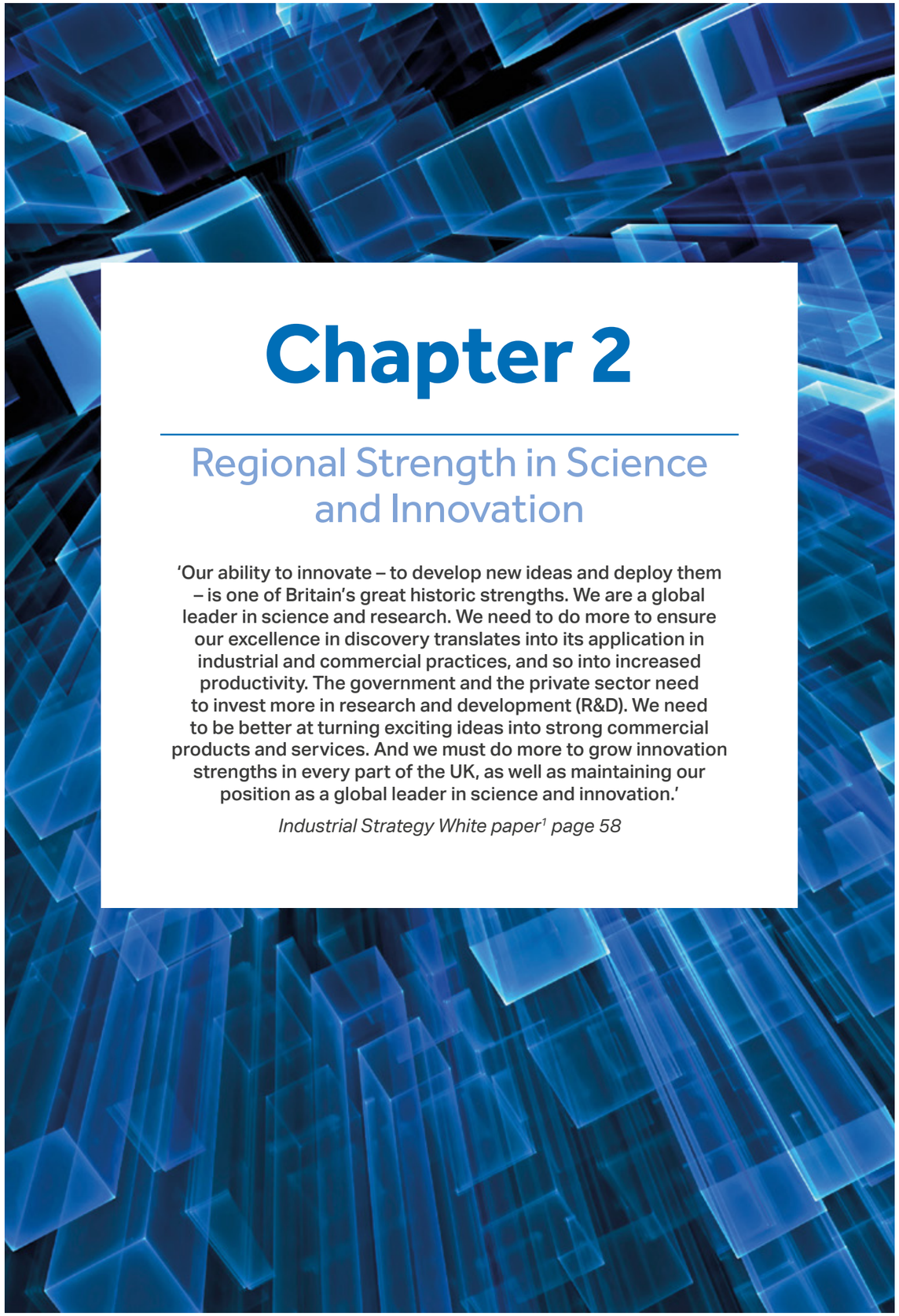


Chapter 2

Regional Strength in Science and Innovation

'Our ability to innovate – to develop new ideas and deploy them – is one of Britain's great historic strengths. We are a global leader in science and research. We need to do more to ensure our excellence in discovery translates into its application in industrial and commercial practices, and so into increased productivity. The government and the private sector need to invest more in research and development (R&D). We need to be better at turning exciting ideas into strong commercial products and services. And we must do more to grow innovation strengths in every part of the UK, as well as maintaining our position as a global leader in science and innovation.'

Industrial Strategy White paper[1] page 58

2.1 Innovation drivers

As highlighted in Chapter 1, it is clear that Clean and Sustainable Growth encompasses several of the 'mega trends' that will drive change in future global trade and so support significant commercial opportunities. These include 'innovating to zero' as resources become scarcer; compliance with climate change obligations to reduce emissions of greenhouse gases, which drives the shift to low or zero carbon systems; adapting to climate change (especially around extreme weather events) and, in an age of rapid urbanisation, upgrading poor drinking water and waste water infrastructure, and feeding the world's growing population.

Our experience echoes the conclusions of the Energy Technologies Institute Report[7] that these opportunities demand more than just a change in how we generate energy. The report concluded that meeting these challenges will require significant innovation across all sectors, including the way energy is generated and delivered, plus the way in which it is used in homes, transport systems, industries and the public sector. Resource scarcity and the depletion of non-renewable resources demands alternative solutions across all sectors and maps on to not only the UK's Clean Growth Strategy[2] but also the UK Industrial Strategy[1] and 25 Year Environment Plan[6]. These solutions touch on every commercial sector and the whole range of research disciplines.

Global corporates are also driving Clean and Sustainable Growth across their global supply chains and there are clear leaders in this field in our NWCA geography. As a result, our SIA is founded on the hypothesis that the NWCA is well-placed to develop the products, technologies and services that are urgently needed to meet the pressing market need and opportunity for Clean and Sustainable Growth and to establish our region as the global leader in this regard.

2.2 Excellence in science and research

In terms of the volume of research outputs, the NWCA published 5.2% of all UK research outputs between 2010 and 2015 (See Annex 5 for Methodology). Against that all subject average, the location quotient (LQ) for the volume of research outputs in eleven broad disciplinary areas pertinent to Clean and Sustainable Growth averages 1.18, with LQs for Earth & Planetary Science (1.92), Environmental Science (1.81) and Agricultural & Biological Sciences (1.51) especially notable. LQs for the volume of publications for the other eight cognate disciplines vary between 0.8 and 1.24.

Analysis of research quality, measured as the percentage of publications in the top 5% of cited publications (Annex 5) for the same basket of eleven cognate subjects, demonstrates that the NWCA outperforms the UK as a whole in seven of the eleven subject areas (Figure 2.1). The NWCA also outperforms the USA & Canada in seven of the eleven disciplines, the EU28 in ten of eleven and in all disciplines when compared with the G20 or China (Figure 2.1).

While this overall audit of research performance confirms the excellence of NWCA's research in these broad disciplines, it also highlights that these disciplines do not coincide well with the inter-disciplinary and challenge-led nature of research for Clean and Sustainable Growth. The NWCA has pioneered a vision of eco-innovation for Clean and Sustainable Growth in which many research activities and business challenges transcend traditional disciplinary boundaries. As described in Chapter 1, this led to the identification of three prime capabilities within this audit, Environmental Industries Technologies & Services (EITS), Future Energy Systems (FES) and Advanced Manufacturing, Chemicals and Materials (AMCM).

In addition, the Enabling Capability - Cross-cutting Research and Innovation for Clean and Sustainable Growth - by drawing on strengths across disciplines and enhancing collaboration with industry, supports the translation of research excellence across the 3 prime capabilities into new products, processes and services for Clean and Sustainable Growth. All four capabilities cut across traditional disciplinary and sectoral boundaries but EITS, FES and AMCM represent our core strengths in science and technology, facilitated and supported by our excellence in innovation.

We focus here on auditing the NWCA's research performance for EITS, FES and AMCM. Analysis of research volume using the SCIVAL database (Annex 5) gave location quotients (LQ) of 1.29 for EITS, 1.11 for FES and 0.96 for AMCM. Research income was also analysed for these capabilities for the period 2007-2017. Across all topics NWCA partners were involved in 7.5% of all UK projects, with location quotients of 1.30, 1.42 and 1.20 for EITS, FES and AMCM respectively. By value, NWCA partners were involved in 9.3% of all UK projects, with location quotients of 1.58, 1.68 and 1.39 for EITS, FES and AMCM respectively.

Corporate leadership in strategies for Clean and Sustainable Growth in the North West Coastal Arc

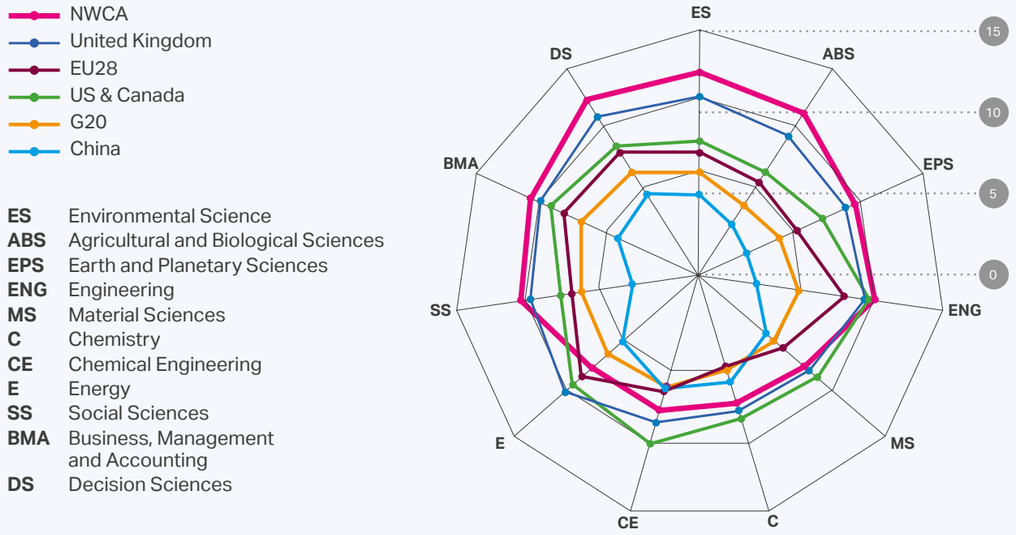
Unilever, based at Port Sunlight in Merseyside, is a world leader in the sustainable business and circular economy movement. Their Sustainable Living Plan aims to double profits and halve environmental impacts through improved efficiencies in waste, packaging and supply chain engagement. Unilever is also leading the move towards solution-driven Open Innovation encouraging ideas from a global community of innovators.

The research base in the NWCA has shown international leadership in building productive collaborations with eco-innovative businesses, especially SMEs.

Walney Wind Farm, Cumbria

Figure 2.1

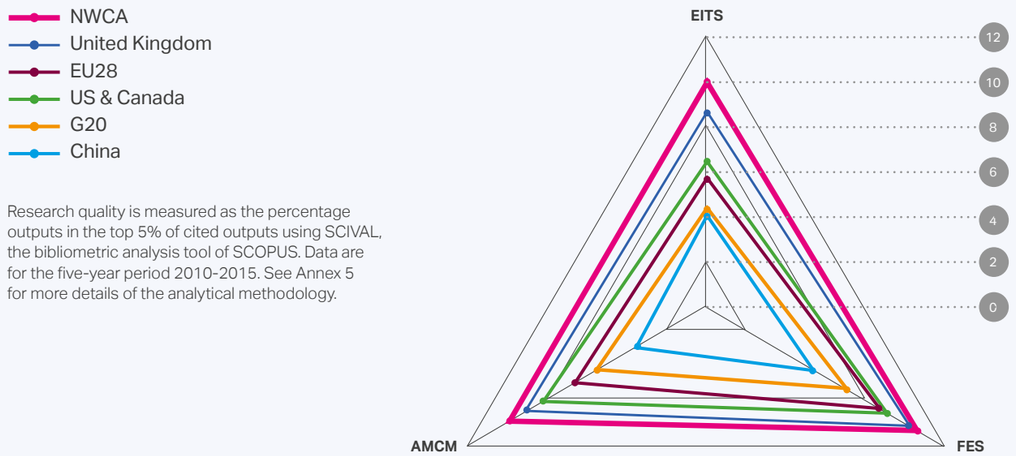
Research quality of the NWCA in eleven broad disciplinary headings compared with the UK, and other nations or nation groups.



Research quality is measured as the percentage of outputs in the top 5% of cited outputs using SCIVAL, the bibliometric analysis tool of SCOPUS. Data are for the five-year period 2010-2015. This analysis, effectively a broad-based audit of all 'high-level' disciplinary groupings pertinent to eco-innovation, formed the first step of our audit of research quality. See Annex 5 for more detail of the analytical methodology.

Figure 2.2

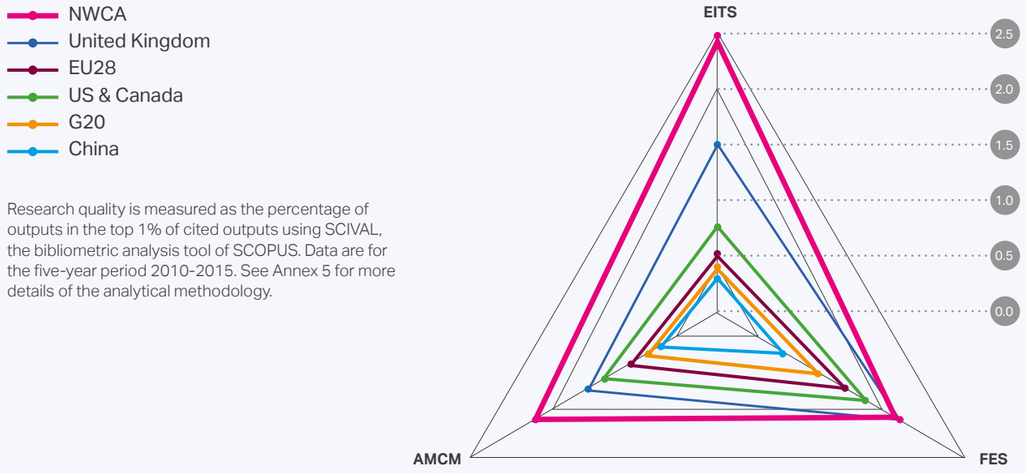
Research quality of the NWCA in the three prime capabilities of this SIA compared with the UK and other nations or nation groups. The three capabilities are Environmental Industries, Technologies and Services (EITS), Advanced Manufacturing, Chemicals and Materials (AMCM) and Future Energy Systems (FES).



Research quality is measured as the percentage outputs in the top 5% of cited outputs using SCIVAL, the bibliometric analysis tool of SCOPUS. Data are for the five-year period 2010-2015. See Annex 5 for more details of the analytical methodology.

Figure 2.3

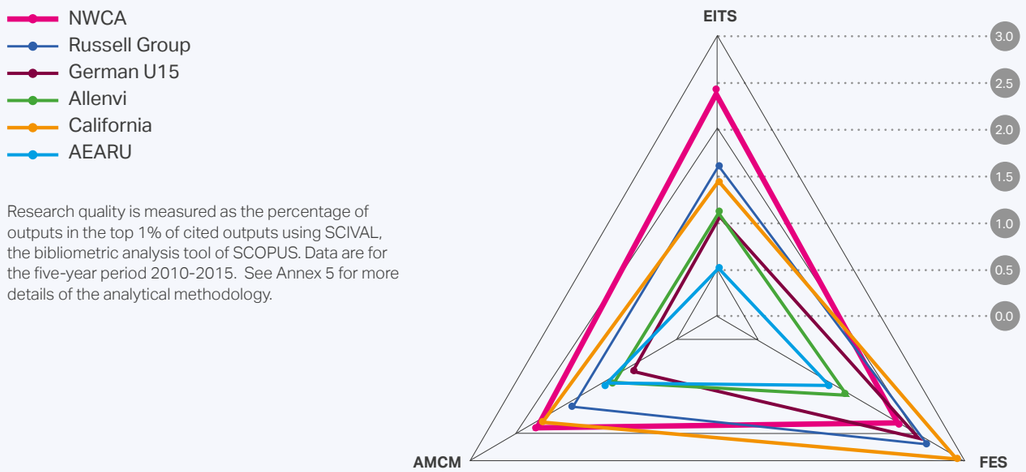
Research quality for the NWCA across our three core capabilities compared with the UK and other nations or nation groups. The three capabilities are Environmental Industries, Technologies and Services (EITS), Future Energy Systems (FES) and Advanced Manufacturing, Chemicals and Materials (AMCM).



Research quality is measured as the percentage of outputs in the top 1% of cited outputs using SCIVAL, the bibliometric analysis tool of SCOPUS. Data are for the five-year period 2010-2015. See Annex 5 for more details of the analytical methodology.

Figure 2.4

Research quality for the NWCA across our three core capabilities compared with other major university groups or regions. The three capabilities are Environmental Industries, Technologies and Services (EITS), Future Energy Systems (FES) and Advanced Manufacturing, Chemicals and Materials (AMCM).



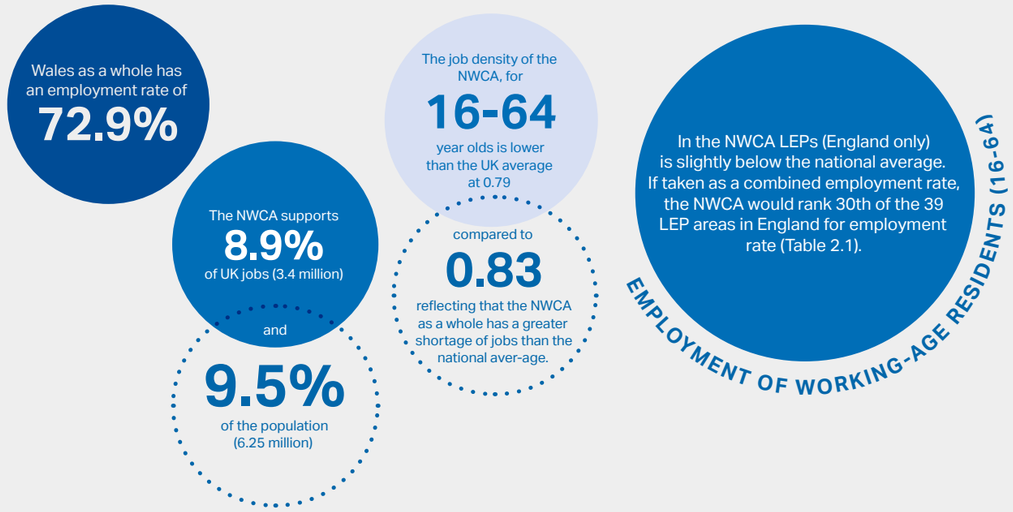
Research quality is measured as the percentage of outputs in the top 1% of cited outputs using SCIVAL, the bibliometric analysis tool of SCOPUS. Data are for the five-year period 2010-2015. See Annex 5 for more details of the analytical methodology.

Materials Innovation Factory, Liverpool

Using the percentage of publications in the top 5% of cited publications as a measure of research quality in these three capabilities places the NWCA ahead of all our comparator nations and nation groups (Figure 2.2). In analysing research quality in the three prime capabilities, we then applied a highly rigorous approach to identify areas of exceptional strength. First, rather than using the percentage of papers in the top 5% of cited publications, the metric used in the initial broad-brush audit, we used the percentage of papers in the top 1% of cited publications. Applying this measure of quality to compare the NWCA with nations or groups of nations (as in Figure 2.1) demonstrates that the region substantially outperforms all comparators in EITS and AMCM (Figure 2.3). For the Future Energy Systems capability the NWCA is similar to the UK overall, but well ahead of all other comparators (Figure 2.3).

Our second element of additional rigour was to compare the NWCA against other major university groups, plus California included as a region recognised for its global leadership in innovation (Figure 2.4 and see Annex 5). In this more rigorous analysis the NWCA substantially outperforms all comparators in research in the EITS capability (Figure 2.4). For AMCM only California has as high a percentage of papers in the top 1% as the NWCA, which is well ahead of all other comparators. The region's performance in FES, although still well above the global average, is less strong relative to these very powerful comparators (Figure 2.4). Nonetheless, based on this overall audit our assessment is that this most rigorous analysis of research strength is the most appropriate for the SIA. This approach has been used in the detailed analysis of the specialised strengths in each prime capability (Chapters 3, 4 and 5).

Innovation strengths and growth points



LEP/Area	Employed	16-64 Population	Percent %
Cheshire and Warrington	421,800	558,700	75.5
Cumbria	224,700	294,100	76.4
Lancashire	665,300	901,000	73.8
Liverpool City Region	656,200	960,000	68.4
Stoke-on-Trent and Staffordshire	522,400	686,000	76.1
NWCA	2,490,400	3,399,800	73.3
England	27,568,200	36,959,200	74.6

The NWCA area generated GVA of £130 billion in 2015, (8.6% of the UK total). The Compound Annual Growth Rate (CAGR) for the region was 3.3% 2002-2015, slightly below the UK rate of 3.6%. Overall productivity in the five LEPs in the NWCA, at £45,100 per job worked, is below the UK average of £50,830 and the rate of productivity growth between 2002 and 2015 was 2.5% per annum, slightly below the UK average of 2.8%. When looking at the whole NWCA region, including the Welsh Local Authorities, GVA per head is £20,891, which is significantly below the UK average of £25,351, with average earnings also ranking below the national average, at £24,231 compared to £28,213.

The region's strength in depth in the research base supporting EITS, FES and AMCM (Chapter 3-5) is enhanced by both underpinning research in our cross-cutting research areas and significant cross-cutting knowledge exchange and business collaboration assets, both described in detail in Chapter 6. In summary, we have innovation strengths in depth in three highly distinctive, complementary areas:

(i) Business-led understanding of the demand for a wide range of eco-innovative goods and services. Our industrial partners, from SMEs to large industry players with international reach, are committed to sharing and identifying the commercial opportunities that will arise from a deeper understanding of the eco-innovation market place as well as specific innovation needs and skills demands. The strength of the wider consortium is connecting these corporate businesses with the wider community of eco-innovative SMEs, building on our significant existing networks, such as the Centre for Global Eco-Innovation (see page 20).

(ii) Complementary strength in the core research and innovation disciplines for low carbon and eco-innovation. In terms of research and innovation infrastructure, the audit has identified sixty internationally significant research and innovation units across the whole NWCA, many developed jointly between academia and industry (see Chapters 3-5, and Annex 3 for full details). It is notable that more than half of these units described themselves as undertaking research that cut across the three capabilities identified in this SIA, one line of evidence for the inherent connectedness across research and innovation for Clean and Sustainable Growth (Chapter 6). However, at present, this infrastructure has been predominantly developed by individual higher education institutions and their key local research users, with only a few exceptions where facilities and activities are joined-up across the region. The lack of connectivity identified in our hypothesis is very clear from the data.

(iii) Specific regional strength in long-term SME eco-innovation capacity-building and evidenced delivery of business benefit. A key strength here is the nationally award-winning Centre for Global Eco-innovation (page 20). Since 2012 CGE has been established and grown supported by ERDF funding and industrial contributions (£30M across all components). CGE has proven power and capacity to stimulate collaboration between eco-innovative business (especially SMEs) and the region's research base by supporting the development of new low carbon/eco-innovative products, processes and services for global markets and the development of a new generation of eco-innovation entrepreneurs and academics.

At the heart of the Centre are innovative SMEs seeking to address global challenges (including energy, water, natural capital, resource efficiency, food, and waste) to deliver economic, social and environmental benefits. CGE was initially a partnership between the Universities of Lancaster and Liverpool, but since 2016 has expanded to include Cumbria, Chester, Liverpool John Moores University and University of Central Lancashire. From this foundation, the SIA is the key next step in growing the approach, broadening and deepening our existing network of successful collaborations to ensure that we secure our competitive advantage ahead of competing regions around the globe.