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# THE BIOECONOMY IN THE NORTH OF ENGLAND




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# THE BIOECONOMY IN THE NORTH OF ENGLAND

*A Science and Innovation Audit Report sponsored by the Department for Business, Energy & Industrial Strategy*

**£25 billion**

projected GVA contribution of the North of England to the UK economy by 2030

**11**

LEPs include aspects of the bioeconomy in their strategic economic plans

**5 million**

jobs directly and indirectly supported by the UK bioeconomy

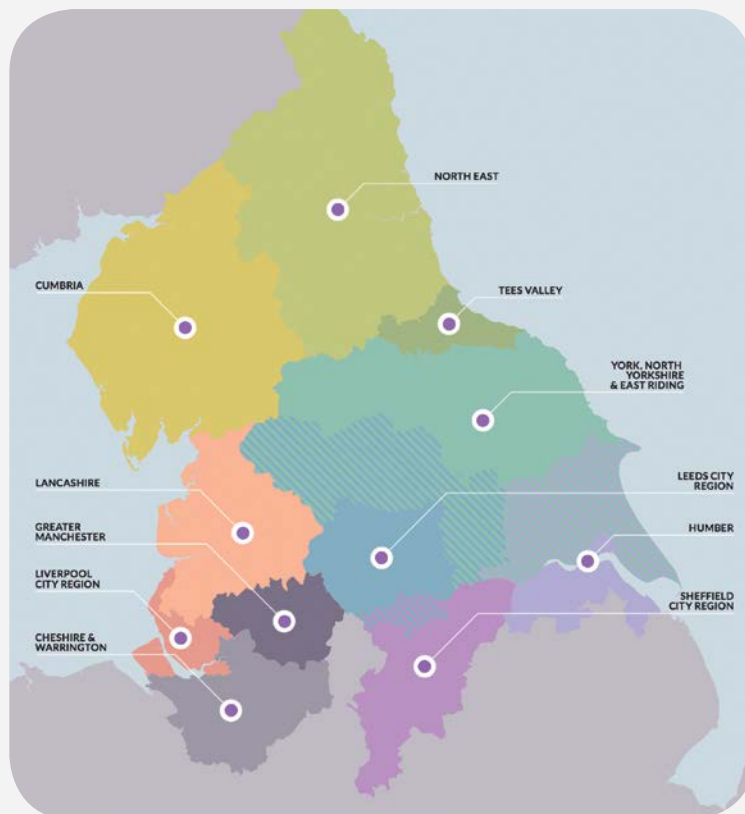
## Introduction

In autumn 2015, the UK government announced regional science and innovation audits (SIAs) to catalyse a new approach to regional economic development. SIAs enable local consortia to focus on analysing regional strengths and identifying mechanisms to realise their potential. One such consortium in the North of England has assessed regional strengths and opportunities in the bioeconomy. This summary report presents the results, which include a broad-ranging analysis of the North of England's bioeconomy capabilities, and highlights the challenges and substantial opportunities for future economic growth.

We are pleased to have the opportunity to present the case to the UK government that the North of England has the facilities, specialised research and innovation capability, and industrial capacity to deliver a world-leading bioeconomy based on agri-science, agri-technology and industrial biotechnology with the potential to alleviate pressing societal challenges. This is a substantial economic opportunity for the region, one that is rooted in its existing process industry infrastructure and skills, its research and innovation expertise (which includes world-class universities), its proven capability in technology translation, and its strong connectivity through good logistics, supply chains and networks.

The SIA consortium is led by the University of York and includes small and large companies, universities, agricultural colleges, the science skills body Cogent Skills, translational organisations working between research and industry, and Local Enterprise Partnerships (LEPs). The geography of the audit is covered by the 11 LEP areas shown in the map below.

### THE 11 LEPs IN THE NORTH OF ENGLAND





## **National and international context**

### *The challenge*

Over the next 30 years, the world population will exceed 9 billion and the global economy will quadruple, with people becoming increasingly affluent. Almost 70 per cent of the population will live in urban areas. Food and energy demand will double, with renewable sources including biofuels and bioenergy accounting for 10 per cent of commercial supplies. Pressure on the environment and competition for land will intensify as demand for food and animal feed increases. Climate change mitigation will require the cultivation of crops for energy and the production of bio-based ingredients to displace petrochemicals. The bioeconomy will have a major part to play in the transformation of global systems to meet these challenges.

### *The opportunity*

Agri-tech and industrial biotechnology provide technological tools to address these issues by improving agricultural resilience, securing food supplies and offering non-petrochemical routes to industrial feedstocks. Agri-tech involves bioscience and bioengineering approaches to improving agricultural productivity by reducing crop and livestock inputs and developing improved crop varieties. Industrial biotechnology harnesses plants and microbes to create novel foods, products and materials, as well as sustainable feedstocks for the agri-food and chemicals industries. It also adds value to waste streams.

### *The bioeconomy*


This summary report adopts the following definition of the bioeconomy: “The bioeconomy is the production of biomass and the conversion of renewable biological resources into value-added products, such as food, bio-based products and bioenergy”.<sup>1</sup> Healthcare and therapeutic applications of industrial biotechnology are considered beyond the scope of this report, but the authors note that the biomedical sector involves similar underpinning expertise and is an important adjacent economic sector in the region, with the potential for technology crossover.

It has been estimated that more than half of total agricultural output and 35 per cent of chemicals and related industrial output will depend on biotechnology by 2030.<sup>2</sup> In recognition of the importance of the bioeconomy, at least 26 nations have introduced specific strategies to address it,<sup>3</sup> and several countries have taken active steps to promote it. For example, since 2002, the US BioPreferred programme has required federal agencies to purchase bio-based products preferentially.

The combined bioeconomy of the UK, including upstream, downstream and induced components, is estimated to generate £220 billion in gross value added (GVA) (2014 figure) and to employ more than 5 million people.<sup>4</sup> Excluding agriculture, the UK’s bioeconomy is the third-largest in the European Union after Germany and France. The UK is a leading country in the key areas of research and innovation that underpin the bioeconomy, and ranks first globally in terms of ‘quality’ of research, as measured by field-weighted citation.<sup>5</sup>

## **Vision for 2030**

The consortium’s vision is one of an integrated and innovation-driven product, process and service bioeconomy in the North of England. This will have the necessary critical mass to compete in the multi-trillion-pound global market for sustainable food, feed, chemicals, materials, consumer products and energy. Using advanced land management strategies and technology-enabled precision agriculture, the region’s farms will cultivate diverse crops for food and non-food markets. Agricultural products, by-products



and urban waste will be processed at regional biorefineries to produce foods, animal feeds and high-value chemicals and materials, at the same time returning carbon and nutrients to the soil. Established chemicals clusters will have undergone a substantial transition to use locally produced and imported biomass feedstocks for the production of bulk bio-based chemicals. By 2030, the region will have gained global recognition for the production and conversion of biomass. Its international profile will attract inward investment into productive, knowledge-based businesses sustaining high-value jobs.

## **Key strengths**

### *Science and innovation*

The North of England has extensive research capability in the science that underpins the bioeconomy. It is comparable with the UK as a whole – a global frontrunner – and, in many regards, outperforms the rest of the country. The region is particularly distinctive for its success in winning funding for translational research, which is at a level well above the national average.

### *Assets and capabilities*

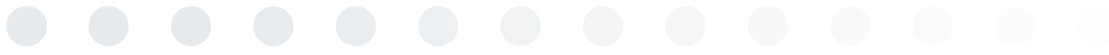
There are over 16,000 companies providing absorptive capacity for innovation in the bioeconomy of the North of England. Collectively, they have an annual turnover of more than £91 billion and employ around 415,000 people. By turnover, food and drink represents around one-third of the regional bioeconomy and chemicals make up one-quarter. Large companies predominate in food and drink, chemicals and utilities.<sup>6</sup>

The close links between industrial biotechnology and the chemicals sector is particularly relevant to the region, where the process industries are a major employer. The bulk chemicals industry is located around the estuary ports where crude oil is imported, and biomass-processing companies are also starting to use seaborne logistics to import raw materials. The size of the opportunity can be gauged from a recent report that concluded 40 per cent of Italy's chemical industry could make the transition to bio-based production.<sup>7</sup>

The N8 Research Partnership<sup>8</sup> is one of the major science and innovation assets of the North of England, with proven collaborative skills in agri-food research. Other universities in the region have bioeconomy-relevant capabilities, including the consortium partners Sheffield Hallam University and the University of Hull.

Technology translator organisations are a major differentiator and unique strength for the North of England. These organisations have both capital equipment and dedicated expertise to support business innovation. They include Fera Science Ltd (Fera) in Yorkshire, which supports a range of aspects of agri-food innovation, including the safety and integrity of food supply chains 'from field to fork'. The Centre for Process Innovation (CPI) on Teesside, home to the National Industrial Biotechnology Facility, and the Biorenewable Development Centre in York have both expertise in process development and the capability to scale up processes from the laboratory to full production. In addition, the Unilever–University of Liverpool Materials Innovation Factory brings high-throughput automation to the development of new, bio-derived consumer products.

The North of England has a distinctive set of bioeconomy assets, including world-class science, applied research excellence, translational expertise and industrial capacity. These can be mobilised to build economic value from agri-tech and industrial biotechnology and achieve full exploitation of the bioeconomy to deliver jobs and economic growth.



## **Talent**

Concentrations of skilled people working in the process and manufacturing industries are a strong basis for building a competitive advantage in bioprocessing. The region holds 38 per cent of the UK's chemicals industry workforce, 31 per cent of the polymers industry workforce,<sup>9</sup> and 36 per cent of apprenticeships<sup>10</sup> relevant to the bioeconomy. Six land-based colleges, including three of the five largest providers of land-based qualifications in England, are in our region and the universities in the North of England provide a quarter of UK science, technology, engineering and mathematics graduates.<sup>11</sup>

## **Growth opportunities**

The products that will create future growth in the bioeconomy include advanced biofuels and bio-based jet fuels; biochemical building blocks and bio-based plastics; novel foods; high-value chemicals from novel crops; functional foods and nutraceuticals; and novel crop varieties that are resistant to pests, diseases and climate-related stresses. It has been estimated that industrial biotechnology, biofuels and bioenergy could reduce global greenhouse gas emissions by 1.0–2.5 billion tonnes of carbon dioxide per year by 2030.<sup>12</sup>


The consortium's ambition is to double the size of the transformative bioeconomy in the North of England in GVA terms from £12.5 billion now to £25 billion in 2030. This will happen primarily through industry responding to economic drivers, but will be facilitated by specific interventions to catalyse growth and remove barriers.

The opportunities to achieve this include:

- making the transition in the chemicals industry to become significantly bio-based
- academic collaborations with major innovation-active companies, such as Croda and Unilever, and encouraging more large companies to pursue open innovation
- supporting disruptive innovators to thrive in the region and bring new products and services to market
- supporting the scale-efficient food- and feed-processing industries to establish competitive advantage in bioeconomy products (e.g. by producing protein from non-animal sources).

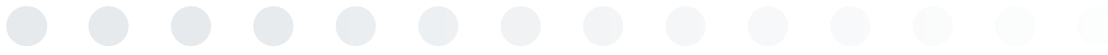
## **Gap analysis**

As stated, the key ambition is to double the size of the transformative bioeconomy in the North of England by 2030. The SIA has identified the main strengths and weaknesses regarding this goal. Combining this analysis with the vision for 2030, feedback from consortium members, primary research with industry participants in the region, and an understanding of what has been critical for success in other regions around the world, gives a clear view of the gaps that need to be filled (see table on page 8).



<b>Current state</b> <b>We have ...</b>	<b>2030 state</b> <b>We want to be ...</b>	<b>Next steps</b>
Strong sector-specific research and a differential strength in translating research into innovation, but this is not fully coordinated	Strategic and joined up in our approach to innovation, accelerating new products and processes to market	Establish a single-entity 'Northern Bioinnovation' to own the vision and coordinate innovation support for businesses in the regional bioeconomy
Used European Union economic development funding to accelerate innovation via short-term applied research projects with our open access innovation centres	Providing a comprehensive 'innovation to market' support service to industry through integrated, self-sufficient applied research and scale-up centres funded by large businesses, and providing public sector support for market access for small- and medium-sized enterprises	Provide a five-year innovation support programme managed by Northern Bioinnovation, including the following components: <ul style="list-style-type: none"> <li>• innovation research projects</li> <li>• skills development</li> <li>• capital grants to support innovation</li> </ul>
No real cluster of innovation activity based around the commercial-scale processing of biomass	Driving economic activity and innovation through bioclusters, providing a focal point around which publicly funded support can be channelled to assist early-stage insurgent companies developing disruptive technologies	Establish the first biocluster as an advanced bio-manufacturing park based around a central biomass process such as sugar production and provide demonstration facilities for new added-value processes using secondary product streams
Joined-up applied research capability in agri-food that combines the work of eight universities	World-leading in our connected industrial biotechnology and agri-food applied research, offering scale and single point of contact benefits to industry	Extend the collaborative 'N8 AgriFood' approach to industrial biotechnology and challenge universities to develop a pipeline of technologies that can be commercialised within the bioeconomy
Transport bottleneck east-west across the Pennines	Able to move substantial quantities of biomass around the region as part of a high-capacity transport network	Begin the process of planning the logistics implications of an economy using much larger quantities of biomass
Regional, non-sector-specific venture funds providing seed funding to emerging businesses	Allowing insurgent bioeconomy companies to access £10–30 million of capital to establish production facilities	Investigate the formation of a substantial (£100 million plus) bioeconomy venture fund for the region
An uncertain policy framework for biofuels and bioenergy, and no equivalent renewables incentives for using biomass for higher-value products	Operating under a policy regime that actively promotes the replacement of petroleum-derived products with biomass-derived products, and gives the process industries a reason to change their supply chains	Government review of the policy framework for biorenewables and adoption of an equivalent of the US BioPreferred programme





## Networking and collaboration

The advance preparation and conduct of this SIA spanned a period of more than 18 months. One of the strengths that the consortium has been able to draw on is the existing network of organisations, each of which has a stake in the bioeconomy of the region. The consortium has grown to incorporate partners from across the North of England and has been able to build on and benefit from specialist knowledge from partners that would not have been available without the catalyst of the audit process.

More specifically, the consortium has:

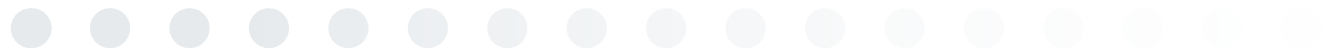
- Engaged partners in the land-based colleges and provided grounds for further and higher education stakeholders to work together on skills mapping and training delivery in the bioeconomy through the analysis of skills in the region, carried out by Cogent Skills.
- Widened and deepened relationships between universities and industry partners; consortium workshops have been a feature of this audit, and have been instrumental in sharing perspectives about what works in innovation and where bioeconomy priorities should be set.
- Allowed consortium members to benefit from a wider national and policy perspective. Some members sit on national bodies, such as the Industrial Biotechnology Leadership Forum and the Chemistry Growth Partnership, which have interests aligned with the vision of the audit. The audit took place in parallel with the consultation on the UK government's industrial strategy, and information has been passed in both directions to help inform the report and consultation processes.
- Generated a large amount of valuable information that is now available to the consortium and other interested stakeholders. This includes size and location information for more than 16,000 companies working in the regional bioeconomy.

Individual LEPs have a good understanding of their business base, particularly the larger players, but can benefit from this new information. This is provided in a format that was not previously available, extends knowledge across the region and can be used to identify potential supply chain partners for both commercial and innovation purposes. The consortium intends that all of its members and partners will make use of this data source.

The process of delivering the SIA is only the beginning of broader collaboration in the bioeconomy of the region. We intend that the information presented within the report, and the network of innovation providers involved, should be used as a basis to create a common innovation platform across the region acting in support of LEPs and other strategic bodies.

The connections among the universities and leading translational organisations, such as Fera and CPI, have developed substantially throughout the audit process and there is strong commitment to working together in further technology development. One of the most significant outcomes of the audit was recognition of the importance of the role played by translational organisations in ensuring that new inventions and innovations reach the market, and the value placed by industry on their assistance. These relationships will be demonstrated in more cohesive and better targeted proposals for research and innovation activity to the research councils and Innovate UK.

There is a strong case to support inward investment in biomass-processing industries, and we believe that such industries will find a hospitable environment in which to conduct business. We are determined to build on substantial investments by large incumbent organisations with incentives and technical support that will



provide opportunities for insurgent companies to invent and commercialise genuinely new products and processes. A clear signal of intent will be the establishment of an advanced bio-manufacturing park in the North of England, dedicated to the development of new technologies for the bioeconomy.

## **Full report**

The full report, *The Bioeconomy in the North of England: A Science and Innovation Audit Report Sponsored by the Department for Business, Energy & Industrial Strategy* can be downloaded at:  
[www.york.ac.uk/research/the-bioeconomy-in-the-north-of-england-sia/](http://www.york.ac.uk/research/the-bioeconomy-in-the-north-of-england-sia/)



## Endnotes

- 1 Bauen, A. et al. (2016) Evidencing the Bioeconomy, Capital Economics, TBR and E4tech.
- 2 OECD (2009) The Bioeconomy to 2030: Designing a Policy Agenda: Main Findings and Policy Conclusions, Organisation for Economic Co-operation and Development International Futures Project.
- 3 Bioökonomierat (2017) International Bioeconomy Strategies, <http://bioekonomierat.de/en/international/>
- 4 Bauen et al. (2016) Op. cit.
- 5 Ibid.
- 6 Information collected by Kepier and Co. during this audit.
- 7 Il Bioeconomista (2016) In EU5 the bioeconomy is worth €1.27 trillion and employs 7 million people, <https://ilbioeconomista.com/2016/01/12/new-report-in-eu5-the-bioeconomy-is-worth-e1-27-trillion-and-employs-7-million-people/>
- 8 Durham University, Lancaster University, University of Leeds, University of Liverpool, University of Manchester, Newcastle University, University of Sheffield, University of York.
- 9 Office for National Statistics (2017) Labour Force Survey, four quarter average, October 2015–September 2016.
- 10 Skills Funding Agency (2016/17) Apprenticeship Starts by Region and Sector Subject Area. SSA's selected of relevance to the bioeconomy were science, maths, engineering, manufacturing, agriculture, horticulture and animal care.
- 11 Higher Education Statistics Agency Student Record 2014/15.
- 12 World Wide Fund for Nature (2009) Industrial biotechnology: More than green fuel in a dirty economy? Quoted in Chambers, G. et al. (2015) Biotech Britain: An Assessment of the Impact of Industrial Biotechnology and Bioenergy on the United Kingdom Economy, Capital Economics, TBR and E4tech.

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