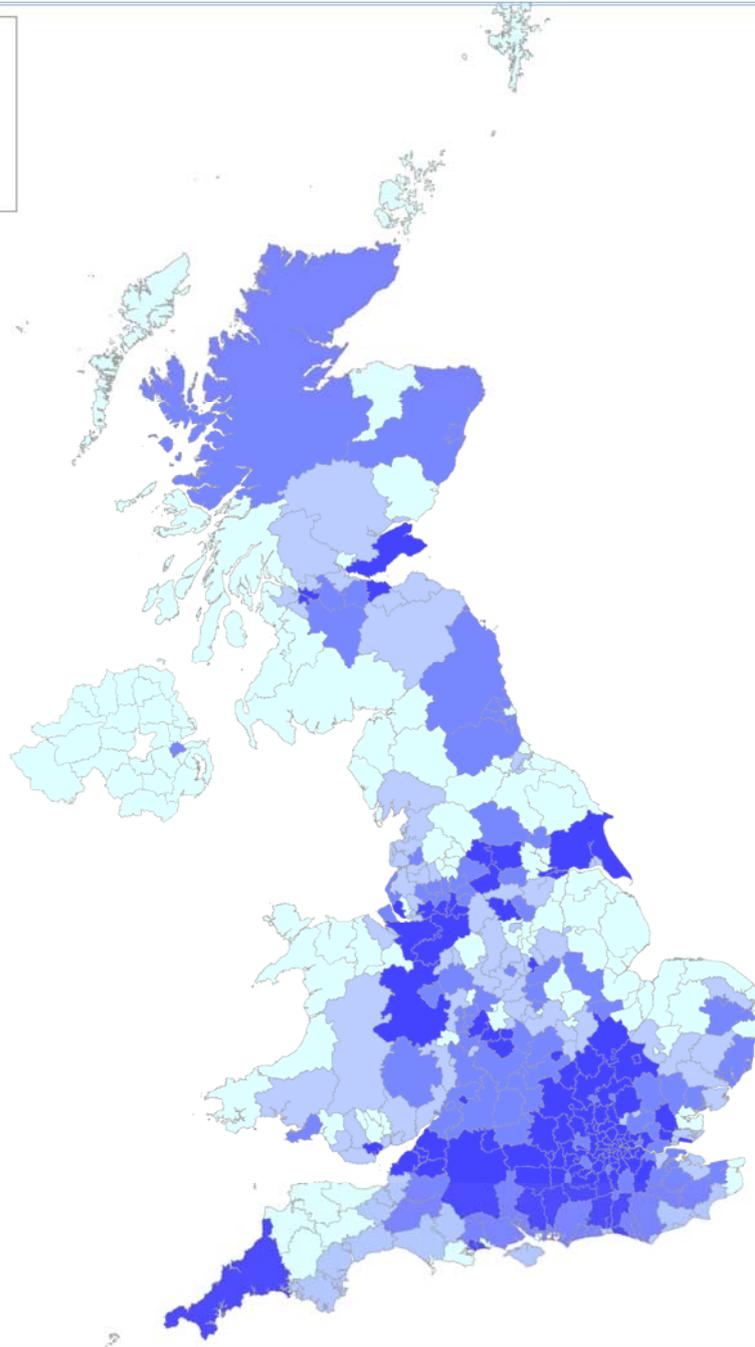


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### Information Economy

**Enterprise Count**

- 0 to 130
- 130 to 210
- 210 to 420
- 420 to 2,360



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## Professional and Business Services

In SIC 2007 terms (see paragraph 5 above), the professional and business services sector is here defined as:

- 69 Legal and accounting activities
- 70 Activities of head offices; management consultancy activities
- 71 Architectural and engineering activities; technical testing and analysis
- 72 Scientific research and development
- 73 Advertising and market research
- 74 Other professional, scientific and technical activities
- 77 Rental and leasing activities
- 78 Employment activities
- 82 Office administrative, office support and other business support activities

72.11 – research and experimental development on biotechnology – is also included in the life sciences sector.

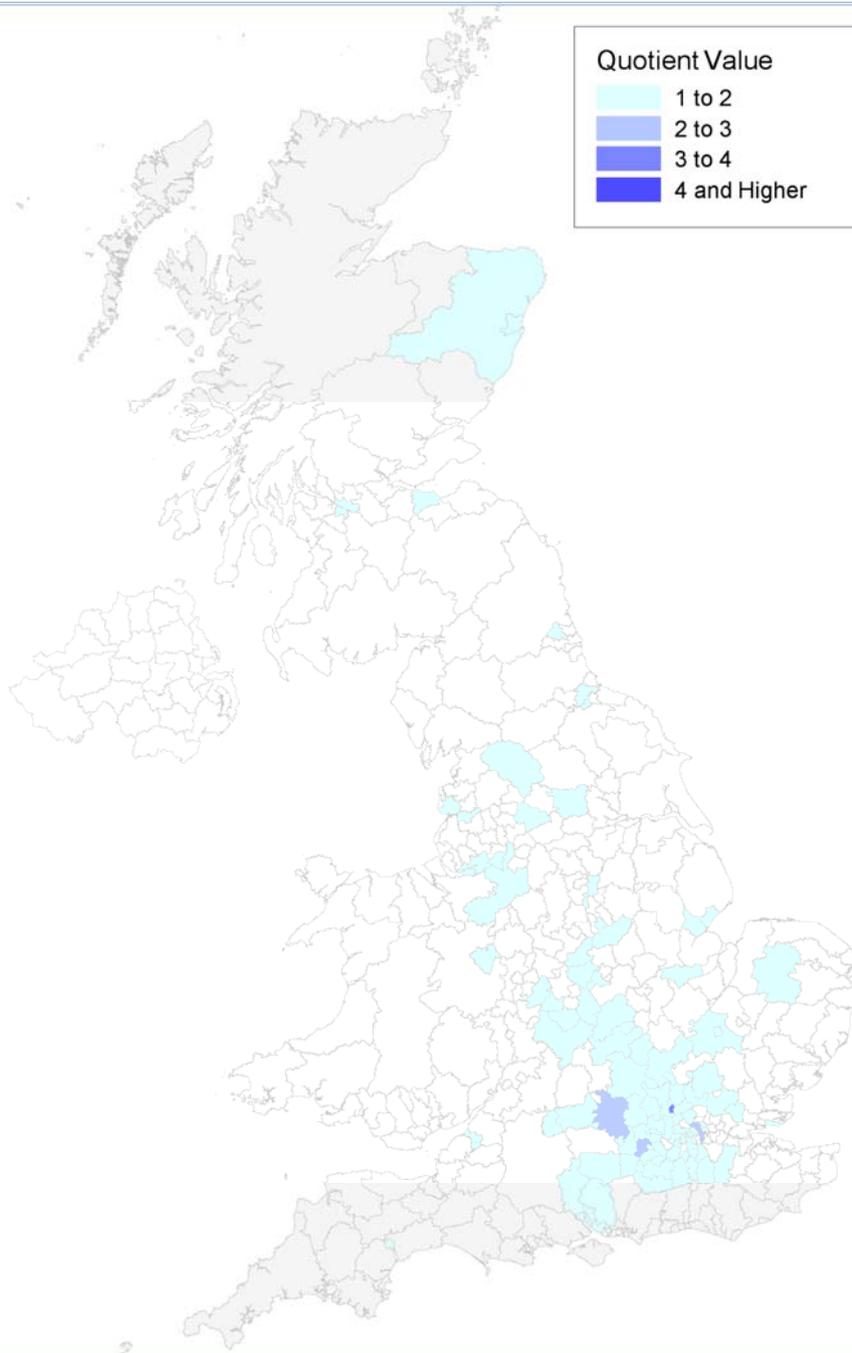
The PBS sector is made up of a number of sub-sectors. Legal and accounting services are the largest of these, representing over a fifth of the sector's output. Head offices/management consultants, architects and employment agencies are also significant.

London is the leading world centre for financial and professional services. There are strong clusters of PBS firms in cities around the UK, including Edinburgh, Glasgow, Birmingham, Manchester, Leeds and Liverpool.



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### Employment Location Quotient - Professional & Business Services



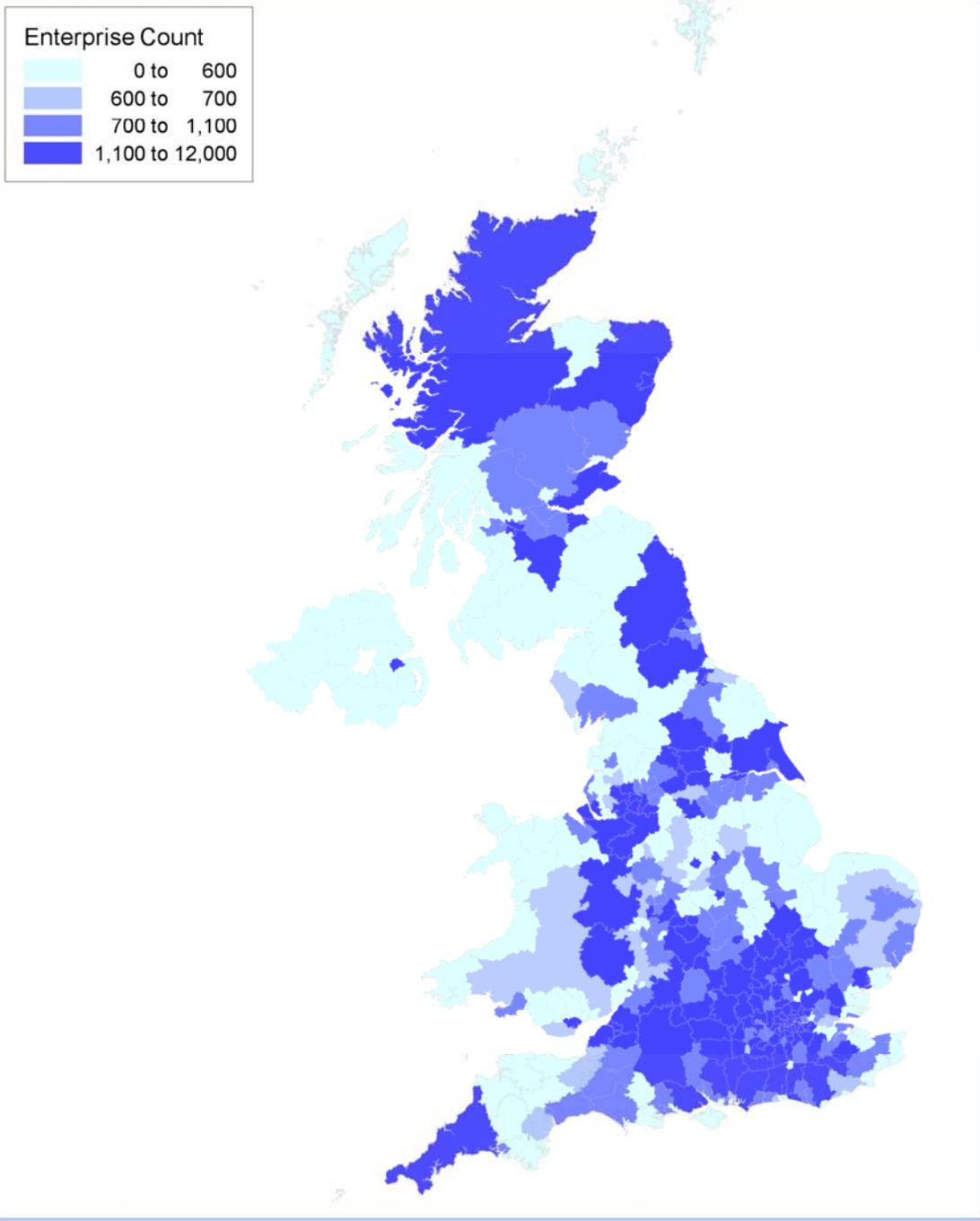
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### Professional & Business Services



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## Nuclear

The civil nuclear sector includes pre-build (design), construction, operations and decommissioning. It also includes the manufacturing and R&D of technologies for use in the nuclear industry. It is not possible to provide official data for the sector because it does not fit within existing SIC codes. However maps have been provided based on information on R&D employment published in the *Review of the Civil Nuclear Research and Development Landscape in the UK*<sup>28</sup> in March 2013.

- The footprint of the nuclear industry in the UK centres around the nuclear power stations (EdF operate 15 reactors at 7 locations, and work with several companies, eg, AMEC, Balfour Beatty, Doosan Babcock Energy, Cape, BNS Nuclear Services, Alstom).
- The industry has plans for building 16GW of new nuclear generating capacity (Hinkley Point, Sizewell, Wylfa, Oldbury and Moorside).
- There is also a concentration of nuclear industry in the North West, the location of a major central spent fuel centre (Sellafield) and fuel processing plant (Urenco).

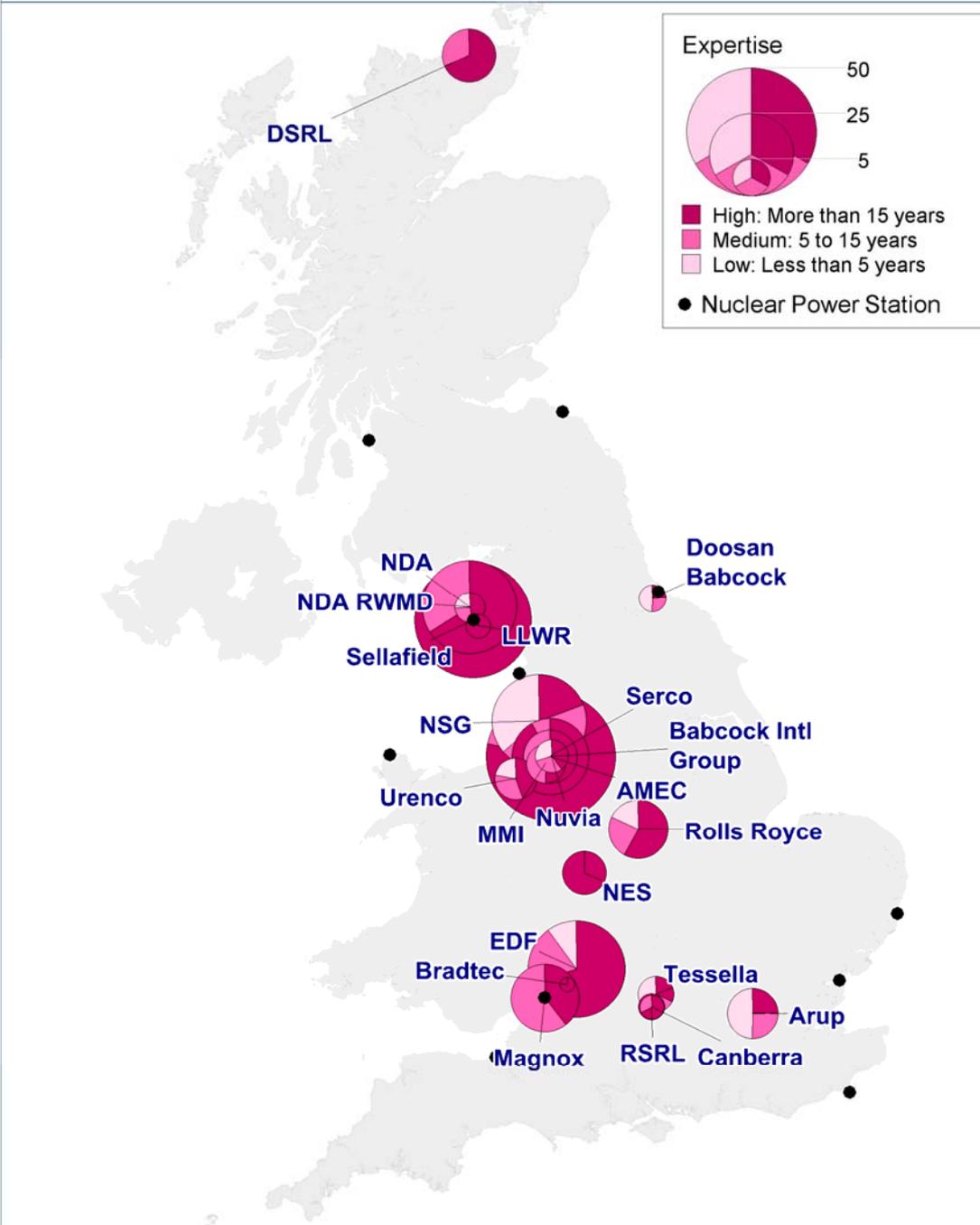
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<sup>28</sup> <https://www.gov.uk/government/publications/civil-nuclear-research-and-development-landscape-in-the-uk-a-review>



Department for Business, Innovation & Skills

### Nuclear R&D Workforce in the Private Sector



Produced by Statistical Analysis Directorate

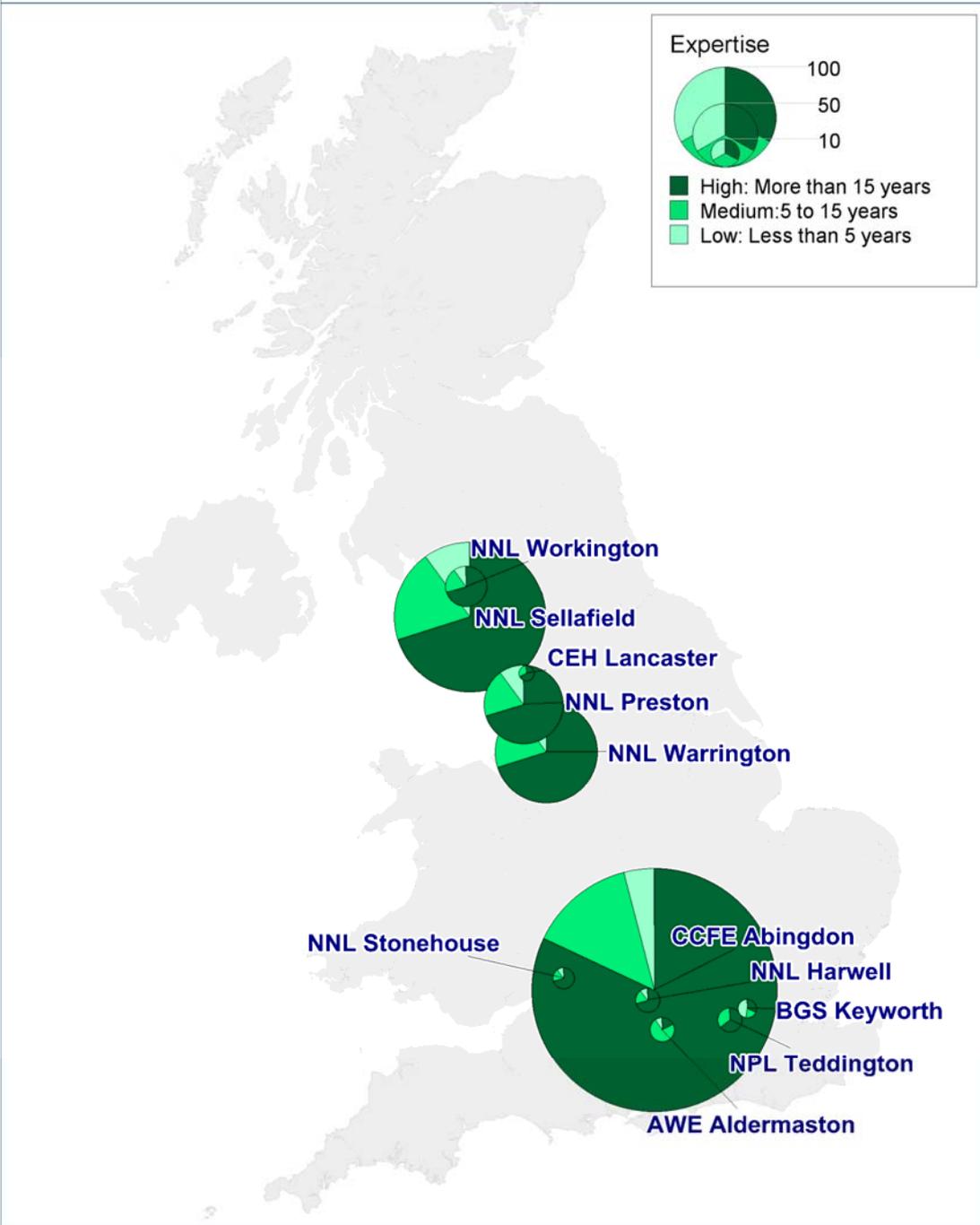
Source: Review of the Civil R&D Nuclear Landscape in the UK

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### Nuclear R&D Workforce in National Laboratories



Produced by Statistical Analysis Directorate

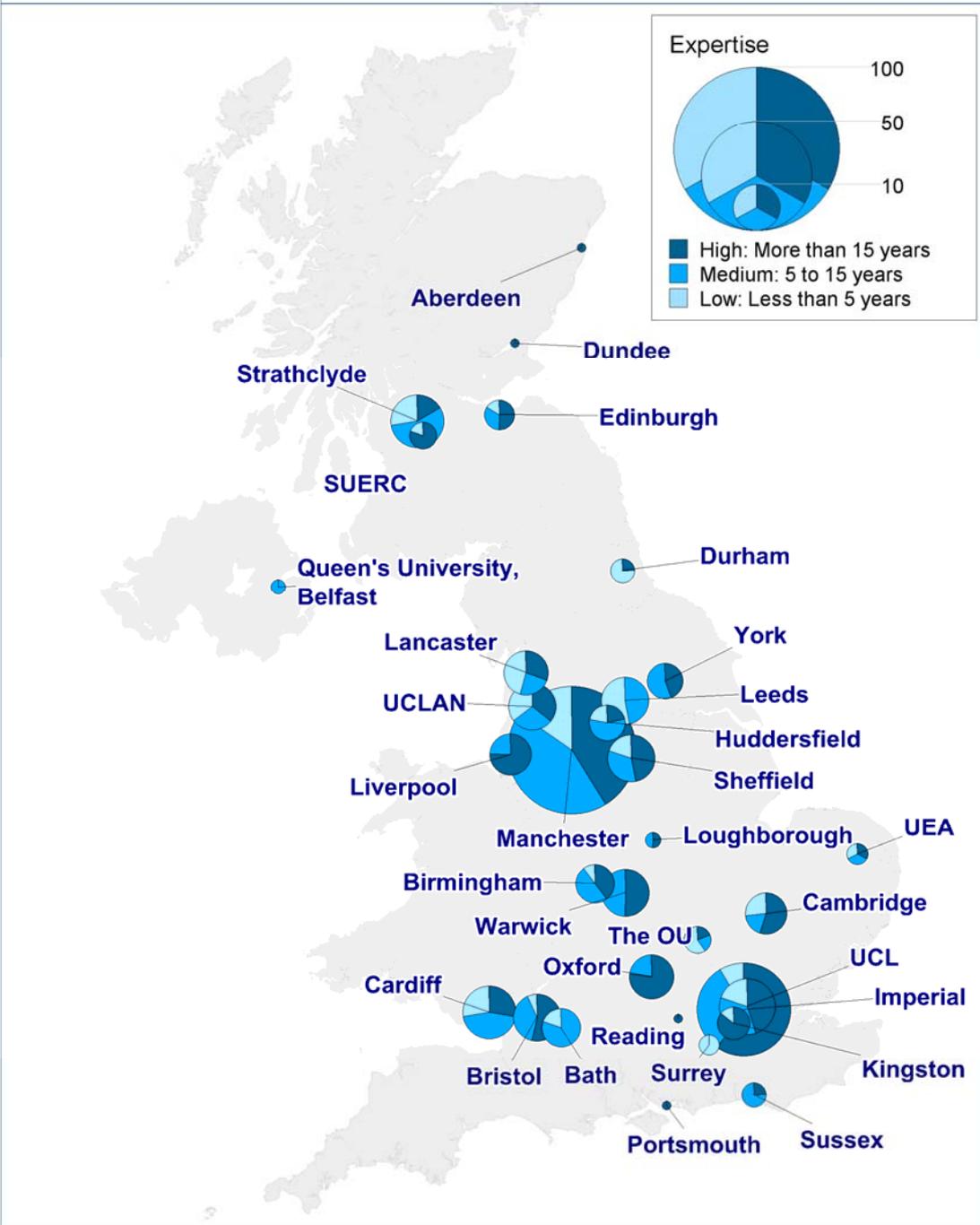
Source: Review of the Civil R&D Nuclear Landscape in the UK

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### Nuclear R&D Workforce in Universities



Produced by Statistical Analysis Directorate

Source: Review of the Civil R&D Nuclear Landscape in the UK

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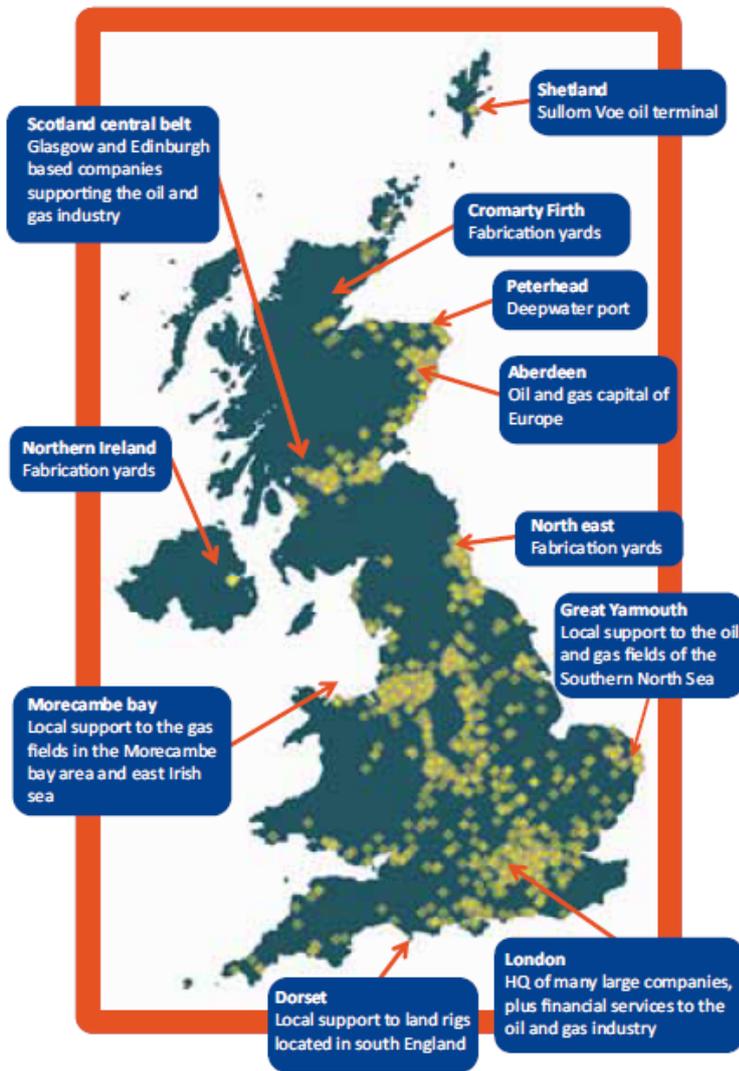
## Oil and Gas

Although the oil and gas sector can be identified in the SIC, it gives a very limited picture of the sector so we have reproduced the supply chain map from the Oil and Gas Industrial Strategy<sup>29</sup>. As well as the oil and gas industry this includes project management, major contracting, design engineering, asset and operational management, design and manufacturing of advanced equipment, research and development, training and education and professional and financial services.

- The UK Oil & Gas industry is mainly clustered around key ports on the east coast with good access to the North Sea.
- One of the key locations is Aberdeen, which is considered the oil and gas capital of Europe.
- The North East and East of England are also important clusters for the manufacturing base and supply chain.
- London is the choice destination for the HQ of many large companies, as well as the financial services tied to the oil and gas industry.
- Whilst most of the gross value added (GVA) is concentrated in the operators' extraction of oil and gas, the supply chain services are an integral part of the industry's success: operators in the UKCS are dependent upon the vibrancy of the domestic supply chain and vice versa.

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<sup>29</sup> <https://www.gov.uk/government/publications/uk-oil-and-gas-industrial-strategy-business-and-government-action-plan>



Source: FPAL

## Offshore Wind

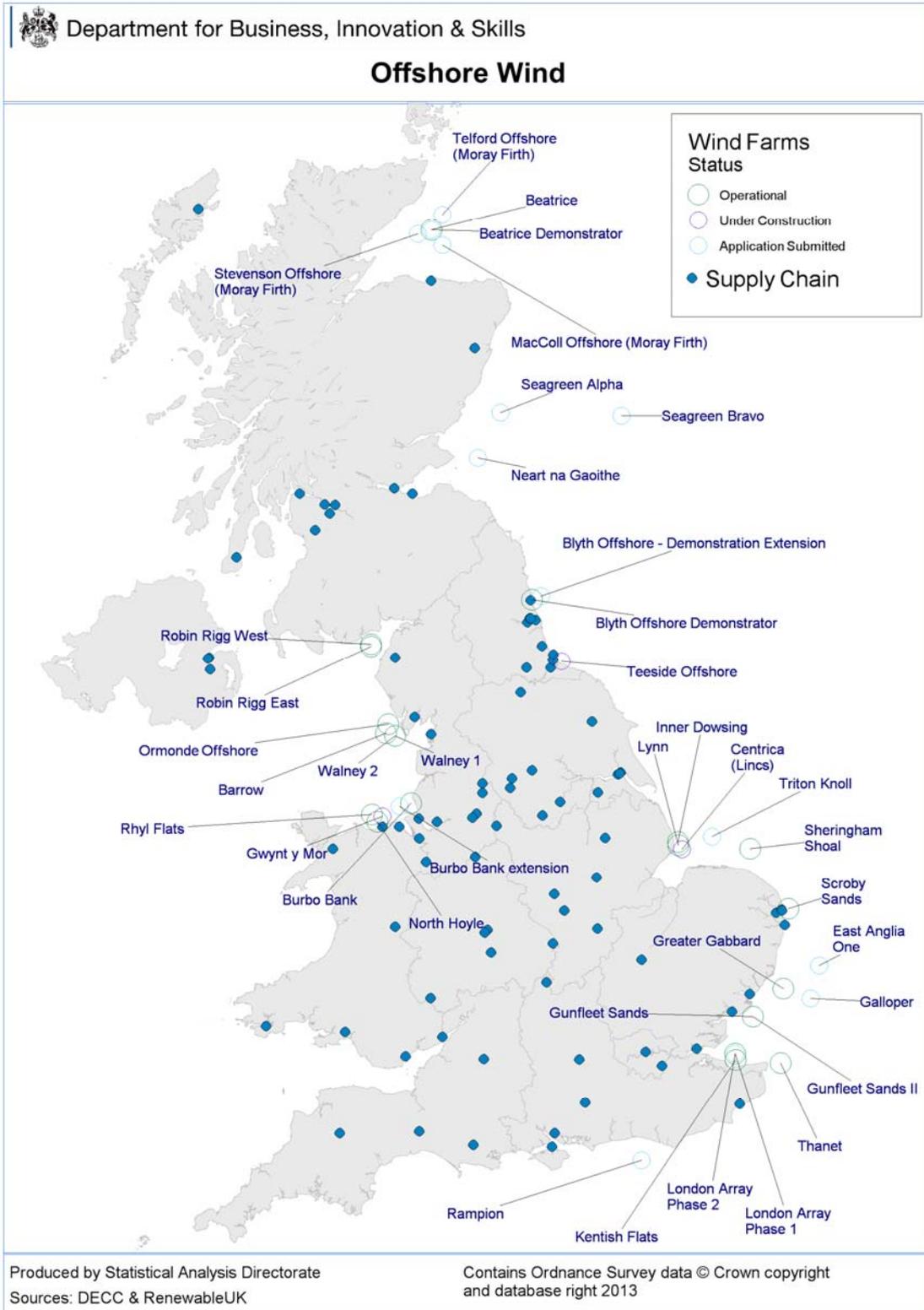
It is not possible to provide official data for the sector because it does not fit within existing SIC codes. Instead we have shown offshore wind supply chain information compiled by RenewableUK and published in more detail in *Wind Energy in the UK*<sup>30</sup>. We have also shown the location of UK offshore wind farms either operational, awaiting or under construction, or for which an application has been submitted, from the Renewable Energy Planning Database<sup>31</sup> maintained by the Department for Energy and Climate Change.

- The UK offshore wind industry is located throughout the UK manufacturing base
- Operations and maintenance bases are established at ports nearest the wind farms they serve such as Barrow, Grimsby, Lowestoft, Mostyn, Ramsgate and Workington

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<sup>30</sup> <http://www.renewableuk.com/en/publications/reports.cfm/SOI2012>

<sup>31</sup> <https://restats.decc.gov.uk/cms/planning-database/>



More detailed information on the supply chain is available in *Wind Energy in the UK* published by RenewableUK in 2012.

## Construction

The construction sector includes construction contracting only; it does not include the production or manufacture of related materials and components, or the related professional and technical services such as engineering or architecture. In SIC2007 terms (see paragraph 5 above) it is defined as:

- 41 Construction of buildings
- 42 Civil engineering
- 43 Specialised construction activities

- Construction in the UK in general is not a heavily clustered industry. The 2012 ONS release *The Geographical Concentration of Industries*<sup>32</sup> confirms this, stating Construction as the second least geographically concentrated industry in the UK.
- This could be due to the need for the production of many construction goods or services to occur close to the population they serve.
- Other reasons can include widely dispersed supply chains and a highly fragmented sector comprised primarily of small and medium enterprises (SMEs).
- As trends in offsite manufacturing increase, there may be more geographic concentration in UK Construction
- Many of the UK's most significant consulting engineering and architecture firms, who focus on major infrastructure and iconic buildings projects, are based in central London including a cluster of 5 of the World's top 25 architecture, consulting engineering and project management firms, and offices of 8 of the World's top 10 architects - second only to the USA, with a geographic concentration around Fitzrovia and the Eastern edge of the City.
- London has two of the most significant centres of university expertise in the built environment in Imperial College London and University College London, through its Bartlett School.

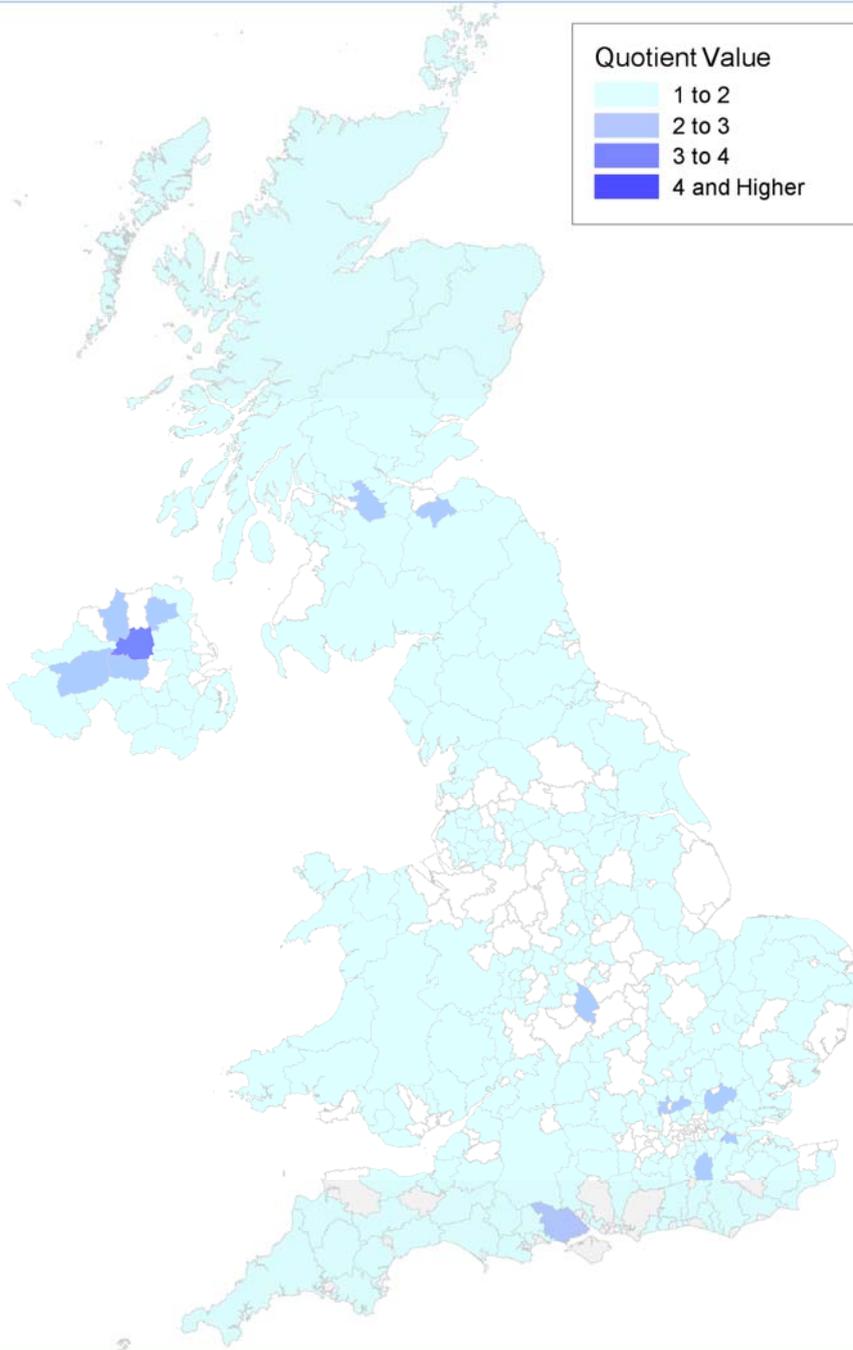
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<sup>32</sup> <http://www.ons.gov.uk/ons/rel/regional-trends/regional-economic-analysis/the-geographical-concentration-of-industries/art-geographical-concentration.html>



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### Employment Location Quotient - Construction



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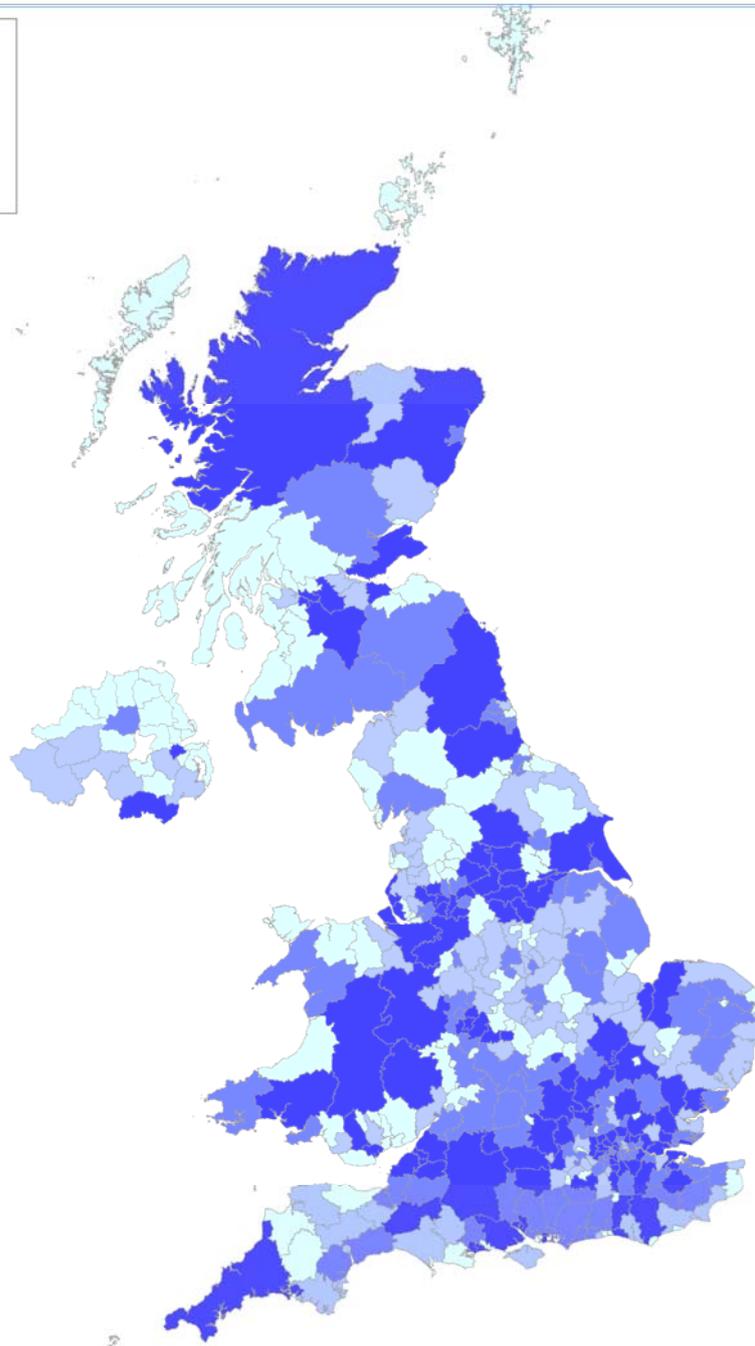


Department for Business, Innovation & Skills

### Construction

Enterprise Count

- 20 to 420
- 420 to 580
- 580 to 760
- 760 to 2,800



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## The Eight Great Technologies

20. The Eight Great Technologies were identified in a speech<sup>33</sup> by the Chancellor of the Exchequer, George Osborne, to the Royal Society in November 2012. In that speech the Chancellor identified the following technologies as those in which he believed that the UK "can be the best – where we already have an edge, but we could be world-leading".

- the Big Data Revolution and energy efficient computing
- Synthetic Biology
- Regenerative Medicine
- Agri-Science
- Energy Storage
- Advanced Materials
- Robotics and Autonomous Systems
- Satellites and commercial applications of Space

21. Subsequently the Minister for Universities and Science, David Willetts, set out in a speech<sup>34</sup> at the Policy Exchange details of how the £600 million announced for science in the Autumn Statement will support the Eight Great Technologies. He also described the technologies in a pamphlet for the Policy Exchange<sup>35</sup>. An extract from the pamphlet explaining the technologies is reproduced below.

22. The Eight Great Technologies maps show the locations of universities which have received grants from the UK Research Councils related to the technologies. There are some caveats to this data:

- Disciplines and departments do not match with industrial sectors of activity. In order to provide real but partial information on the location of some of the excellent research activity in each of the Eight Great Technologies, the Research Councils reported on universities and research institutions that receive funding under the technologies.
- These technologies and the associated funding were launched in 2013 and thus recipients listed cover only the partial funding dedicated to these particular technologies.

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<sup>33</sup> <https://www.gov.uk/government/speeches/speech-by-the-chancellor-of-the-exchequer-rt-hon-george-osborne-mp-to-the-royal-society>

<sup>34</sup> <https://www.gov.uk/government/news/600-million-investment-in-the-eight-great-technologies>

<sup>35</sup> <http://www.policyexchange.org.uk/images/publications/eight%20great%20technologies.pdf>

- The list covers recipients of funding in the current rounds: it is likely that excellent research in any of these areas is also being funded through general unclassified funds that cannot be allocated to one or another of the technologies.
- For agri-science and big data a cut-off of £1m funding per recipient has been applied to restrict the map to showing the most significant recipients of funding. Research funding for these technologies has been awarded to a large number of different institutions, and the cut-off has been applied to avoid making the maps unclear.
- As indicated above, research funded from other sources also takes place, and the Review will explore whether it is possible to identify other funding sources to extend the information base from which these maps are derived. We would welcome views on this.<sup>36</sup>

### The Eight Great Technologies

1. The data deluge will transform scientific enquiry and many industries too. The UK can be in the vanguard of the **big data** revolution and energy-efficient computing.

2. There is a surge in data coming from **satellites** which do not just transmit data but collect data by earth observation. We have opportunities to be a world leader in satellites and especially analysing the data from them.

3. There are particular challenges in collecting data from a range of sources in designing **robots and other autonomous systems**. We can already see that this is a general purpose technology with applications ranging from assisted living for disabled people through to nuclear decommissioning.

4. Modern genetics has emerged in parallel with the IT revolution and there is a direct link – genetic data comes in digital form. The future is the convergence of “dry” IT and “wet” biological sciences. One of the most ambitious examples of this is **synthetic biology** – engineering genes to heal us, feed us, and fuel us.

5. **Regenerative medicine** will open up new medical techniques for repairing and replacing damaged human tissue.

6. Although genetics is above all associated with human health, advances in **agricultural technologies** can put the UK at the forefront of the next green revolution.

7. Just as we understand the genome of a biological organism so we can think of the fundamental molecular identity of an inorganic material. Here too we can increasingly design **new advanced materials** from first principles. This will enable technological advances in sectors from aerospace to construction. Quantum photonics is an exciting area where advanced materials and digital IT converge.

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<sup>36</sup> Comments on the heat maps should be sent to the Review mailbox ([universitiesandgrowth@bis.gsi.gov.uk](mailto:universitiesandgrowth@bis.gsi.gov.uk)) by 26 July 2013

8. One of the most important applications of advanced materials is in **energy storage**. This and other technologies will enable the UK to gain from the global transition to new energy sources.

Extract from *Eight Great Technologies* © Policy Exchange

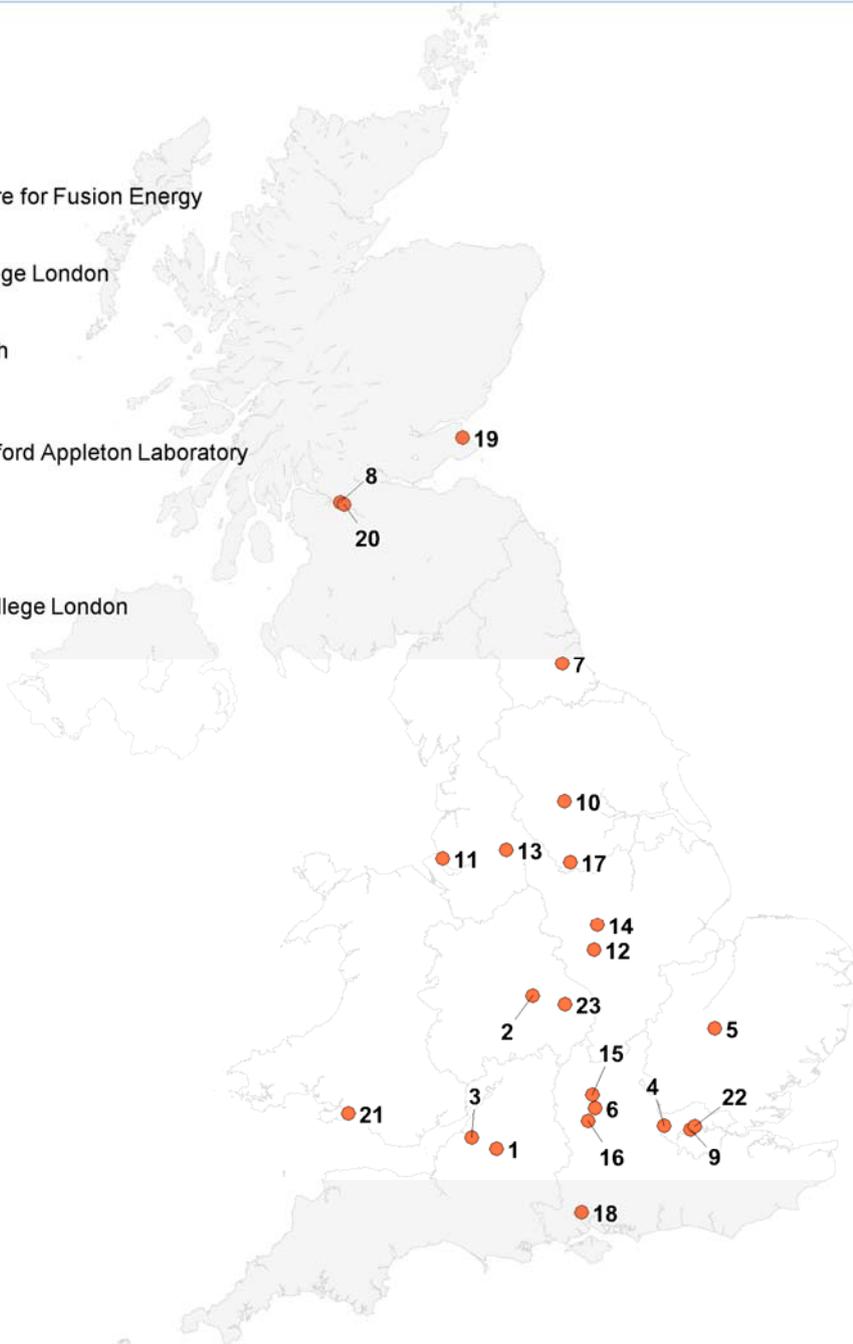


Department for Business, Innovation & Skills

### Advanced Materials

**Institutions**

1. Bath
2. Birmingham
3. Bristol
4. Brunel
5. Cambridge
6. Culham Centre for Fusion Energy
7. Durham
8. Glasgow
9. Imperial College London
10. Leeds
11. Liverpool
12. Loughborough
13. Manchester
14. Nottingham
15. Oxford
16. STFC Rutherford Appleton Laboratory
17. Sheffield
18. Southampton
19. St Andrews
20. Strathclyde
21. Swansea
22. University College London
23. Warwick



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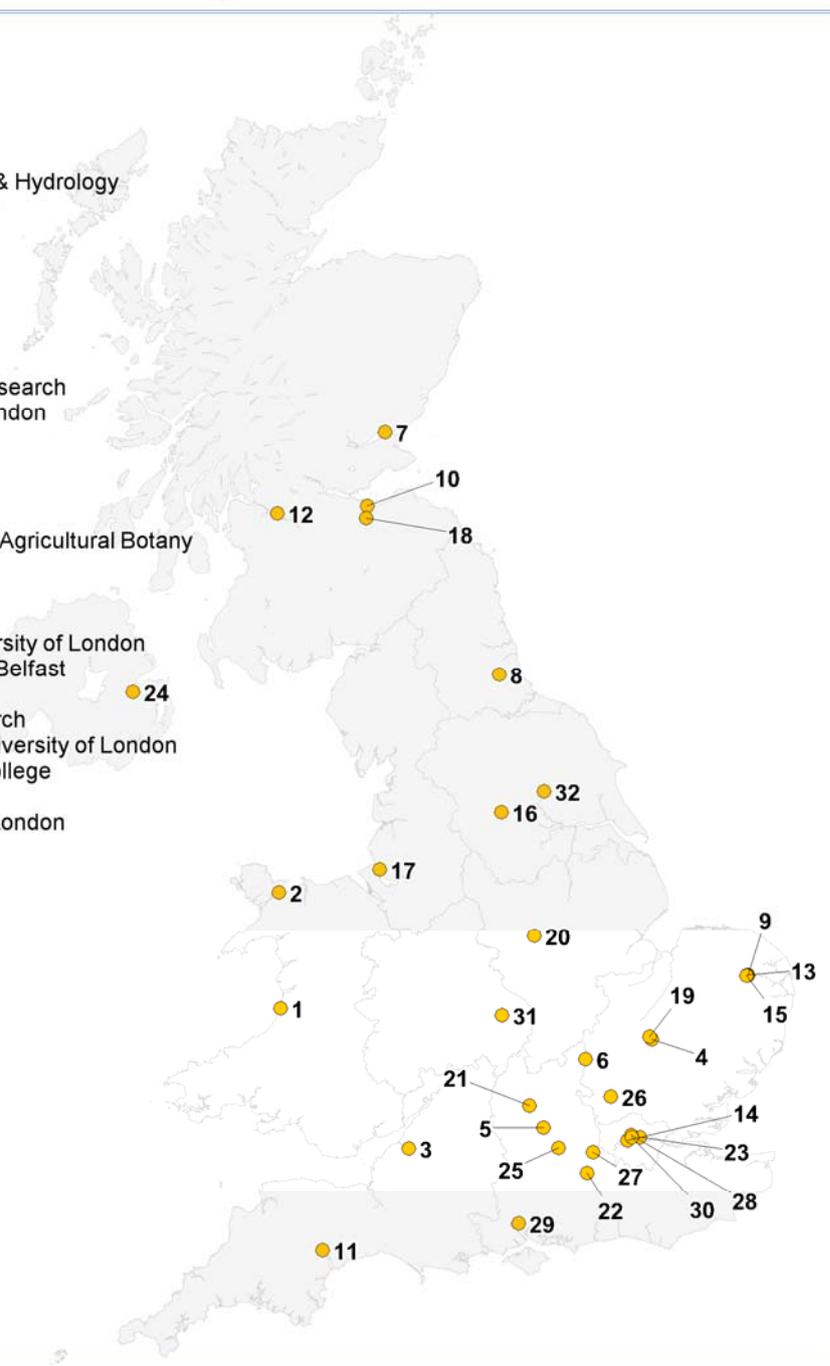


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### Agri-Science

**Institutions**

1. Aberystwyth
2. Bangor University
3. Bristol
4. Cambridge
5. Centre for Ecology & Hydrology
6. Cranfield University
7. Dundee
8. Durham
9. East Anglia
10. Edinburgh
11. Exeter
12. Glasgow
13. Institute of Food Research
14. Imperial College London
15. John Innes Centre
16. Leeds
17. Liverpool
18. Moredun
19. National Institute of Agricultural Botany
20. Nottingham
21. Oxford
22. Pirbright
23. Queen Mary, University of London
24. Queen's University Belfast
25. Reading
26. Rothamsted Research
27. Royal Holloway, University of London
28. Royal Veterinary College
29. Southampton
30. University College London
31. Warwick
32. York



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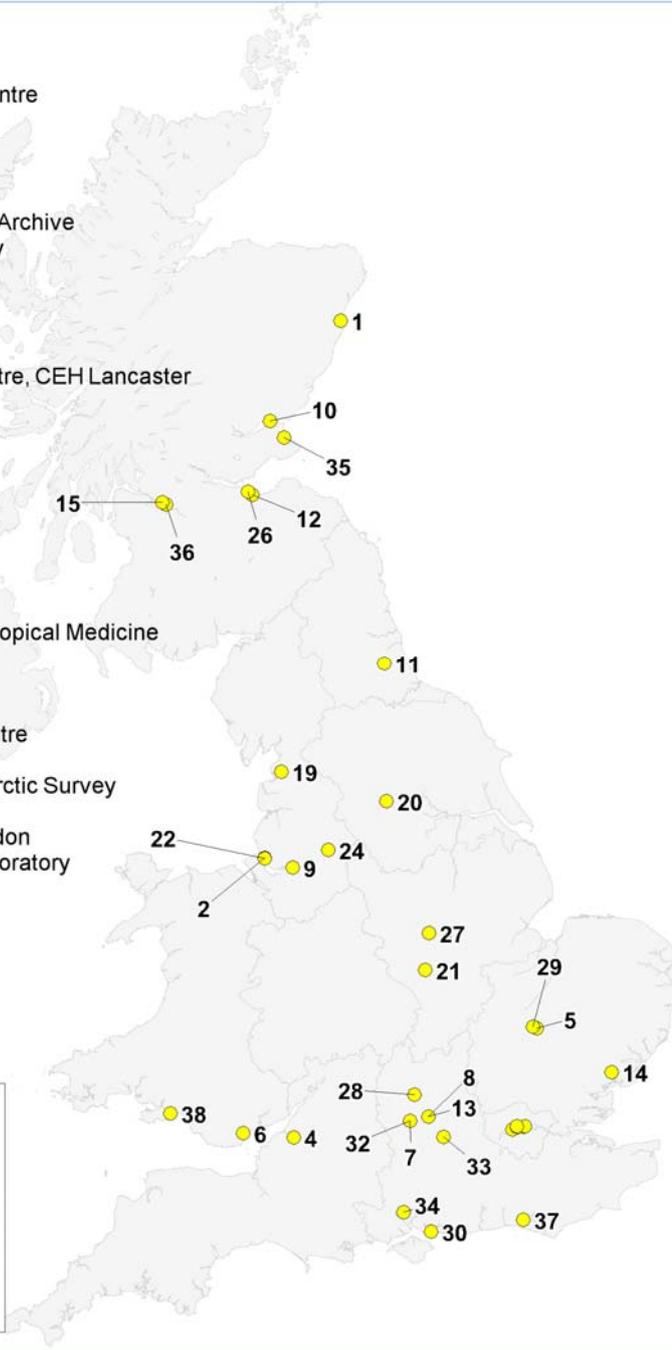
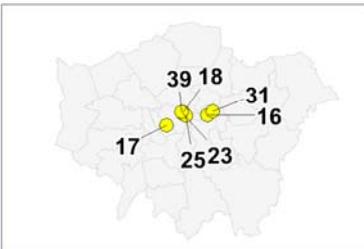


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### Big Data

**Institutions**

1. Aberdeen
2. British Oceanographic Data Centre
3. British Geological Survey
4. Bristol
5. Cambridge
6. Cardiff
7. Centre for Environmental Data Archive
8. Centre for Ecology & Hydrology
9. STFC Daresbury Laboratory
10. Dundee
11. Durham
12. Edinburgh
13. Environmental Informatics Centre, CEH Lancaster
14. Essex
15. Glasgow
16. Health Protection Agency
17. Imperial College London
18. Institute of Education - London
19. Lancaster
20. Leeds
21. Leicester
22. Liverpool
23. London School of Hygiene & Tropical Medicine
24. Manchester
25. MRC Clinical Trials Unit
26. MRC Human Genetics Unit
27. National GeoScience Data Centre
28. Oxford
29. Polar Data Centre, British Antarctic Survey
30. Portsmouth
31. Queen Mary, University of London
32. STFC Rutherford Appleton Laboratory
33. Reading
34. Southampton
35. St Andrews
36. Strathclyde
37. Sussex
38. Swansea
39. University College London



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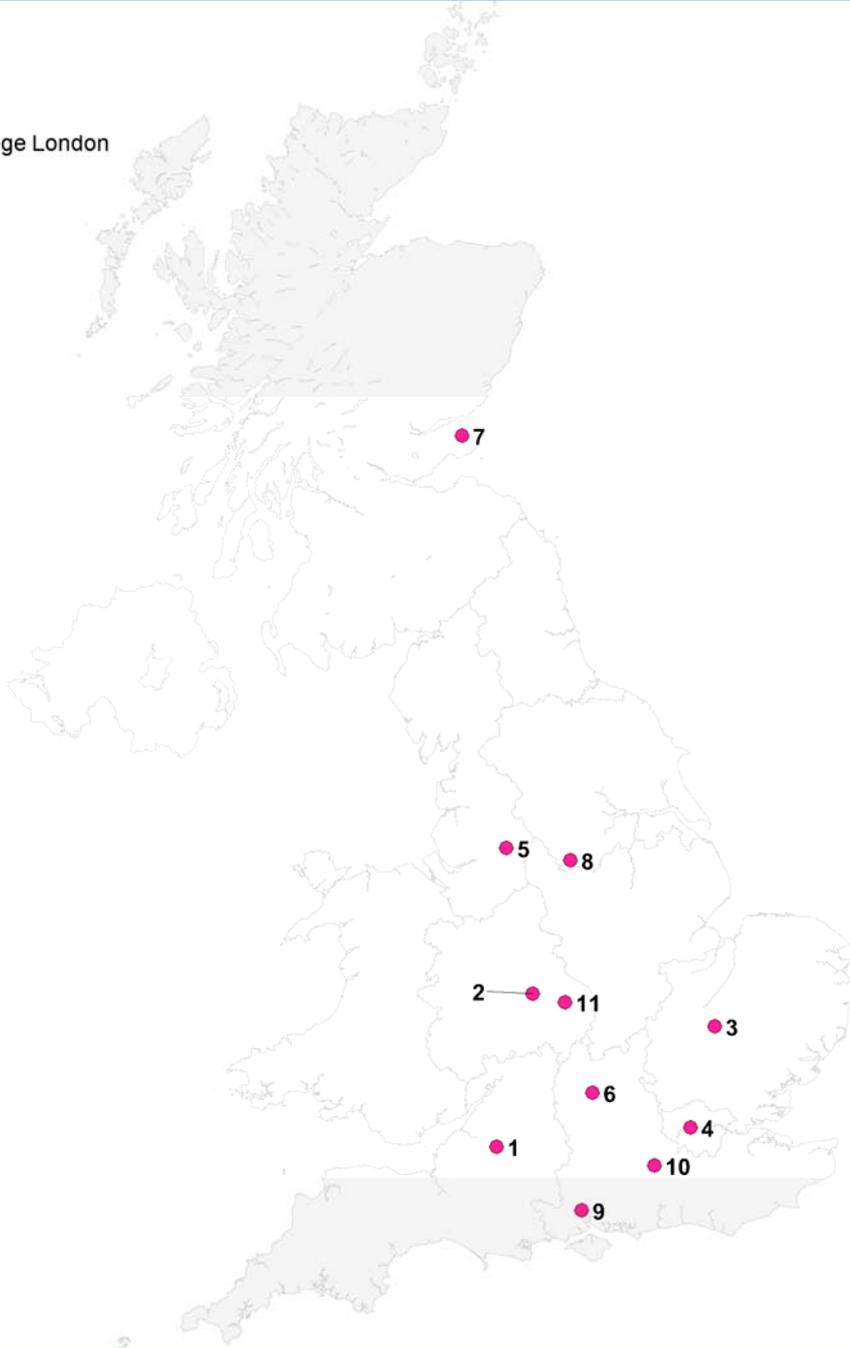


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### Energy Storage

#### Institutions

- 1. Bath
- 2. Birmingham
- 3. Cambridge
- 4. Imperial College London
- 5. Manchester
- 6. Oxford
- 7. St Andrews
- 8. Sheffield
- 9. Southampton
- 10. Surrey
- 11. Warwick



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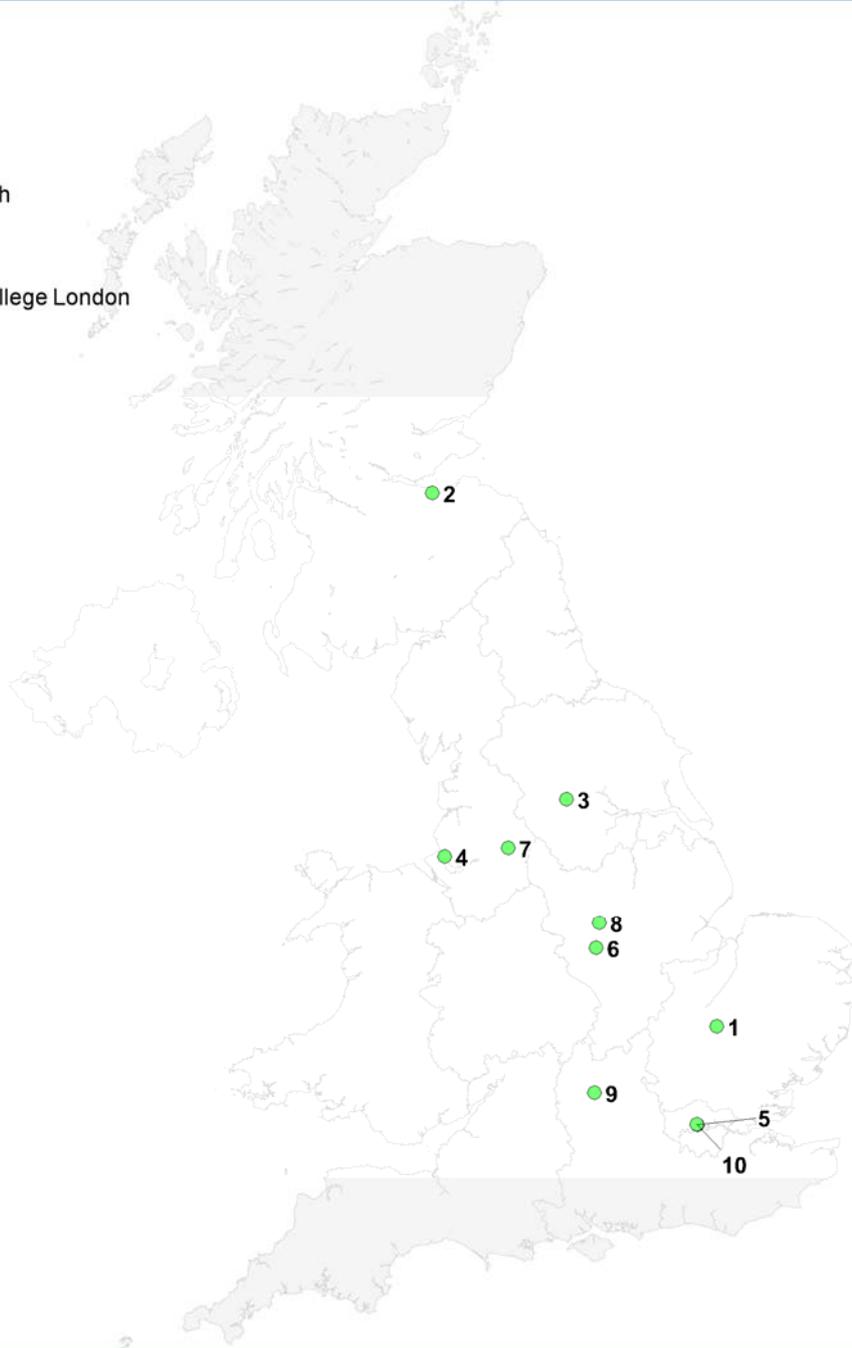


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### Regenerative Medicine

Institutions

- 1. Cambridge
- 2. Edinburgh
- 3. Leeds
- 4. Liverpool
- 5. London
- 6. Loughborough
- 7. Manchester
- 8. Nottingham
- 9. Oxford
- 10. University College London



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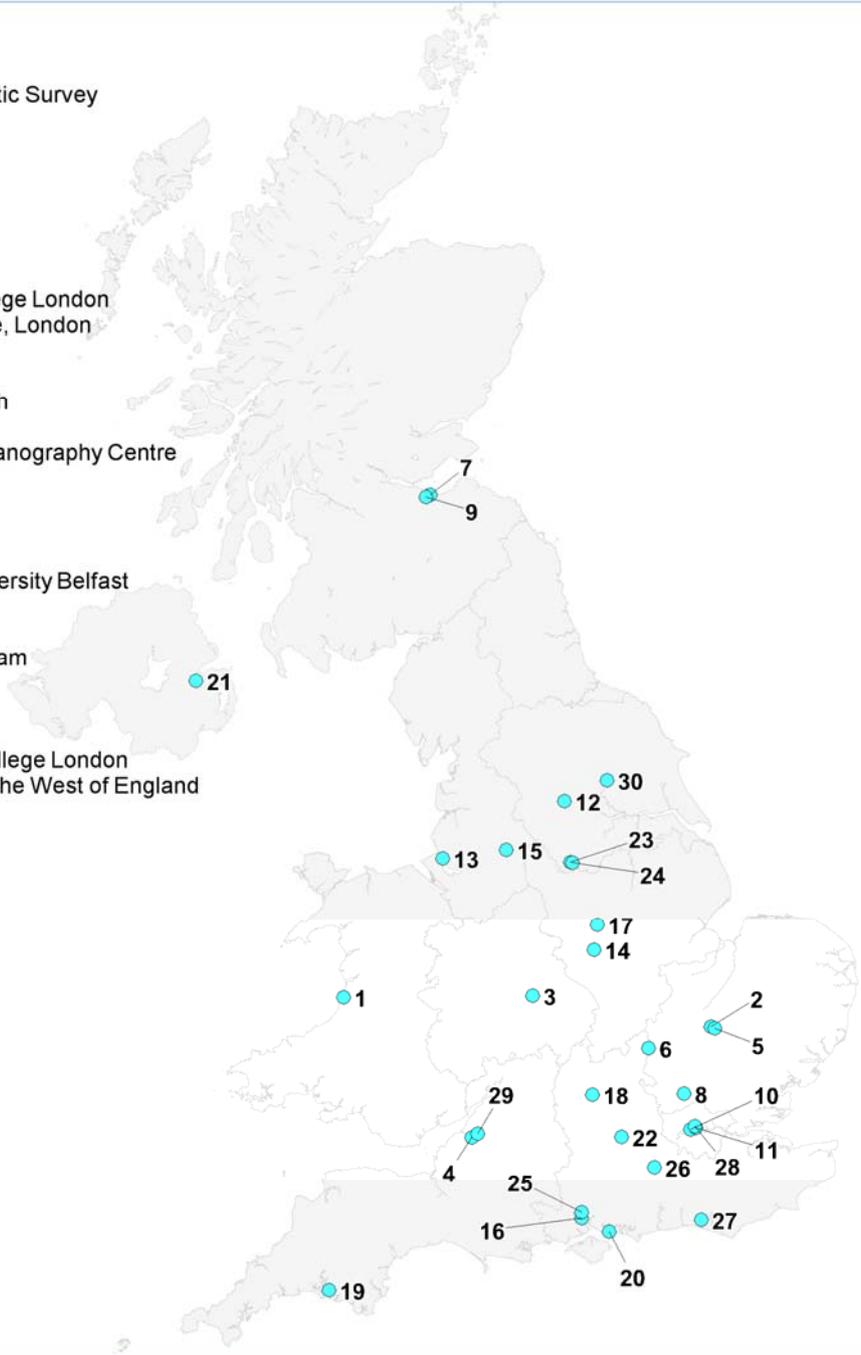


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### Robotics

**Institutions**

1. Aberystwyth
2. British Antarctic Survey
3. Birmingham
4. Bristol
5. Cambridge
6. Cranfield
7. Edinburgh
8. Hertfordshire
9. Heriot-Watt
10. Imperial College London
11. Kings College, London
12. Leeds
13. Liverpool
14. Loughborough
15. Manchester
16. National Oceanography Centre
17. Nottingham
18. Oxford
19. Plymouth
20. Portsmouth
21. Queen's University Belfast
22. Reading
23. Sheffield
24. Sheffield Hallam
25. Southampton
26. Surrey
27. Sussex
28. University College London
29. University of the West of England
30. York



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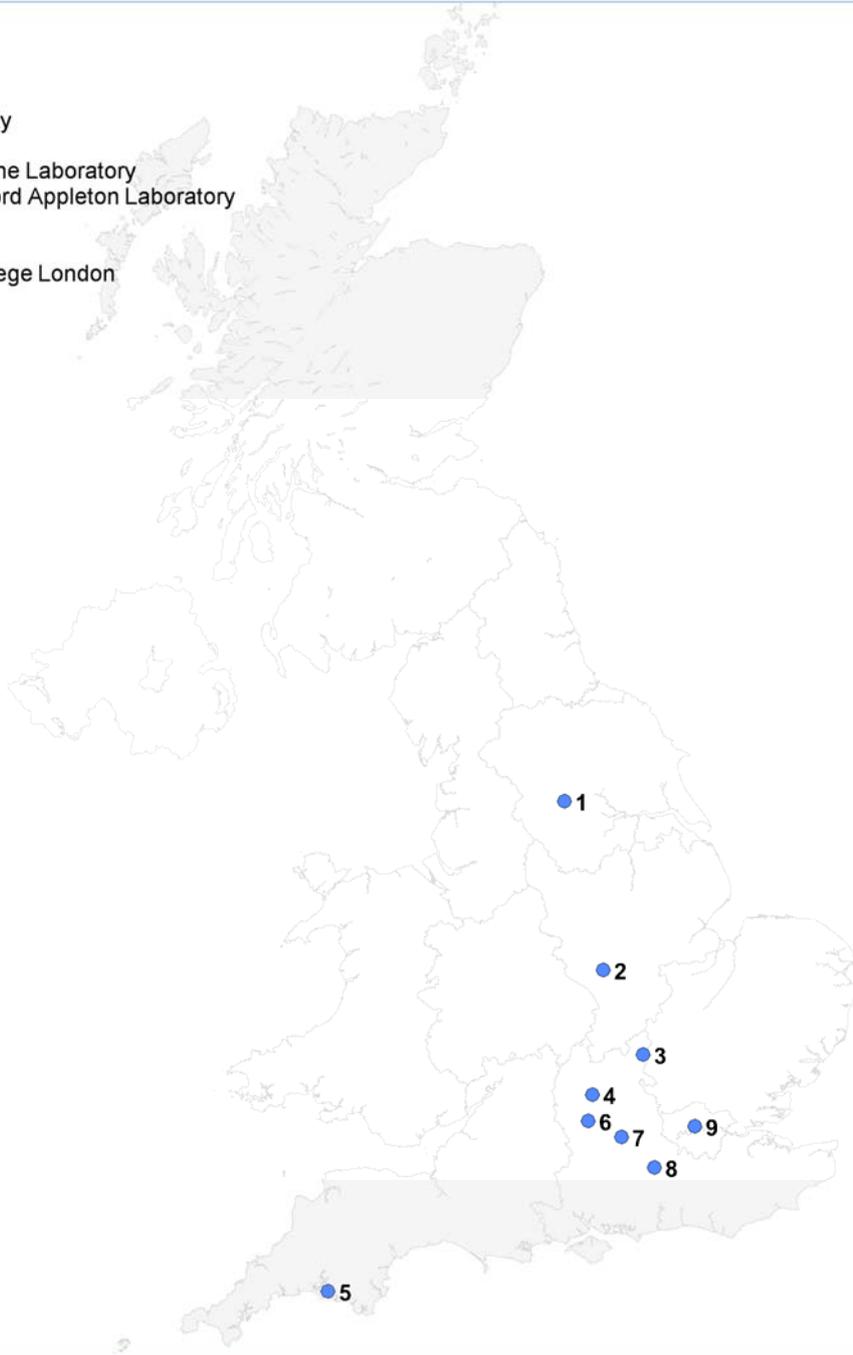


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### Satellites

#### Institutions

- 1. Leeds
- 2. Leicester
- 3. Open University
- 4. Oxford
- 5. Plymouth Marine Laboratory
- 6. STFC Rutherford Appleton Laboratory
- 7. Reading
- 8. Surrey
- 9. University College London



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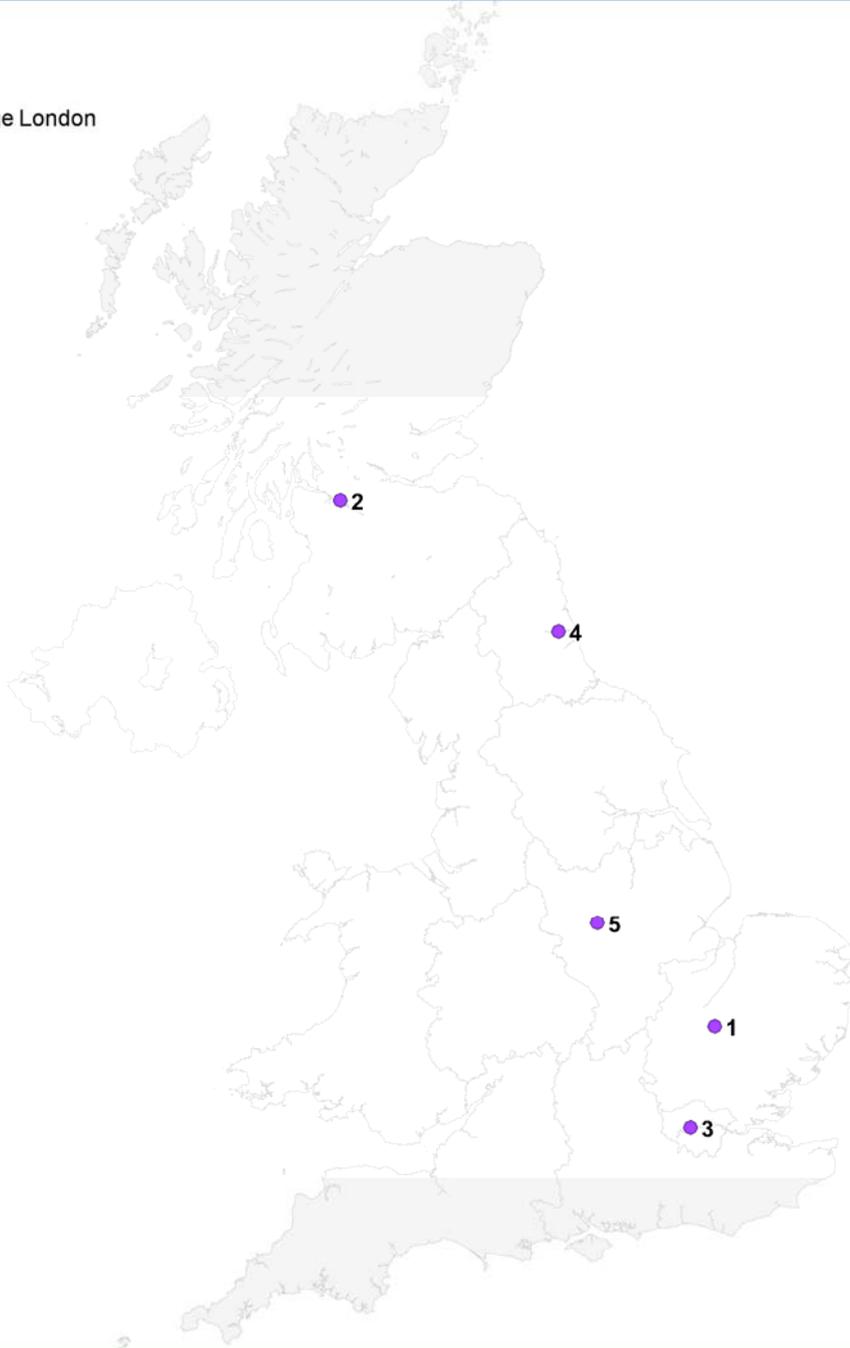


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### Synthetic Biology

Institutions

- 1. Cambridge
- 2. Glasgow
- 3. Imperial College London
- 4. Newcastle
- 5. Nottingham



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## University rankings

23. While information on UK universities identified as world-leading does exist, it is not available by Industrial Strategy sector. However maps have been provided showing UK universities in the QS World Top 200 by research field in science, technology, engineering and mathematics (STEM) subjects.

24. There are several sources of international university rankings, with different strengths. The Review has chosen to use the QS World University Rankings<sup>37</sup>. These rankings combine the results of academic and employer reputation surveys with information from Scopus<sup>38</sup> on citations to produce an overall ranking by subject area. While this does introduce an element of perception, a strength of this source is that it provides a more detailed breakdown of subject areas. Even so it is not sufficiently granular necessarily to convey world class performance. A more specific research capability may not be captured. The rankings identify the top 50 universities globally in order, and then group universities into rank bands, e.g. 51-100. Within bands, universities are shown alphabetically by full title. The maps show the UK universities included in the Top 200, with their world rank given in brackets.

25. The subject areas included within STEM are:

- Agriculture and Forestry
- Biological Sciences
- Chemical Engineering
- Chemistry
- Civil and Structural Engineering
- Computer Science
- Earth and Marine Sciences
- Electrical and Electronic Engineering
- Environmental Science
- Materials Sciences
- Mathematics
- Mechanical, Aeronautical and Manufacturing Engineering
- Medicine
- Pharmacy and Pharmacology
- Physics
- Psychology

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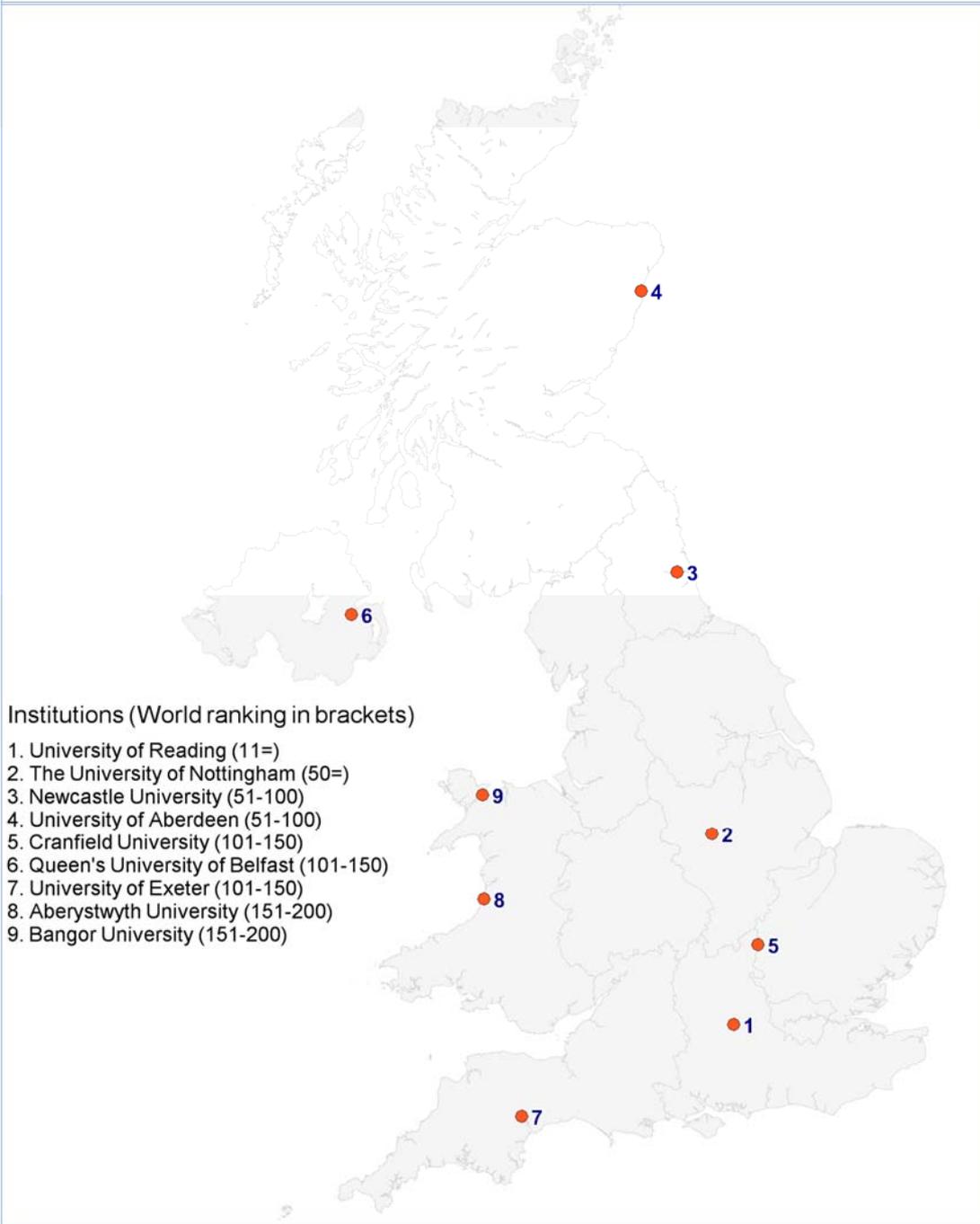
<sup>37</sup> <http://www.topuniversities.com/subject-rankings>

<sup>38</sup> <http://www.info.sciverse.com/scopus>



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### QS World University Rankings - Agriculture & Forestry



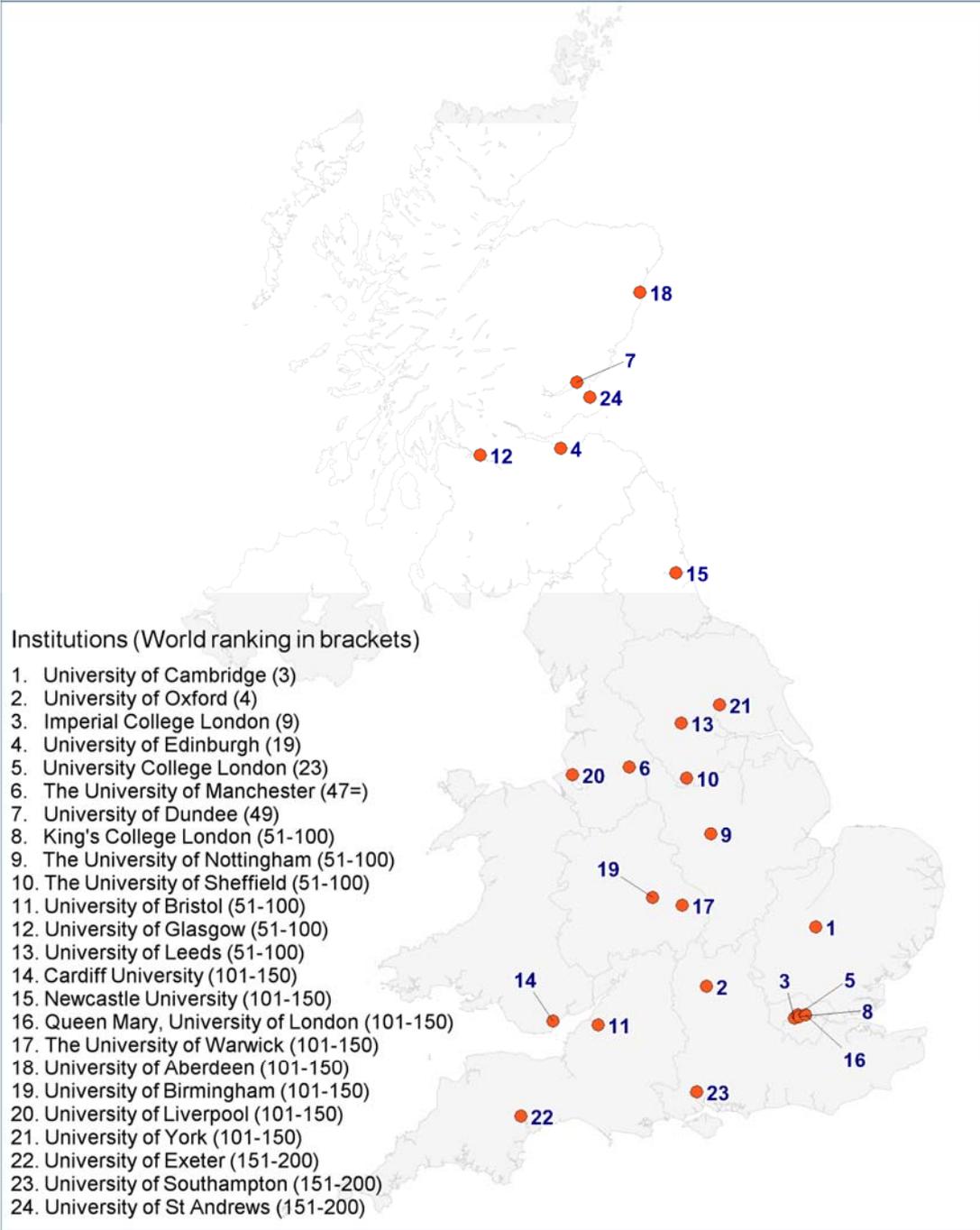
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### QS World University Rankings - Biological Sciences



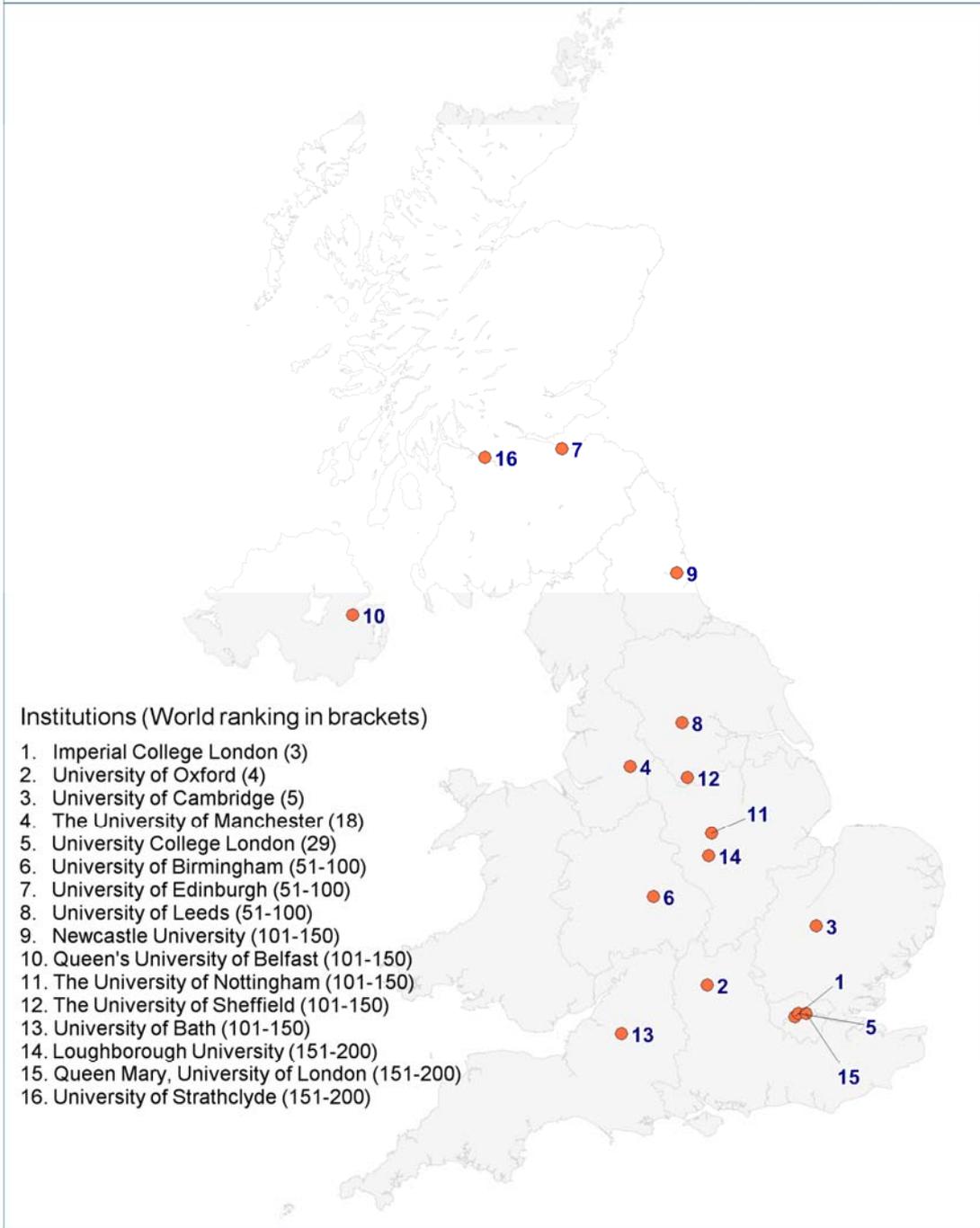
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### QS World University Rankings - Chemical Engineering



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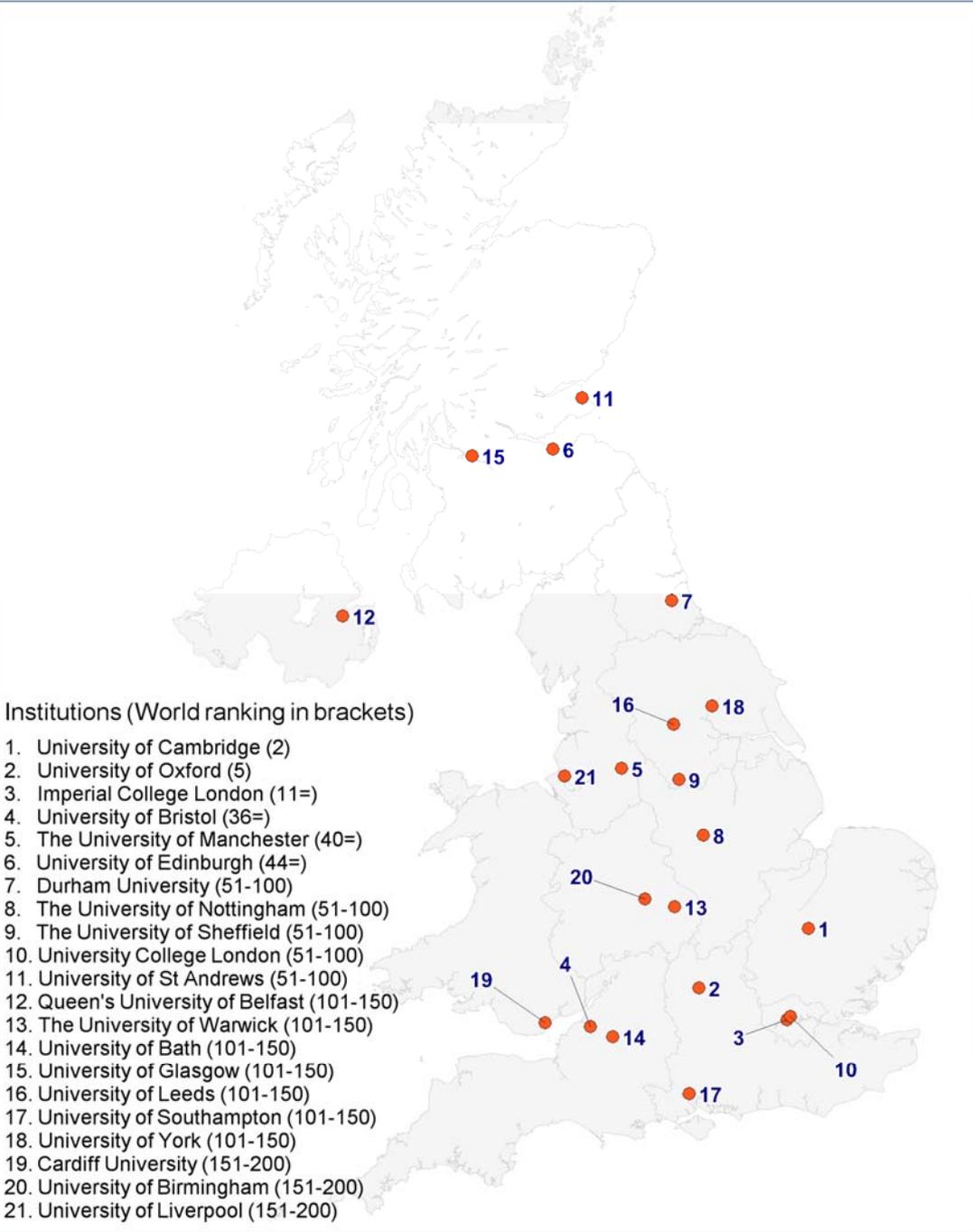
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### QS World University Rankings - Chemistry



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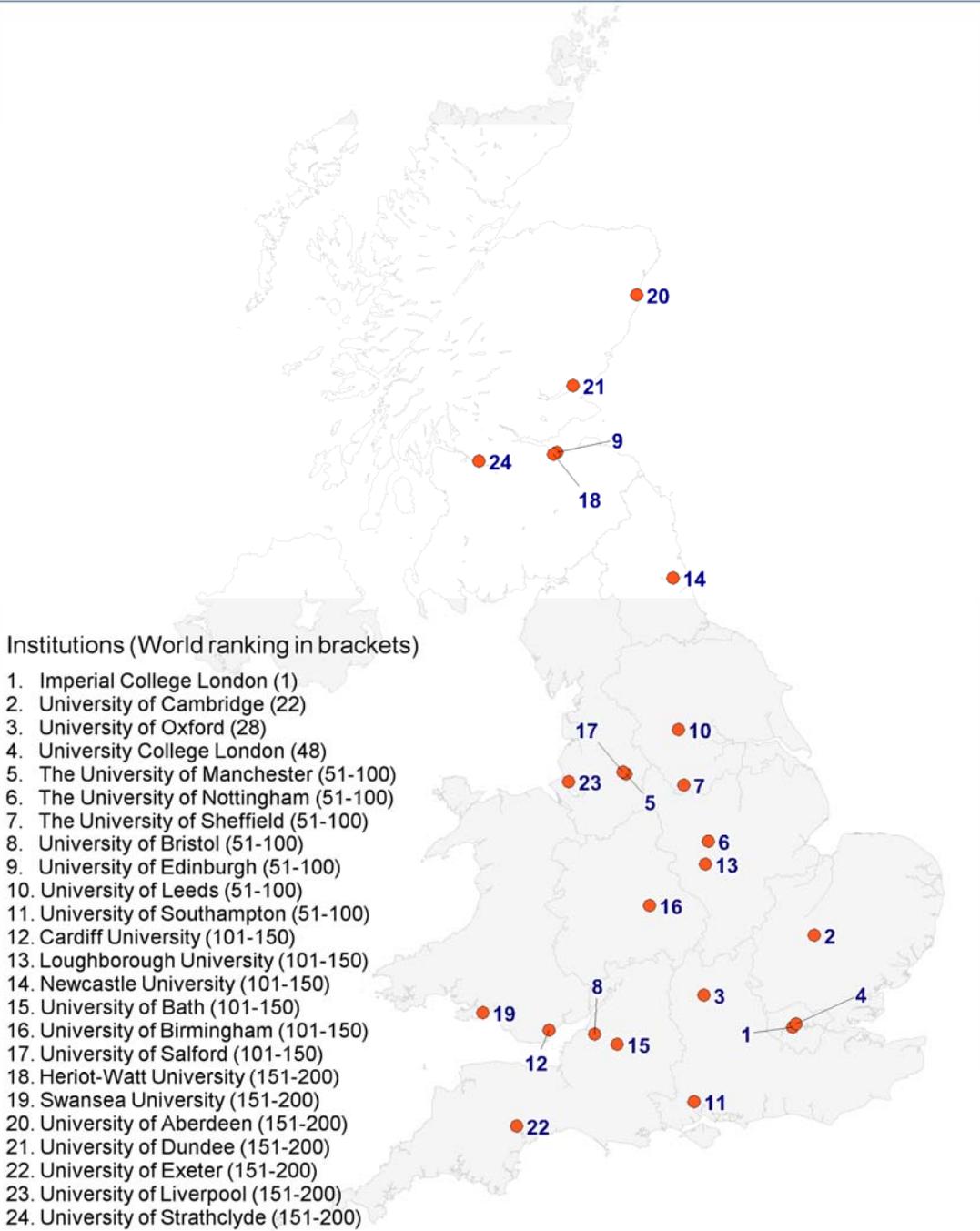
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### QS World University Rankings - Civil & Structural Engineering



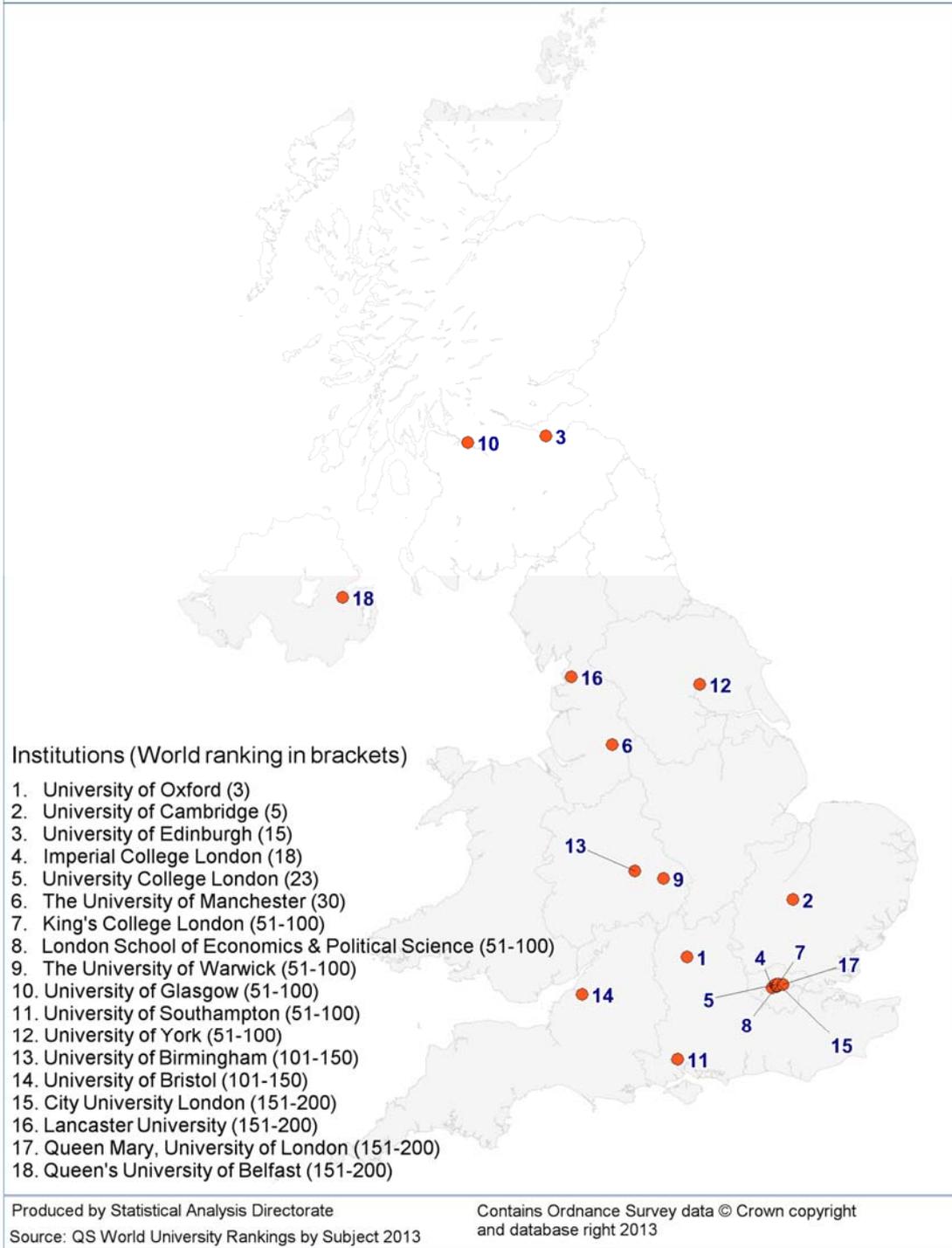
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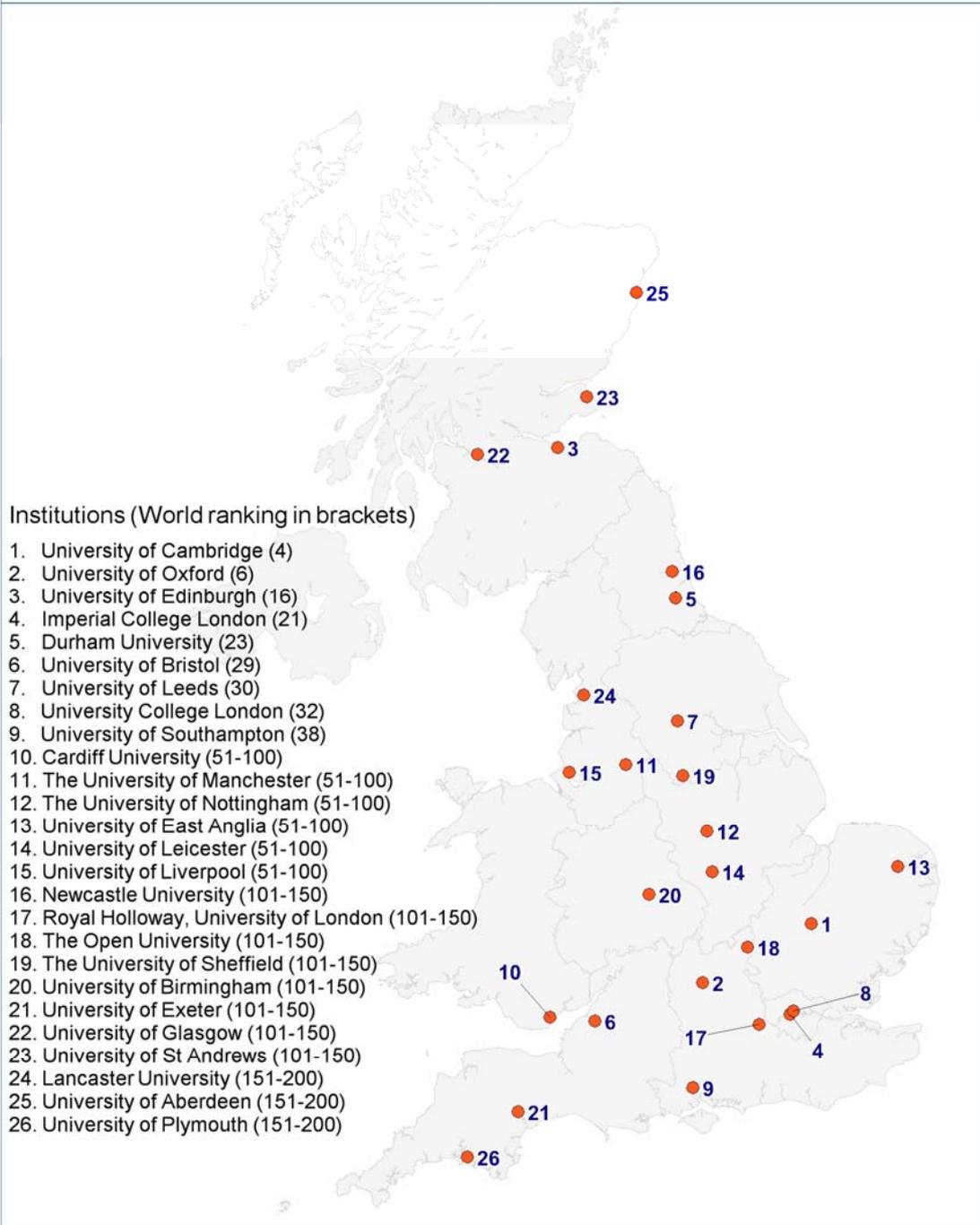
### QS World University Rankings - Computer Science





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### QS World University Rankings - Earth & Marine Sciences



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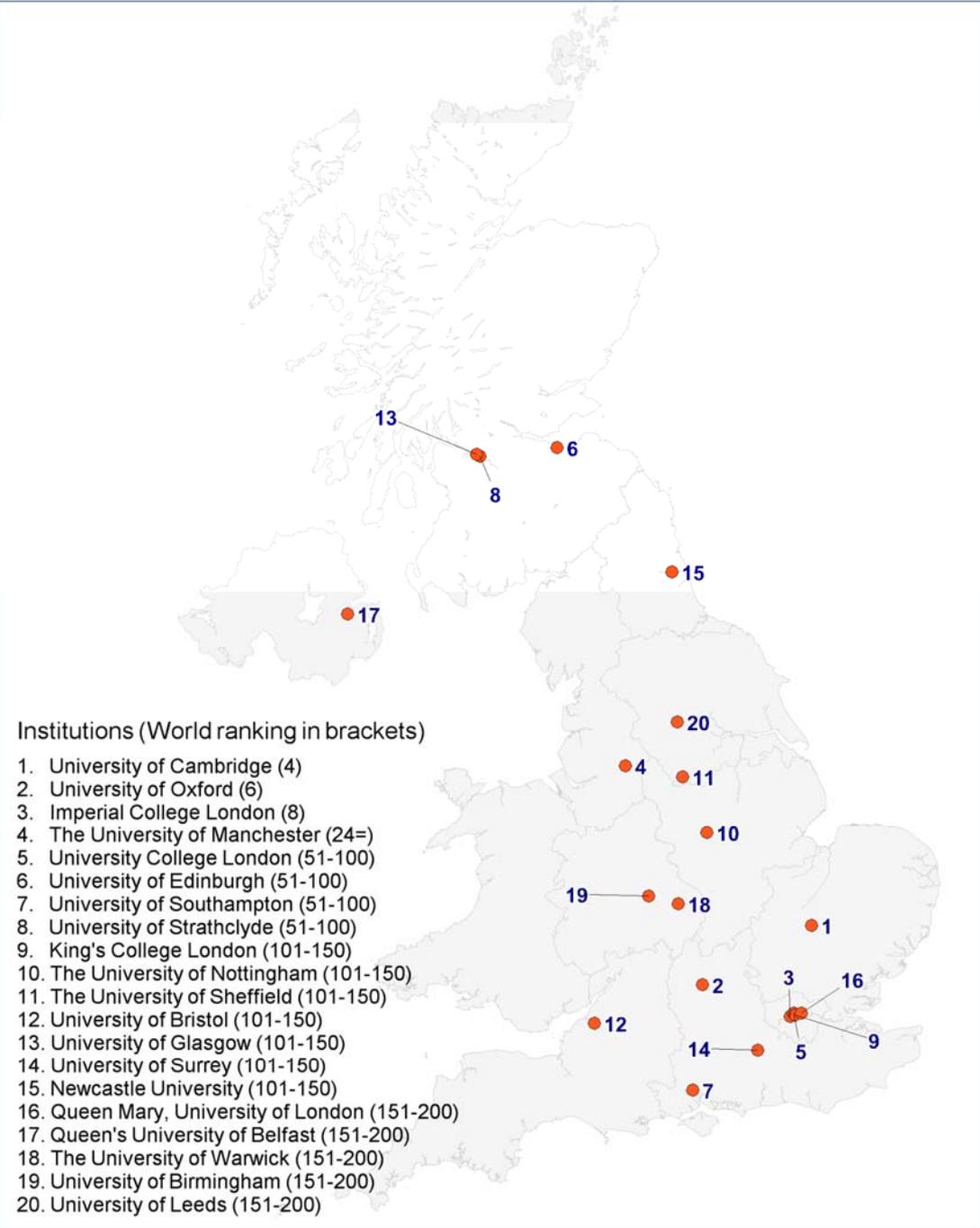
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### QS World University Rankings - Electrical & Electronic Engineering



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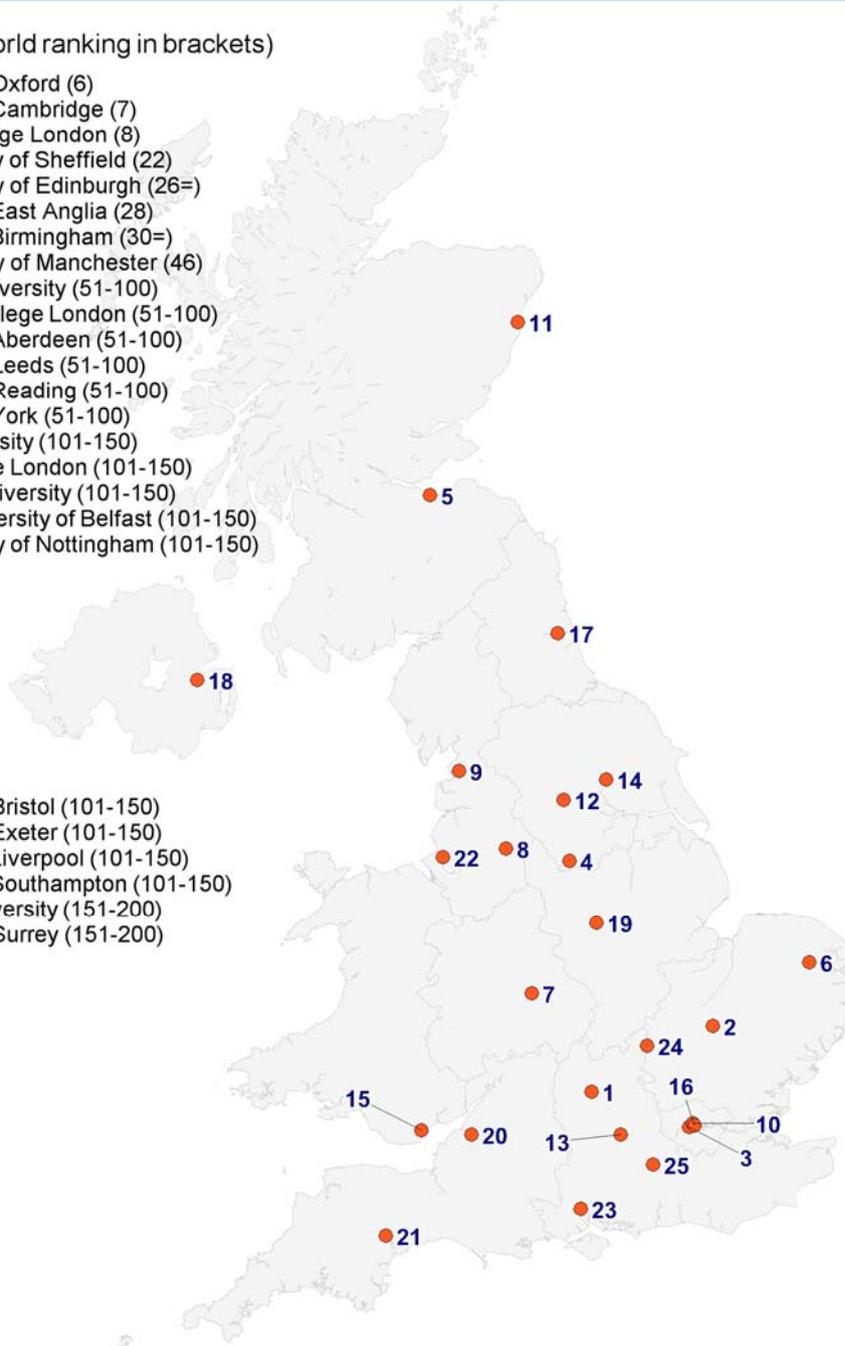
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### QS World University Rankings - Environmental Science

Institutions (World ranking in brackets)

1. University of Oxford (6)
2. University of Cambridge (7)
3. Imperial College London (8)
4. The University of Sheffield (22)
5. The University of Edinburgh (26=)
6. University of East Anglia (28)
7. University of Birmingham (30=)
8. The University of Manchester (46)
9. Lancaster University (51-100)
10. University College London (51-100)
11. University of Aberdeen (51-100)
12. University of Leeds (51-100)
13. University of Reading (51-100)
14. University of York (51-100)
15. Cardiff University (101-150)
16. King's College London (101-150)
17. Newcastle University (101-150)
18. Queen's University of Belfast (101-150)
19. The University of Nottingham (101-150)

20. University of Bristol (101-150)
21. University of Exeter (101-150)
22. University of Liverpool (101-150)
23. University of Southampton (101-150)
24. Cranfield University (151-200)
26. University of Surrey (151-200)



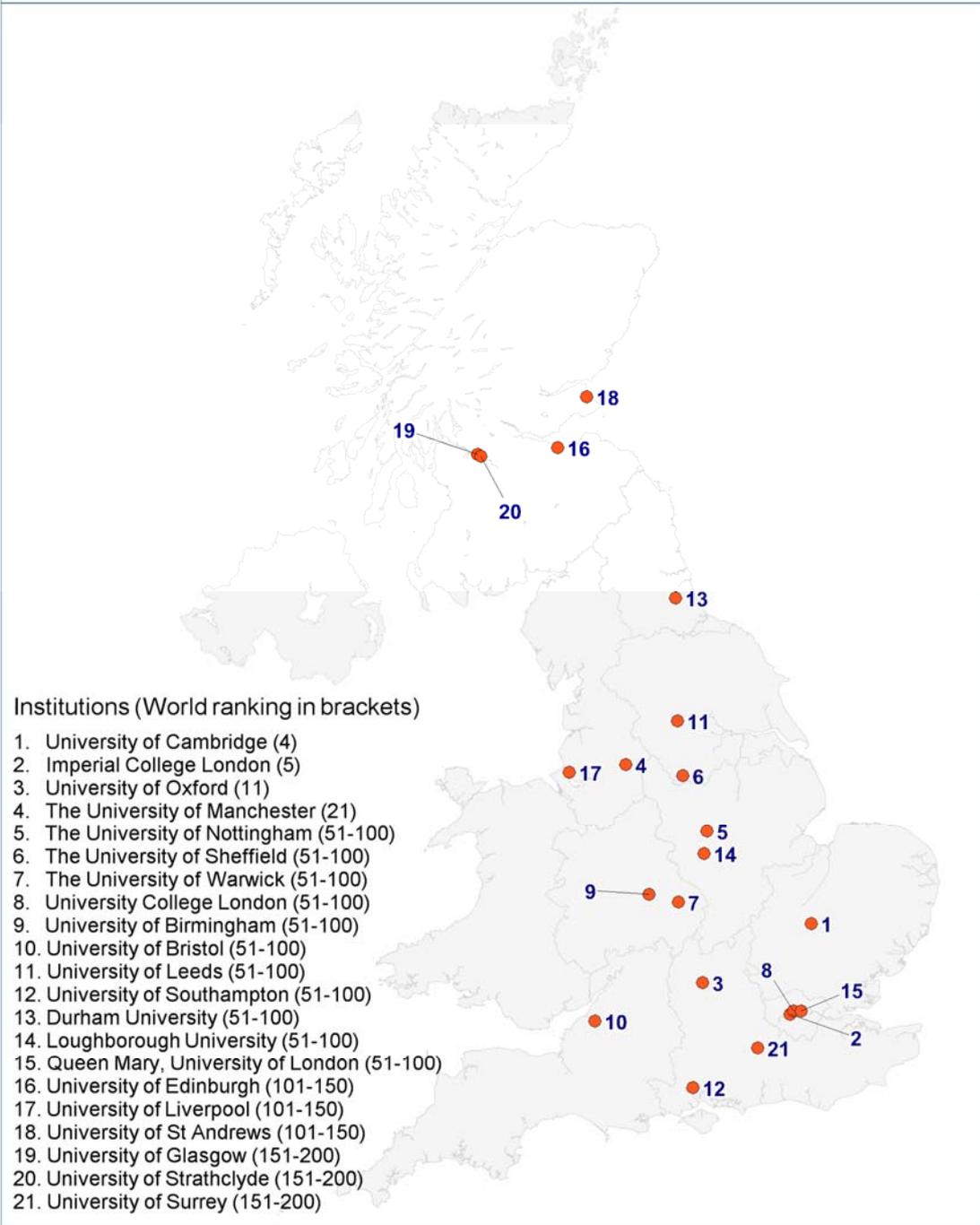
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### QS World University Rankings - Materials Sciences



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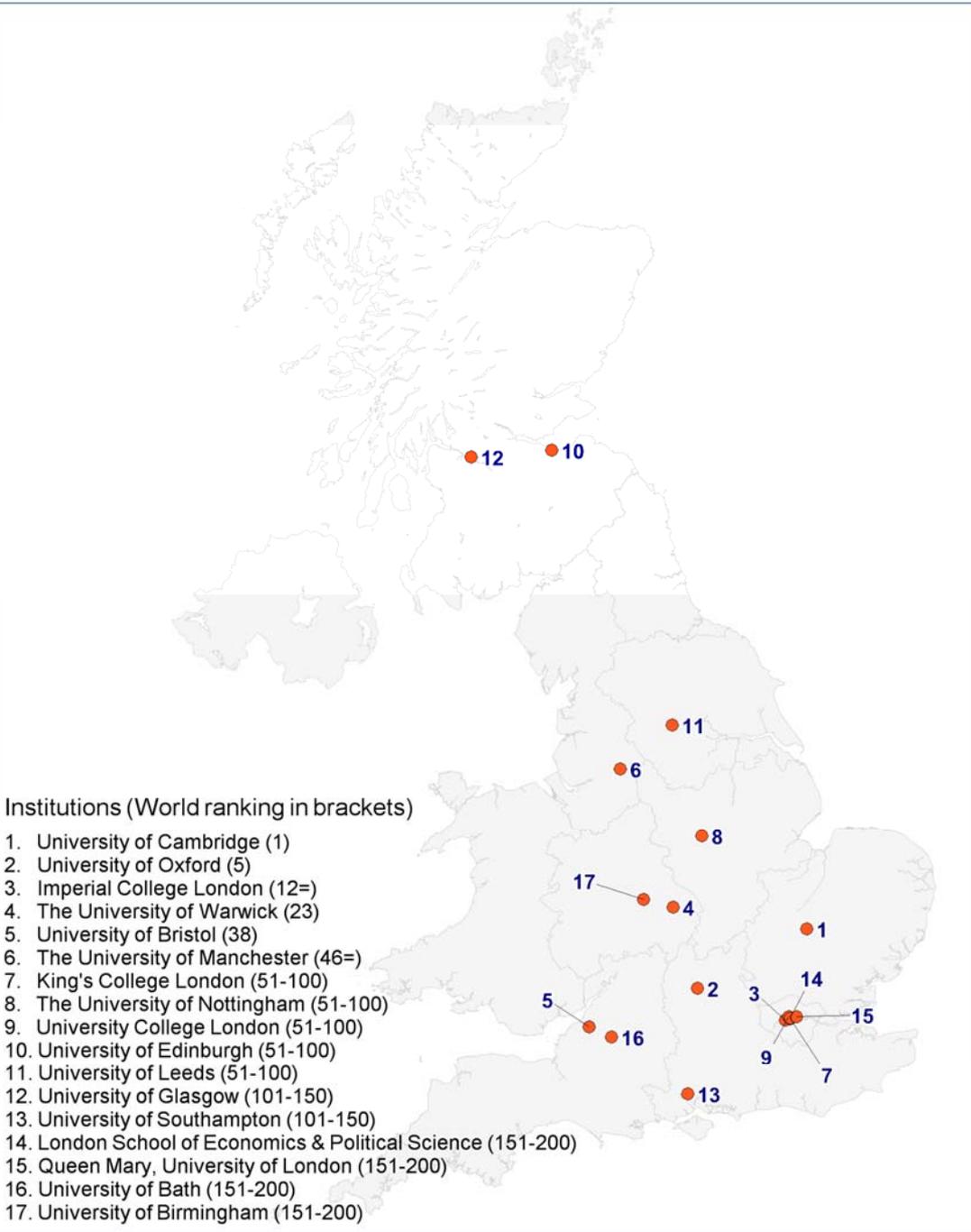
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### QS World University Rankings - Mathematics



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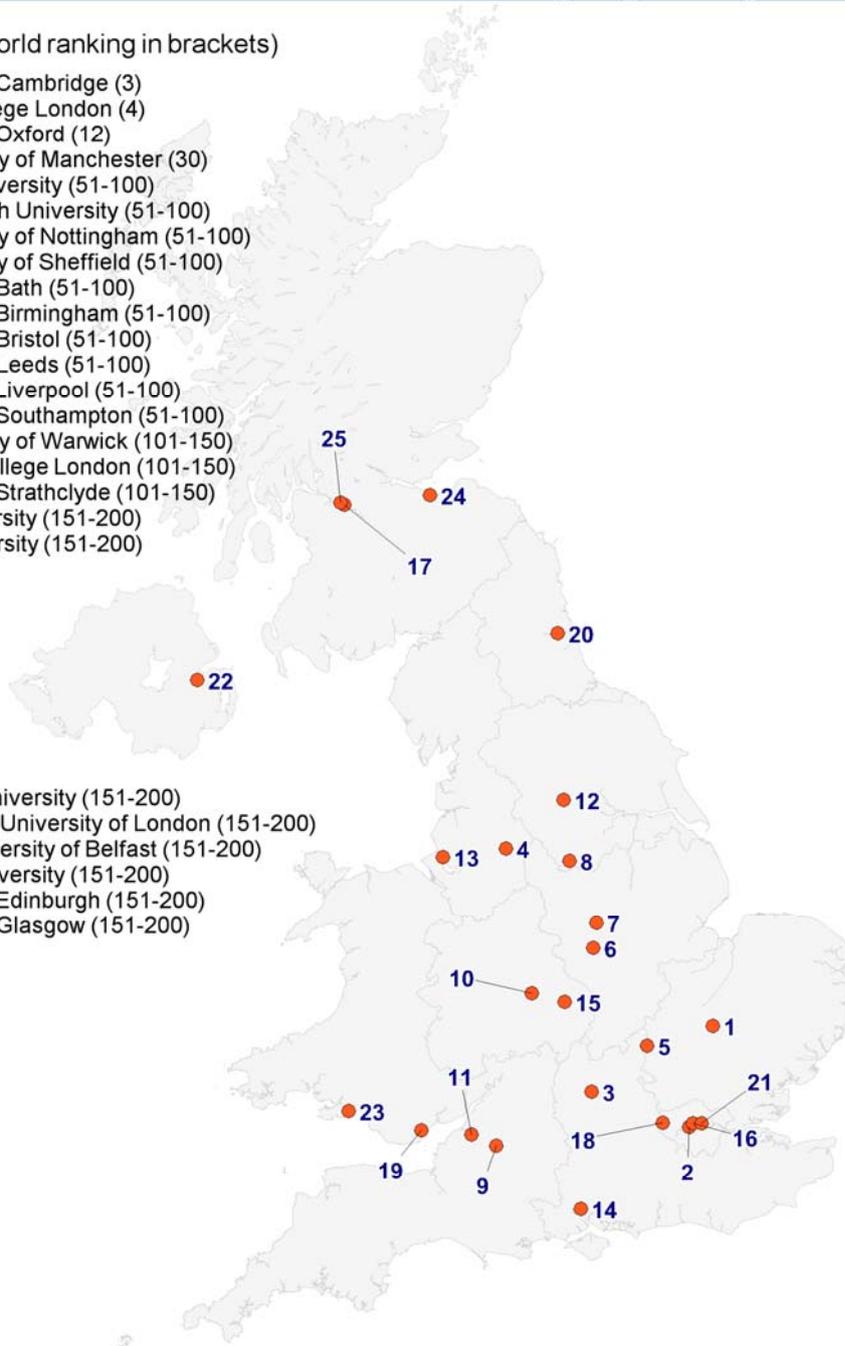
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### QS World University Rankings - Mechanical, Aeronautical & Manufacturing Engineering

Institutions (World ranking in brackets)

1. University of Cambridge (3)
2. Imperial College London (4)
3. University of Oxford (12)
4. The University of Manchester (30)
5. Cranfield University (51-100)
6. Loughborough University (51-100)
7. The University of Nottingham (51-100)
8. The University of Sheffield (51-100)
9. University of Bath (51-100)
10. University of Birmingham (51-100)
11. University of Bristol (51-100)
12. University of Leeds (51-100)
13. University of Liverpool (51-100)
14. University of Southampton (51-100)
15. The University of Warwick (101-150)
16. University College London (101-150)
17. University of Strathclyde (101-150)
18. Brunel University (151-200)
19. Cardiff University (151-200)

20. Newcastle University (151-200)
21. Queen Mary, University of London (151-200)
22. Queen's University of Belfast (151-200)
23. Swansea University (151-200)
24. University of Edinburgh (151-200)
25. University of Glasgow (151-200)



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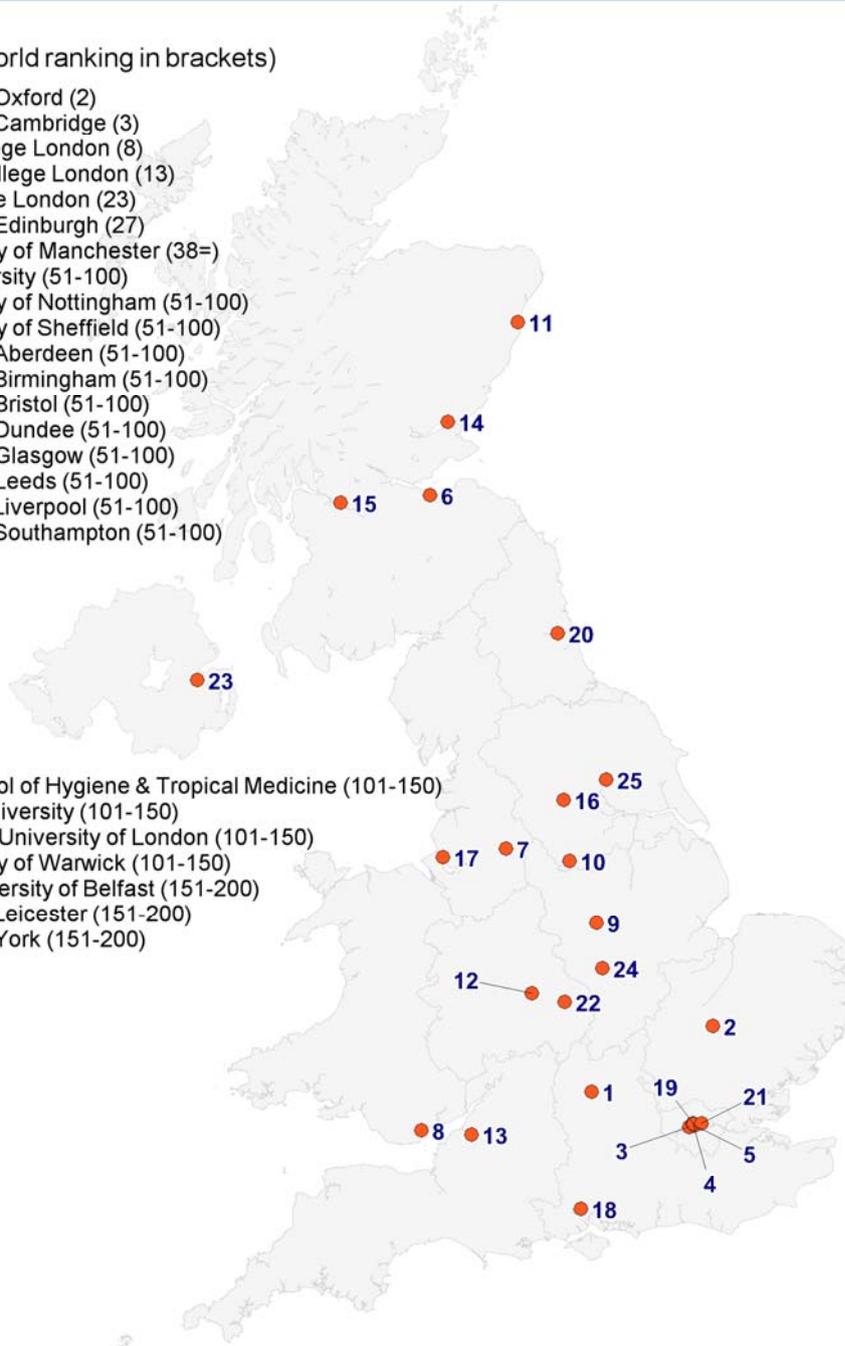
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### QS World University Rankings - Medicine

Institutions (World ranking in brackets)

1. University of Oxford (2)
2. University of Cambridge (3)
3. Imperial College London (8)
4. University College London (13)
5. King's College London (23)
6. University of Edinburgh (27)
7. The University of Manchester (38=)
8. Cardiff University (51-100)
9. The University of Nottingham (51-100)
10. The University of Sheffield (51-100)
11. University of Aberdeen (51-100)
12. University of Birmingham (51-100)
13. University of Bristol (51-100)
14. University of Dundee (51-100)
15. University of Glasgow (51-100)
16. University of Leeds (51-100)
17. University of Liverpool (51-100)
18. University of Southampton (51-100)

19. London School of Hygiene & Tropical Medicine (101-150)
20. Newcastle University (101-150)
21. Queen Mary, University of London (101-150)
22. The University of Warwick (101-150)
23. Queen's University of Belfast (151-200)
24. University of Leicester (151-200)
25. University of York (151-200)



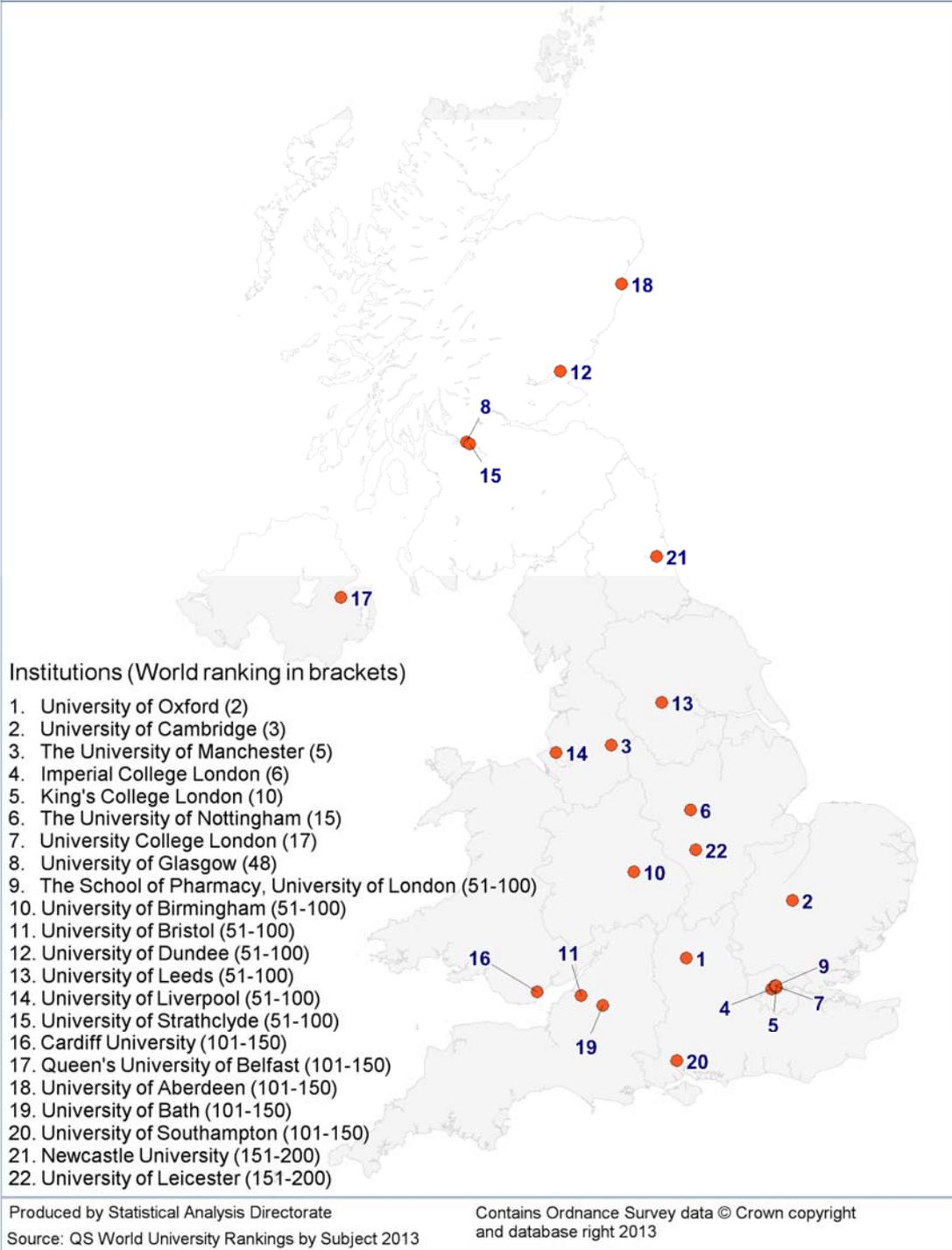
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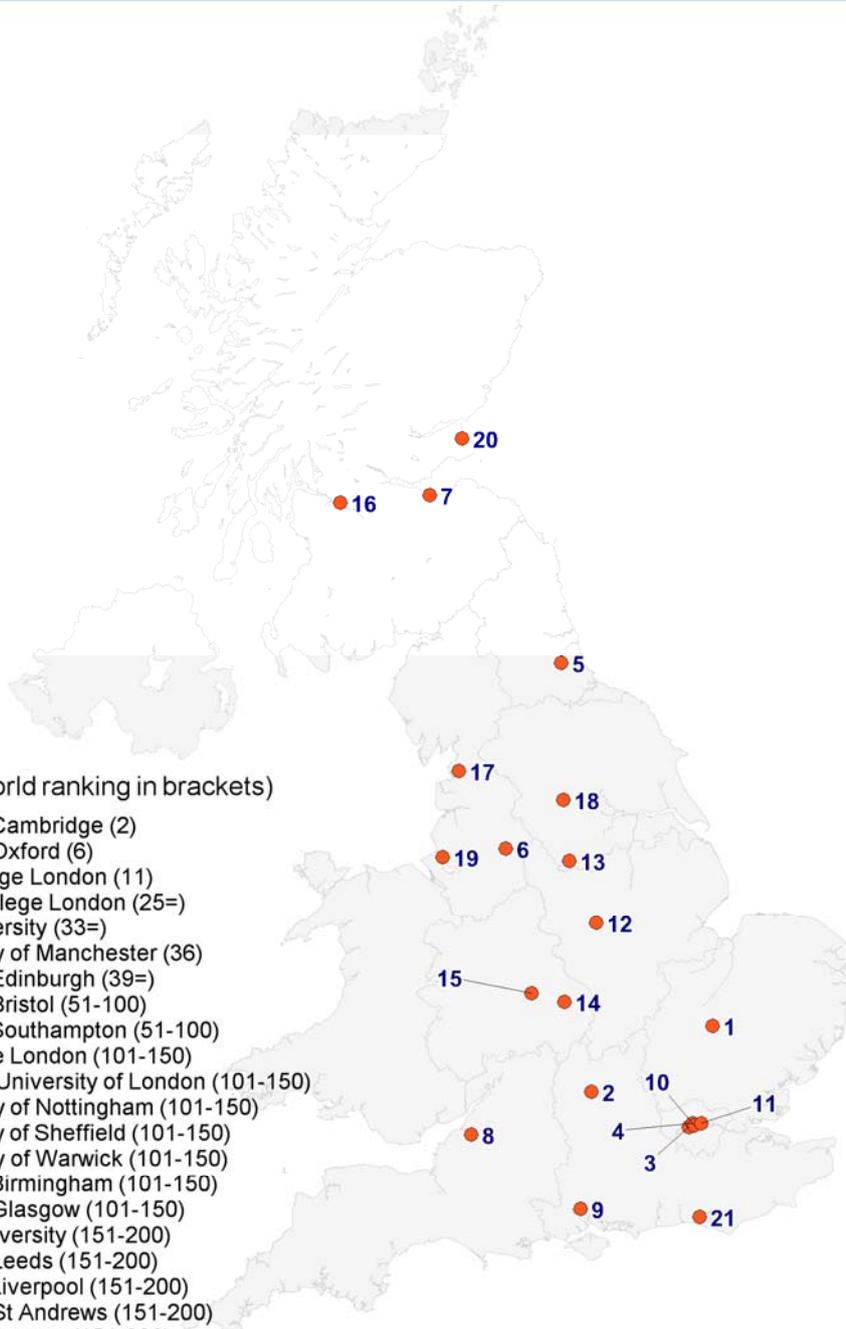
### QS World University Rankings - Pharmacy & Pharmacology





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### QS World University Rankings - Physics



**Institutions (World ranking in brackets)**

1. University of Cambridge (2)
2. University of Oxford (6)
3. Imperial College London (11)
4. University College London (25=)
5. Durham University (33=)
6. The University of Manchester (36)
7. University of Edinburgh (39=)
8. University of Bristol (51-100)
9. University of Southampton (51-100)
10. King's College London (101-150)
11. Queen Mary, University of London (101-150)
12. The University of Nottingham (101-150)
13. The University of Sheffield (101-150)
14. The University of Warwick (101-150)
15. University of Birmingham (101-150)
16. University of Glasgow (101-150)
17. Lancaster University (151-200)
18. University of Leeds (151-200)
19. University of Liverpool (151-200)
20. University of St Andrews (151-200)
21. University of Sussex (151-200)

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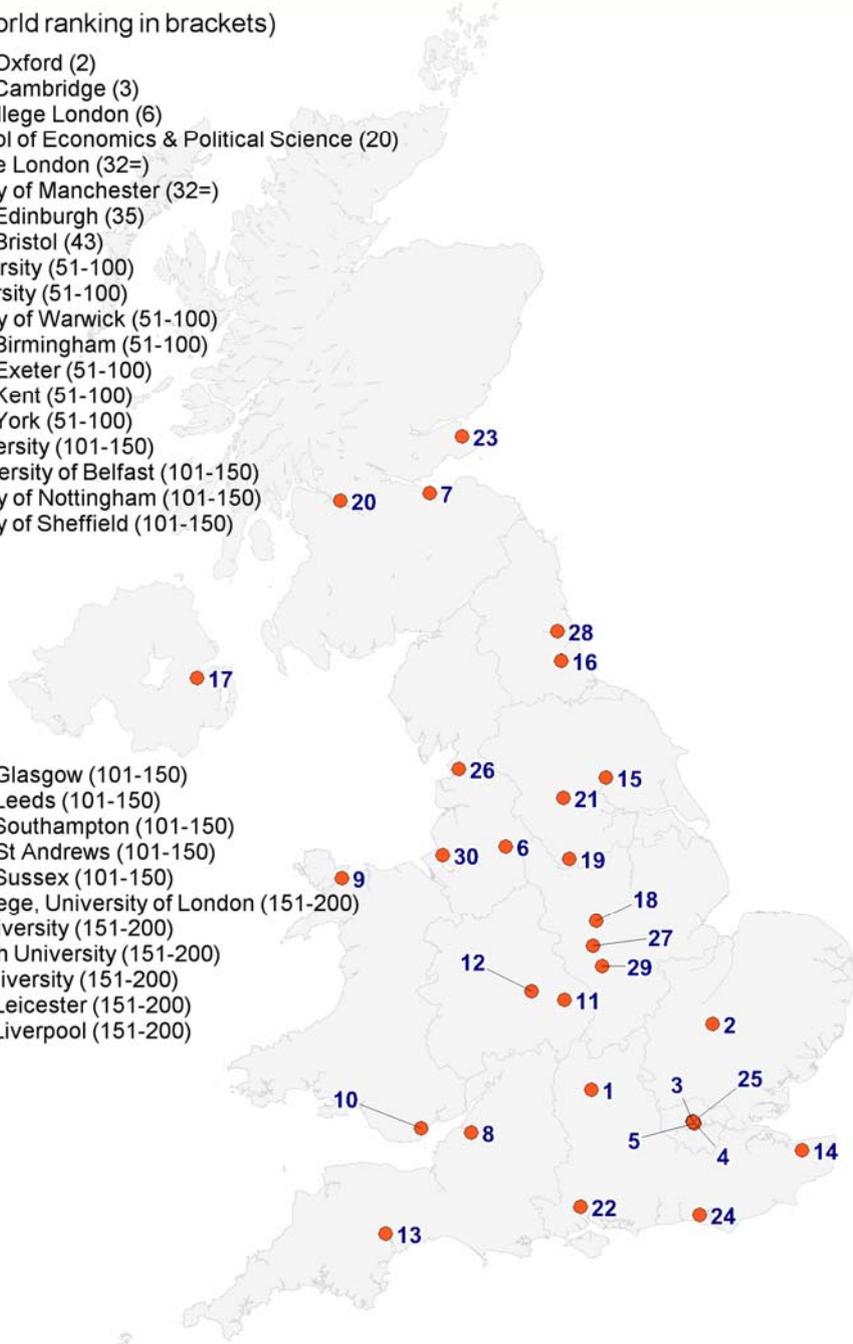
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### QS World University Rankings - Psychology

Institutions (World ranking in brackets)

1. University of Oxford (2)
2. University of Cambridge (3)
3. University College London (6)
4. London School of Economics & Political Science (20)
5. King's College London (32=)
6. The University of Manchester (32=)
7. University of Edinburgh (35)
8. University of Bristol (43)
9. Bangor University (51-100)
10. Cardiff University (51-100)
11. The University of Warwick (51-100)
12. University of Birmingham (51-100)
13. University of Exeter (51-100)
14. University of Kent (51-100)
15. University of York (51-100)
16. Durham University (101-150)
17. Queen's University of Belfast (101-150)
18. The University of Nottingham (101-150)
19. The University of Sheffield (101-150)

20. University of Glasgow (101-150)
21. University of Leeds (101-150)
22. University of Southampton (101-150)
23. University of St Andrews (101-150)
24. University of Sussex (101-150)
25. Birkbeck College, University of London (151-200)
26. Lancaster University (151-200)
27. Loughborough University (151-200)
28. Newcastle University (151-200)
29. University of Leicester (151-200)
30. University of Liverpool (151-200)



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