Department for
Business, Energy
& Industrial Strategy

GROWING THE BIOECONOMY

Government Response to the Bioeconomy Call for Evidence

December 2018

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Any enquiries regarding this publication should be sent to us at enquiries@beis.gov.uk.

This publication is available for download at www.gov.uk/government/consultations/uk-bioeconomy-call-for-evidence.

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Introduction

On the 1st December 2016 the Department for Business, Energy and Industrial Strategy published a call for evidence on the subject of the bioeconomy.

The bioeconomy represents the economic potential of harnessing the power of bioscience, using renewable biological resources to replace fossil resources in innovative products, processes and services. The bioeconomy in the UK in 2014 contributed to £220bn of output across the UK economy, supporting 5.2m jobs[1].

Building a world-class bioeconomy will transform our economy by removing our dependence on finite fossil resources. Bioscience and biotechnology has the potential to create new solutions that are economically and environmentally sustainable as well as resource-efficient. These solutions will help to tackle global challenges and create opportunities in agri-food, chemicals, materials, energy and fuel production, health and the environment.

The call for evidence asked a series of questions intended to help identify the opportunities, challenges, barriers and enablers associated with increasing the size and impact of the bioeconomy in the UK. Views were particularly sought on areas where there is room for growth and what needs to be done to achieve the full potential of the bioeconomy. Over 100 responses were received from businesses, the research community, trade bodies, NGOs, public authorities and interested individuals, and this document sets out UK government's response to that call for evidence.

The information provided here, alongside a continued period of stakeholder engagement and input, has contributed to the development of the UK's first Bioeconomy Strategy. The Bioeconomy Strategy signals the start of a transformation. It sets out how government, industry and the research community can create the right supportive environment to help double the impact of the UK bioeconomy from £220bn in 2014 to £440bn by 2030. Whilst this document summarises responses to the call for evidence, the strategy sets out the actions needed to grow the bioeconomy for the future.

[1] BEIS / BBSRC (2016), Evidencing the Bioeconomy: http://www.bbsrc.ac.uk/documents/1607-evidencing-the-bioeconomy-report/

Main Themes

Introduction

This section sets out a summary of the main themes that were brought up through the call for evidence, based on an overview of all responses. Fundamental to this is the very definition of the bioeconomy, which elicited responses from over 80% of respondents. Whilst few of these respondents disagreed with the general definition, most had thoughts on how it could be expanded or refined.

When looking at all answers to all questions, we can identify the most common terms used by respondents to the Call for Evidence. The words ‘energy’, ‘waste’ and ‘research’ were the most frequently cited terms, followed by ‘industry’, ‘sustainability’ and ‘materials’. This gives an indication of the themes that emerged, which are set out below.

Getting best value from unavoidable waste

A critical part of growing the bioeconomy involves addressing the need to make the best use of unavoidable waste materials as feedstocks. The issue of waste as a resource was raised by around of third of all respondents, reflecting a general need to make better use of the resources that are embodied in the materials that we throw away.

Many emphasised the importance of wastes as feedstock materials for the bioeconomy, with suggested end uses ranging from high value platform chemicals through to energy generation. It should be noted that the use of the term ‘waste’ can be misleading, as when put in the context of industrial processes it is can often be better described as a by-product or co-product due to its residual value.

The need to increase the amount of waste that is separately collected (particularly food waste) was seen as a key factor, particularly in terms of making more food waste available as a feedstock for biorefining and anaerobic digestion. An increased use of residues and wastes as feedstock was seen by many as preferable to incentivising bio-feedstock crop production, although there were a small number of responses calling for further investment into bio-feedstock crops.

Most effective use of resources

Priorities need to be led by ensuring that the resources are put to their most effective use both environmentally but also in respect to maximising the value from them. For example, separate collection of food waste not only maximises the value of this material when composted or anaerobically digested and the resulting compost or digestate is used on land.

Renewable Energy Association

The obvious need to make better use of our resources, particularly those that are currently being wasted is a central pillar of this strategy. As scientific and technological advances have taken place, new opportunities have arisen within the bioeconomy to tackle some of the challenges that are facing society and industry in the UK and globally.

One such opportunity is the potential to convert underutilised wastes into high value products. As an alternative to virgin materials, wastes could provide valuable sustainable resources for the bioeconomy. Producing the energy, fuels and chemicals required to support modern life from waste derived feedstocks not only presents an economic opportunity for the UK but also provides a potential low carbon alternative to what are traditionally petrochemical, virgin material or finite resource based activities.

Waste as a resource

Waste is an abundant resource (feedstock) for the bioeconomy; its inherent molecular heterogeneity and complexity should be utilised for production of value-added products including chemicals, materials and fuels, and not solely for energy generation via incineration.

There is an opportunity to incentivise chemical companies to use sustainable bio-based feedstocks and so create a market pull and stimulate businesses in the bio-based feedstock supply chain.

Royal Society of Chemistry

Further to this, it should be noted that most sectors within the bioeconomy are interlinked, either through using the same feedstock or making use of the waste or by-products from one sector to create a valuable feedstock for another. There are already examples of industrial clusters, such as Tees Valley, that actively identify opportunities for sharing such resources.

By making more efficient use of by-products and unavoidable waste that is readily available in the local area, companies can not only reduce carbon emissions, but this can also lead to financial savings. This should underpin efforts on a national scale to make best use of waste, by-products and residues that can add value as part of our energy mix or manufacturing processes.

The Capital Economics[2] report commissioned by BEIS and BBSRC in 2016 represents a core data source that answers many of the data gaps highlighted by the two previous reports mentioned above. It also mentioned the role of resource management and highlighted further work that is needed to stimulate the bioeconomy in the UK.

The use of waste derived feedstocks and their role in growing a vibrant bioeconomy has been discussed at length in the 2014 House of Lords select committee report ‘Waste or resource? Stimulating a bioeconomy’ and in the subsequent government publication of 2015 ‘Building a high value bioeconomy – opportunities from waste’. Both reports sought to set out the importance of resource recovery through the bioeconomy in the UK, providing a clear picture for the scale of potential growth. See Figure 2 below for details.

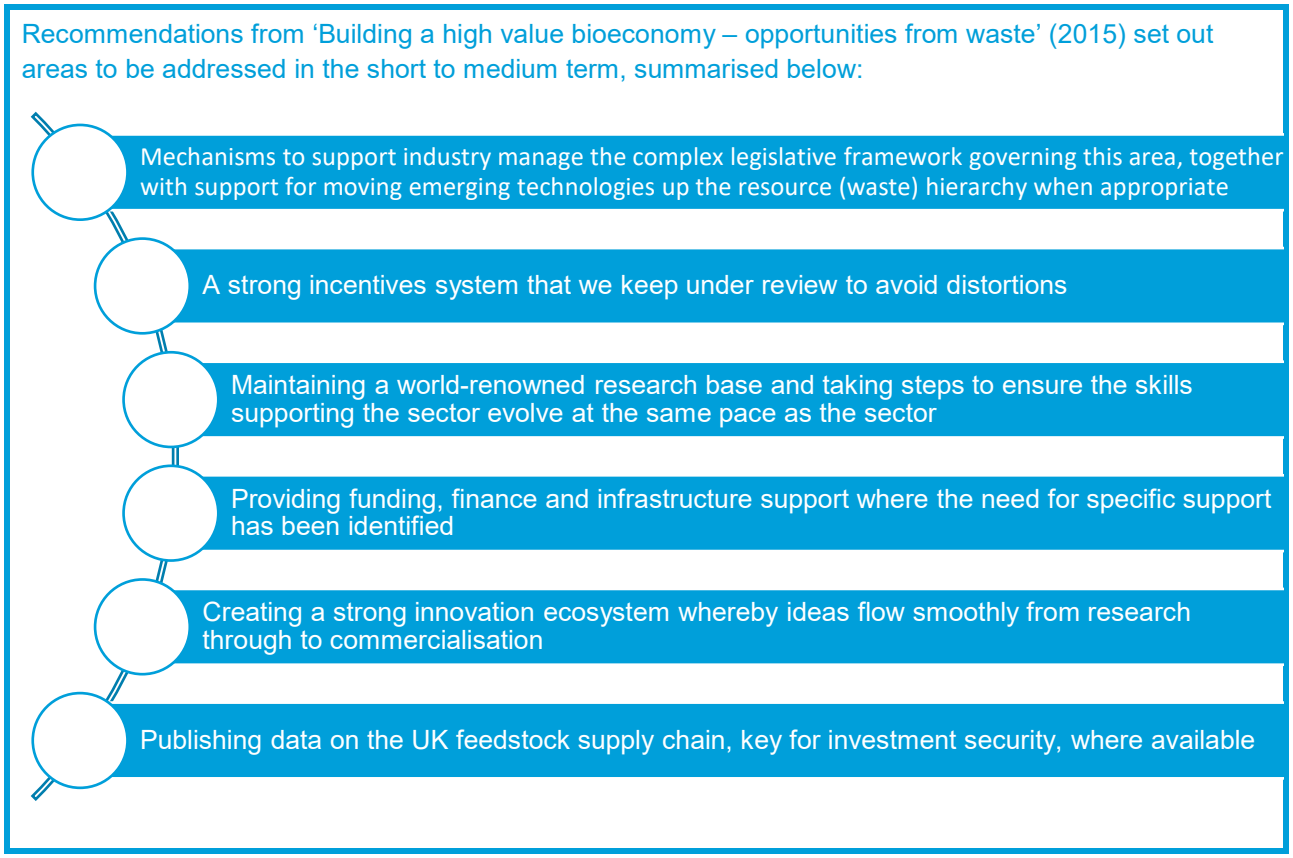
[2] http://www.bbsrc.ac.uk/news/policy/2016/160726-pr-evidencing-the-bioeconomy/

Defra's 25 Year Environment Plan further committed to ensuring that natural resources are used more sustainably and efficiently, doubling resource productivity by 2050.

In order to turn the recommendations set out in previous reports into concrete actions to stimulate the UK bioeconomy, the following needs will have to be addressed:

- Reliable and live data on where waste derived resources are generated;
- Reduced regulatory burdens when waste is used as a feedstock;
- Increased confidence in new products materials and ingredients, particularly when they are waste derived;
- Stimulated investment in the sector;
- Joined up policy making, to ensure no unintended negative consequences that constrict sustainable development of a waste based bioeconomy.

Figure 1: Opportunities from waste



Competing Demands for Biomass

2017 saw record levels of electricity from renewables, with almost 25TWh generated in the first quarter[3], accounting for 26.6 per cent of total UK electricity generation. Bioenergy accounted for over a third of this total, but future support for electricity generation from biomass may be more limited with long term support for fuelled technologies in the Contracts for Difference scheme under review. There may still a potential long-term role for biomass electricity when combined with carbon capture and storage, which could deliver negative carbon emissions, and more research is currently underway in this area.

The UK also has a thriving renewable heating industry which generates biomethane for the gas grid, and provides heat to homes, business and industry through biomass boilers and combined heat and power plants. Since launching in November 2011, the non-domestic Renewable Heat Incentive scheme has generated and paid for almost 24TWh of renewable heat[4], most of which was from bioenergy. This includes over 900 biogas and biomethane plants.

Increasing biogas exports

If the UK leads research efforts to reduce the costs of building biogas plants, UK companies (which already export over £100m-worth of biogas-related expertise and equipment per year) could export at least £5bn per year, creating a further 22,000 UK jobs on top of 35,000 jobs created in the growing biogas industry within the UK..

ADBA

Use of biomass across the bioeconomy emerged as a key issue amongst respondents, with many highlighting the need to make the most of the bioresources available within the UK. Our natural resources are limited by the availability of land, water and other factors, and there is a growing demand for these resources. Not only does this demand cover food, paper, construction timber, fuels and energy generation, but also production of bio-based chemicals and materials.

Delivering 10% bioenergy by 2050

We will need to source significantly larger volumes of competitive biomass feedstocks and make use of residual waste arisings to enable the growth of a bioenergy sector capable of delivering around 10% energy in the 2050s and which contributes to a productive low carbon UK energy system.

ETI

There is a concern that this growing demand for resources puts different end uses in competition or even conflict with each other. Not only through the ‘food versus fuel’ debate but also whether biomass should be prioritised for energy over higher value products such as bio-based chemicals.

[3] https://www.gov.uk/government/statistics/energy-trends-section-6-renewables
[4] https://www.gov.uk/government/collections/renewable-heat-incentive-statistics

Careful land use management, utilisation of marginal land and productive use of waste and residues from the forestry sector can help to ensure resources are used effectively. The use of biomass for energy also plays a key role in meeting our long-term carbon reduction targets, as set out in 2017's Clean Growth Strategy[5].

Many respondents indicated that they are keen to ensure that the natural resources used within the bioeconomy are done so efficiently and sustainably. By adopting the 'cascading use of biomass' principle, whereby one or more material uses are realised before using the residual biomass for other outputs such as energy, we can help ensure the most efficient use of our natural resources. In addition to more traditional woody biomass sources, there is considerable potential for increased productivity from agri food residues and from unavoidable food waste.

This includes all aspects of the process, from collection to eventual output, and was addressed in the 'Opportunities from Waste' publication of 2014. Defra's upcoming Resource and Waste Strategy will look further at the long term opportunities from waste.

Whilst it is important to realise the economic benefits of biomass, stakeholders also highlighted the importance of ensuring broader sustainability and environmental goals are not compromised by an increase in bioeconomic activity. When assessing the most appropriate use of bioresources, emissions must be considered across the product life-cycle to deliver real reductions in CO_2 emissions.

Confidence in bio-based feedstocks

If land use change is managed carefully then there should be net benefits. For example the use of more marginal land to grow low input industrial crops can increase food production in other parts of farm and therefore overall productivity. Crop and landscape diversity will be more resilient and can be used to optimise overall landscape benefits.

Aberystwyth University

Confidence in bio-based feedstocks

Consistent quality and supply and knowledge of the feedstocks is essential to give confidence to end users that bio-based feedstocks are appropriate and suitable. Good case studies of successful processes and products are essential to lead the way and showing capability.

IBLF

Transition to a bio-based economy

The transition from a fossil-fuel based economy to a bio-based economy requires significant investment and a complex policy framework. Feedstock availability and the avoidance of competition between food and other uses of biomass resource will be critical. The adoption of a cascading approach to biomass use such that any biomass is used for the highest-value option first will lead to enhanced resource efficiency and sustainability.

iBioIC

Efficient use of resources

[5] https://www.gov.uk/government/publications/clean-growth-strategy

A thriving bioeconomy should not only stimulate growth and productivity, but also strengthen the UK's contribution to achieving the UN's Sustainable Development Goals[6].

> Priorities need to be led by ensuring that the resources are put to their most effective use both environmentally but also in respect to maximising the value from them.
>
> For example, separate collection of food waste not only maximises the value of this material when composted or anaerobically digested and the resulting compost or digestate is used on land.
>
> ***Renewable Energy Association***

As set out in the accompanying Bioeconomy Strategy, government will explore the benefits of a market intelligence tool and whether that could support evidence-based decision making in resources allocation. This would look at various potential high value uses of existing natural resources, showing the relative value that can be derived from different feedstocks such as food waste, industrial by-products and other forms of biomass while ensuring the natural environment is protected and enhanced.

[6] https://www.un.org/sustainabledevelopment/sustainable-development-goals/

Innovation

The UK has a long history of promoting basic science and technology. National and international trends and the need to conserve stocks of biological and chemical resources mean that further investment in low carbon solutions and better and more efficient use of scarce resources will be essential.

A number of innovation centres which foster academic-industry partnerships, and which provide infrastructure and expertise, have been invaluable in helping businesses access new technologies. The support to Catapult Centres and open access facilities such as Biopilots UK; a consortium of organisations which provide specialist equipment and capability for trialling new bioprocesses, and the National Biologics Manufacturing Centre in Darlington has been essential to de-risking new products and process development for companies.

Support for Innovation

The UK has a strong research base in its higher education institutes, some cutting-edge companies, and active support from funding bodies and policymakers, which are great assets for bioeconomy related research, and offer great potential to be a world-leader in bioeconomy innovation.

Royal Society of Biology

Through the call for evidence respondents have indicated that there are specific R&D needs to be met to enable the UK bioeconomy to grow. This includes:

Government support through the Science and Innovation Budget is key. The quality of research in UK HEIs, underpinned by the dual funding model, helps attract private investment (in various forms) in research and new ventures.

University of Oxford

- Support for industrial biotechnology, the more efficient production of current chemicals and biochemicals and the development of new products will continue to be areas of key importance. This together with continued support for synthetic biology where the UK really does have a world-class reputation and capability will ensure that the UK remains as a go-to place for bioscience and biotechnology research and development.

The sector needs stronger support across the middle TRLs. This needs to be addressed through mechanisms that connect the roles of the research councils and Innovate UK and provide pipelines from research through to demonstration and first commercial plants. It is a cohesive join-up that is missing. The IB Catalyst fulfilled this role very well.

University of York

- Building on our existing research base we need to consider the need for work on converting feedstocks for use, including feedstocks from waste. There is a particular need for the scaling up of processes, and improved (simplified, more efficient, optimised) bioprocessing capability.

- The use of anaerobic digestion technology and the bioenergy more generally offers the opportunity to exploit existing renewable resources, particularly where waste materials could be used as a feedstock and where there is considerable potential to harness technologies to increase the value of outputs.
- Research in the field of synthetic biology must focus on genetic engineering, bioprocessing and manufacturing, and expressing complex genes to enable the development of new products and processes.
- Research and innovation needs in the agri-food sector are important to maintain this sector in the vanguard of innovation. The development of novel uses for crops and the development of new crop husbandry technologies such as bio-pesticides could be key areas for early focus to deliver increased productivity for the sector.
- The further advancement of anaerobic digestion and smart reuse technology will enable the effective realisation of benefits from high intrinsic value feedstocks as well as developing a range of technologies to add value to waste.

Support for Innovation

If funding for field scale trials is made available, the translation of research into practice can be accelerated. This can be further accelerated by properly leveraging start-ups and equity funding to such start-ups.

Queen's University Belfast

It is much easier to transfer early development projects overseas (e.g. China) to progress to commercialisation. The UK needs to position itself more effectively by supporting early development work and by investing in the infrastructure to deliver it (Catapults etc).

University of Manchester

The UK does not lack ideas, invention or even innovation. It lacks the economic and commercial incentives to change established infrastructure and supply chains to deliver the bioeconomy agenda.

Centre for Process Innovation

Gaps are probably most at the strategic and applied end. In other words how can we get science translated and demonstrated at scale so that industry are willing to adopt the latest innovations.

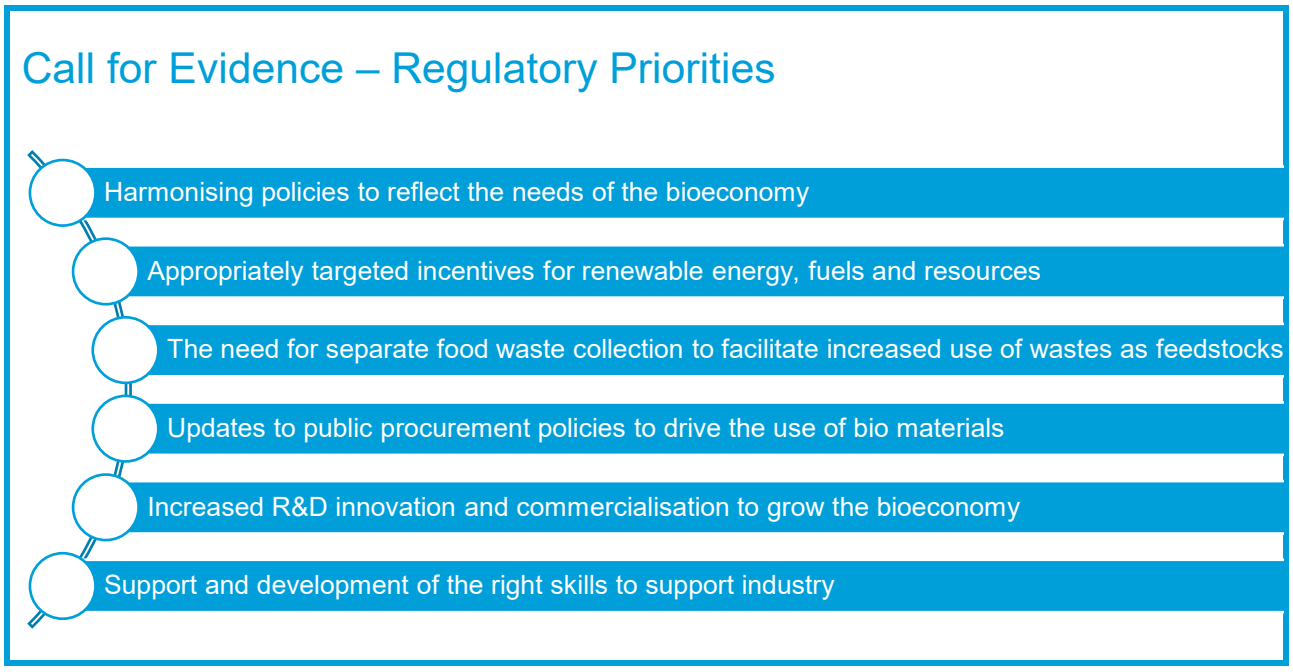
Aberystwyth University

Regulatory landscape

The overall response to the call for evidence showed the complexity of the regulatory landscape with respect to the bioeconomy. Cutting across multiple sectors, regulations covering air quality, health and safety and environmental protection could impact on the bioeconomy just as much as those governing intellectual property, finance and trade. Due to the diversity of the regulatory landscape, many of these regulations would not necessarily have been developed with the bioeconomy in mind.

The call for evidence asked respondents a specific question around where they thought the most effective steps could be made to deliver effective policy to enable the development of the bioeconomy. There was generally a good response to this question and responses can be broadly categorised into six topics.

Figure 2: Regulatory priorities from the Call for Evidence



Government recognises that it will need to work across policy areas to ensure a joined-up approach to growing the bioeconomy. This includes reviewing the existing policy landscape as well as the legislative implications and opportunities resulting from leaving the European Union.

A summary of the policies and programmes respondents considered to have an impact on the bioeconomy is included in Annex II. This includes policies at an EU, national and regional level as well as relevant standards and funding streams that can support the bioeconomy.

Summary of Responses

Respondent Information

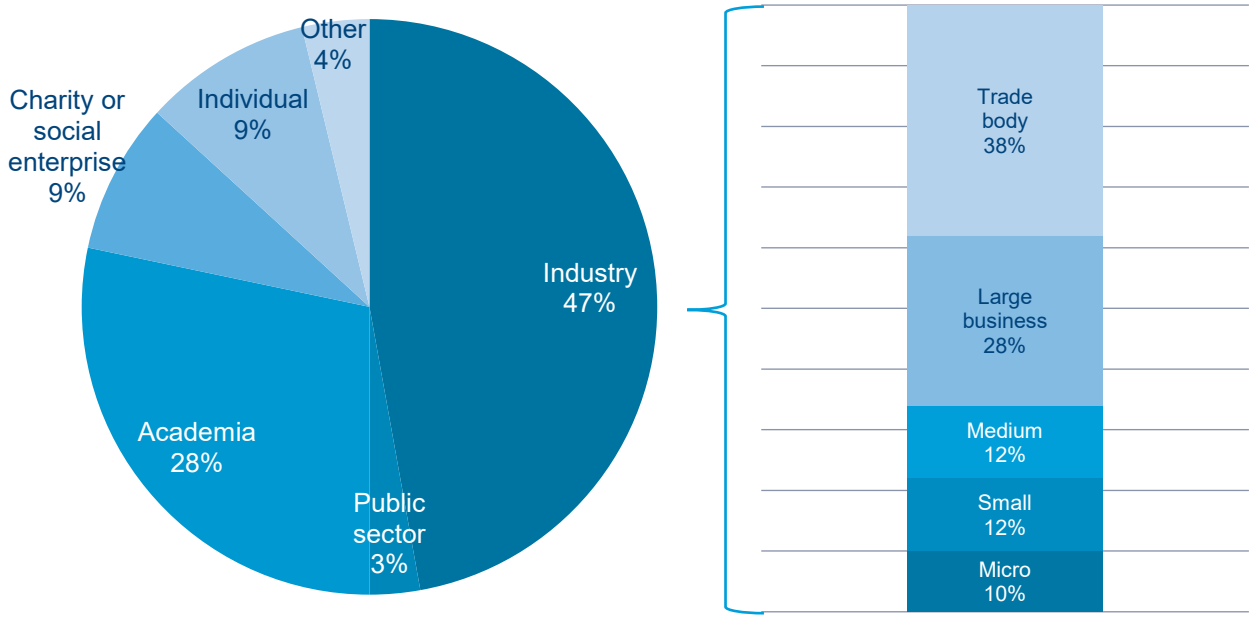
Introductory Questions 1-6

The first part of the call for evidence asked respondents for information about themselves and their organisations. For businesses, this included their size, the sector they operate in and any further information that might help to put the answers in context.

A total of 111 organisations and individuals responded to the call for evidence. The responses were detailed and comprehensive, providing around 250,000 words of input or the equivalent of about 625 pages of text.

The split of respondents is shown in Figure 3 below, providing a good spread of representation across different sectors and from different sizes of business.

Figure 3: Type of respondents



Micro business: fewer than 10 staff; Small: 10 - 49; Medium: 50 - 250; Large business: over 250 staff

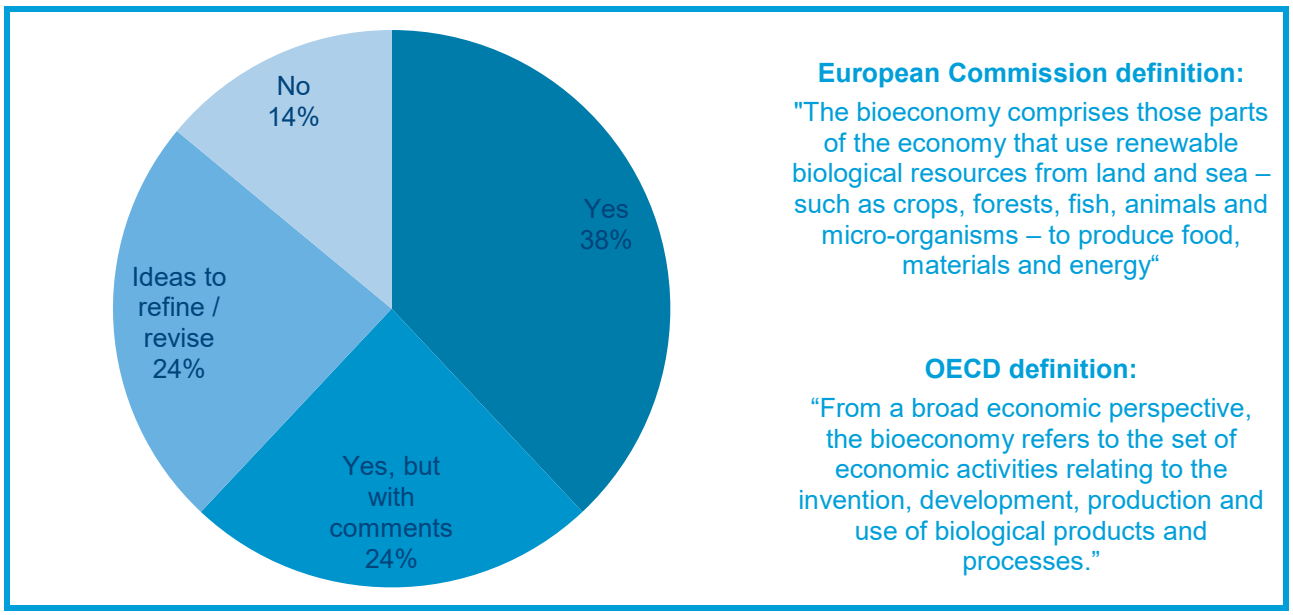
Bioeconomy Definition

Q7: Does our definition of the bioeconomy include within its scope all of the relevant bio-based products and processes? If not, please explain.

There were 90 responses to this question.

Most were generally supportive of the description provided, although many suggested ways to revise or refine the definition. Some referenced existing definitions such as those used by the European Commission or the OECD.

Figure 4: Agreement with definition of 'bioeconomy'



Suggestions for how the definition could be refined included:

- Making clear reference to use of bio-based processes in 'conventional' processes e.g to process fossil fuel-derived feedstock;
- Removal of the reference to fossil fuel-based feeds-stocks;
- Explicitly referring to sustainable / renewable benefits and the "circular" bioeconomy;
- The inclusion of specific topics such as food security, agri-food aspects and health/pharmaceuticals.

The resulting definition of the bioeconomy, in terms of how it relates to UK industry and the government policy in this area, is included in the accompanying Bioeconomy Strategy.

Economic Growth

Q8: Within your sector or organisation, what are the prospects for economic growth that are related to the bioeconomy?

There were 91 responses to this question.

Almost all respondents suggested that there are either good or potentially good prospects for economic growth within the bioeconomy. Some highlighted the importance of providing specific support to realise full potential, e.g. through regulations, standards and government investment. A number of respondents also suggested that opportunities to use waste as a resource could be further exploited, for energy as well as bio-based materials and chemicals.

Increasing biogas exports

If the UK can establish a reputation for a world-class bioeconomy infrastructure through academic excellence, a network of open access centres and excellent packages for businesses to locate to, there should also be prospects for economic growth through inward investment and major bioeconomy business relocations and expansions to the UK.

BDC

Q9: Given your expectations, do you think there are potential issues that are holding back further economic growth in the sector?

There were 90 responses to this question.

The respondents that answered this question raised issues in several different areas. A lack of skills was raised as one of the key issues, with a strong need for skilled workers in terms of both technical and entrepreneurial ability. Areas of concern for SMEs were also identified, primarily with regards to the potential high costs of scaling up and of coping with some administrative burdens of accessing funding and complying with product and process regulations.

Increased investment to promote growth

There are already a number of identified skills issues placing restrictions on potential growth in the sector. These challenges are expected to escalate and grow unless action is taken to develop people with the appropriate skills to meet the needs of the industry, particularly the parts of the bioeconomy dominated by small businesses with new innovative products to scale up.

Cogent Skills

Some respondents also highlighted that the industry was currently quite fragmented and therefore not particularly ‘SME-friendly’.

Many of the respondents also emphasised that there was a widespread lack of investment from both public and private sources, with investment from financiers and venture capital companies limited by political uncertainty and a lack of understanding of the bioeconomy.

The responses also showed that this was visible at various stages of the process, including early-stage technical development.

Increased investment to promote growth

Significant economic development potential exists in UK bio-wastes but it needs favourable policy, investment and technologies to realise it.

The Environmental Services Association (ESA) estimates that a favourable investment / policy framework would lead to an additional £10bn investment by this industry.

CIWM

A number of issues were raised on the topic of resources and materials. Respondents suggested that in order for the sector to expand, demand for bio-based products needed to be stimulated and negative perceptions of some technologies (such as GM food) needed to be addressed. Some respondents also highlighted the lack of efficiency in harnessing UK resources, particularly in waste where only a limited amount of it was currently utilised. There was also some concern over feedstock availability, with respondents referring to it as variable or uncertain.

Several respondents stressed the importance of long-term policy planning for boosting certainty and encouraging investment into the sector.

Q10: Do you think that growth in a particular sector of the bioeconomy impacts growth in other sectors in a way that should affect priorities?

There were 72 responses to this question.

There was no clear theme to these responses, as whilst many were positive about the benefits of growth across sectors, they were balanced by others suggesting that increased emphasis on one technology diverted resources from others.

It was highlighted that the bioeconomy is highly interconnected and a typical bioeconomy value chain consists of a biomass resource, conversion processes and a final product.

It was therefore conceivable that growth in one sector, or competition for biomass resource, could impact many value chains across the bioeconomy.

Benefits across the value chain

The large scale nature of bioenergy has the potential to create logistical systems and biomass hubs capable of supporting an ecosystem of smaller bio-based process industries, in some cases adding value to such systems by developing added value by-products from feedstocks or by-products.

NNFCC

Other positive comments included:

- Biomass / renewable energy have benefits for woodland management and agriculture.
- Process sectors in the bioeconomy have many linkages; for instance, industrial symbiosis where agri-food residues or by-products are used as raw materials for chemicals production.
- Growth in one sector could contribute towards the growth in other sectors by creating increased uptake and end user confidence, thereby enabling the growth in volumes of bio-based feedstocks.
- Learning and transfer activities between the sectors could also help cross-sector growth.

However, positive comments were set against those that strongly stressed the need for balance. For example, excessive emphasis on phenotyping versus other breeding methods and use of waste for energy rather than recycling. Some replies also said that renewable energy and fuel subsidies that resulted in the biomass market being distorted potentially had a negative impact on other uses of biomass such as materials and chemicals.

The responses showed a need to encourage growth across all areas of the bioeconomy, and it was important to create a level playing field for all technologies, so that those which are most efficient and provide best value for money to the taxpayer can thrive.

Q11: What do you think the UK's bioeconomy goals should be in the long term i.e. 15 years or more? You could add to your reply by telling us what actions we should be taking to get there. This could include actions by government, biotechnology developers/providers, UK user sectors and consumers.

There were 92 responses to this question.

Responses can be broadly categorised as "actions to be taken" and the "preferred state" of the UK's bioeconomy. Several actions were suggested, with the most common including:

- Increased development of international collaborations in an effort to harness ideas and expertise

Capitalising on our research base

Over the long-term, in order to generate a world-leading bioeconomy, the UK should aim to capitalise on its strong research base, translating the expertise in its researchers into innovative products and processes.

Royal Society of Biology

- An increase in research investment
- Increased support for SMEs and “scale-up” activity
- Better harnessing of UK’s bio-resources

The respondents who mentioned their goals for the future state of the UK’s bioeconomy predominantly focused on sustainability (including a sustainable feedstock supply, lower greenhouse gas emissions, providing low carbon solutions and the circular economy) and reduced fossil fuel dependence.

Underpinning a prosperous UK economy

Longer term the UK should be a beacon of how a strong bioeconomy underpins a strong and prosperous nation's economy contributing to a sustainable global economy as measured by the UN's sustainable goals for 2030.

To enable this we need a strong set of public goals that we can measure progress against. We need a broadly owned road map and strategy of how we plan across all sectors of government (national and local), industry and academia to achieve these goals.

Fujifilm Diosynth

Q12: What do you think the UK’s bioeconomy goals should be in the short term?

There were 82 responses to this question.

Suggestions for short-term goals included supporting translational activities (i.e. translating research outputs into business opportunities), SME “scale-ups” and building links between innovation funding and the industry and/or the investors. Some respondents emphasised the importance of using bio-waste as a resource alongside greater understanding of the UK resources (in respect of availability and sustainability).

Leading in bioenergy sustainability criteria

As the UK prepares to leave the EU, it will be important to decide how current rules and incentives that impact the bio-economy will be affected.

The UK is a leader in bioenergy sustainability criteria across the EU and a robust approach to biomass sustainability must be retained following the UK’s exit from the EU.

ETI

It was also suggested that there should be greater public engagement around the concepts of bioeconomy.

Q13: Can you tell us about any “quick wins” to increase the growth of the bioeconomy?

There were 57 responses to this question.

Suggestions were made in several areas in response to this question and a comprehensive list of quick wins suggested by respondents is included at Annex I.

These suggested ‘quick wins’ included: public procurement to stimulate the market, further support for R&D and SMEs, collection of bio-waste, use of regulations and legislation to support key sectors (such as transport fuels and the use of waste as a resource) and tax incentives for priority activities (renewable bio-based materials from sustainable sources, non-medical R&D etc.).

Leading in bioenergy sustainability criteria

A greater emphasis on focussed, applied research is important in order to bridge the "valley of death" in the innovation chain. Therefore, the development of strategically appropriate technology centres and institutes (separate from, but collaborating with, Universities) could be highly beneficial.

Institute of Food Research

Q14: Do you think the UK is likely to miss any of these “quick wins”? If so, why is that?

There were 66 responses to this question.

Several potential barriers were raised. As previously mentioned, skills shortage was seen as a concern and a number of respondents mentioned potentially restrictive immigration rules that could make filling those skill gaps even more difficult. Some emphasis was also made on the role that government could potentially play in achieving these quick wins.

Greater government action, including further investment to match that of other well-developed economies, was thought necessary alongside more detailed long-term planning to ensure that quick wins were achieved. A competitive environment needed to be established by creating stability, combined with a supportive regulatory and legislative environment.

Around a quarter of the respondents also highlighted that the UK has tended to be more reactive rather than proactive, so adopting a more proactive and agile approach would prevent it from lagging behind more entrepreneurial countries. Increased understanding of some areas (e.g. anaerobic digestion) and further collaboration between different government departments was also suggested as potentially improving the UK’s chances of achieving the quick wins. Some respondents also agreed that a greater degree of sectoral cooperation was necessary.

Q15: Can you tell us about any other issues in the broader environment that are holding back economic growth in the bioeconomy?

There were 58 responses to this question.

A number of responses highlighted that as the bioeconomy needed time to grow and develop, there was a need for stability in related policy-making. Long term plans that stretch beyond parliamentary terms should be prioritised. The effect of exiting the European Union on market access, as well as immigration and skills, was emphasised by many of those who responded to this question.

There was also significant concern regarding bridging the skills gap as the effect of leaving the EU may mean a smaller skills pool. Additionally, a negative perception of the UK's immigration stance could result in potentially skilled migrants being reluctant to enter or remain in the UK for employment.

Some weight was also placed on the importance of the public's perceptions of the bioeconomy. The respondents in this case believed that engaging the public and raising awareness was a key way of ensuring a positive perception to growth of this sector. The lack of agility and slow 'reactive' thinking were again raised as potential barriers to growth, and there was general concern regarding the need to secure the future of the bioeconomy through a stable policy environment.

Sustainability

Q16: How sustainable is your sector of the bioeconomy in respect of infrastructure issues e.g. roads, planning issues, telecommunications, energy and water supply?

There were 62 responses to this question.

It was observed that in many sectors advantage could be taken to exploit existing infrastructure, especially in areas such as energy crops and liquid biofuels. Examples provided by respondents included utilising current facilities, such as the oil refining, chemicals and biomass production facilities in Yorkshire and the Humber, or the Kielder reservoir in north east England which sees three water-dependent chemical plants located nearby. Using and repurposing underutilised and available land (pre-existing manufacturing sites, agricultural and forestry land) also provides an opportunity for efficiencies. However, the high cost of energy in the UK compared to most other EU member states was described as detrimental to the sustainability of the sector.

Respondents from the biomass and bioenergy sectors highlighted that in several areas (north east England / Scotland in particular) there was already pre-existing infrastructure and resource availability which would enable further businesses to be co-located in existing clusters. In some areas of the bioeconomy, such as agriculture, a lack of rural infrastructure necessary for crop growth was cited by several respondents to be hampering a potential increase in efficiency and growth. A need for better waste management infrastructure was also raised, however there were issues surrounding public acceptance of new treatment facilities.

Q17: How does your sector contribute to or impact on sustainability in respect of environmental issues including concerns about high energy use, water, greenhouse gas emissions, air and land pollution and destruction of animal habitats?

There were 73 responses to this question.

Responses to this question suggested that Industrial Biotechnology and Synthetic Biology and the use of bioenergy were inherently beneficial to the environment, as they helped to transition the economy away from fossil fuel dependence. On the other hand, some respondents acknowledged that certain high-impact industries, such as sewage treatment and agriculture, face considerable sustainability challenges. These can be mitigated by following regulations and voluntary sustainability schemes, and acknowledgment was made regarding the contribution of research, technology and replacing fossil fuel-based products and processes on improving sustainability.

Q18: How should the strategy take into account UN sustainable development goals?

There were 75 responses to this question.

Some responses to this question highlighted that the UN sustainable development goals were both relevant and complimentary to the implementation of a bioeconomy strategy. Technologies that underpin the bioeconomy naturally help in delivery of these goals, as they can address sustainability challenges. Those respondents who provided more specific examples such as more responsible production, reducing waste, cleaner energy and protection of ecosystems focused on the importance of showing how the UK was contributing to those goals as well as the importance of such goals being of clear benefit to the UK.

Figure 5: UN Sustainable Development Goals

Q19: How sustainable is your sector of the bioeconomy with respect to workforce skills?

There were 71 responses to this question.

There were a range of responses in this area, as whilst a shortage of skills caused concern for some, many companies seemed to be supporting their own training schemes and having success in recruiting locally.

In some industries, such as petro-chemicals, skills could be transferred across into the bioeconomy. In the area of biomass and feedstocks, including using waste as a resource, new skills were said to be rapidly evolving with significant opportunities being created for new highly-skilled jobs. Some respondents also suggested the potential opportunity in supporting rural communities by bringing in high skill jobs to remote locations.

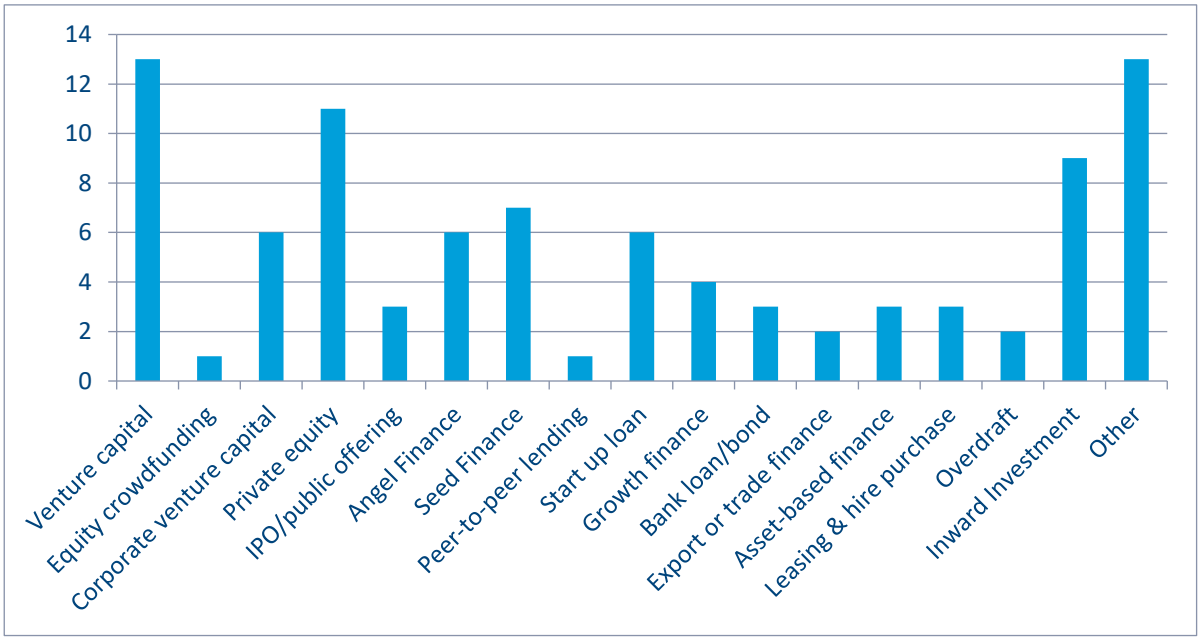
Investment

Q20: Has your organisation or businesses received finance from one (or more) of these sources in relation to its bioeconomy activities?

There were 44 responses to this question, with respondents able to identify more than one source of funding if appropriate.

The responses are represented in Figure 4 below, and show a variety of funding sources are being used across the bioeconomy. The most frequently accessed were venture capital, private equity and inward investment, although other sources of funding also featured prominently.

Figure 6: Sources of finance

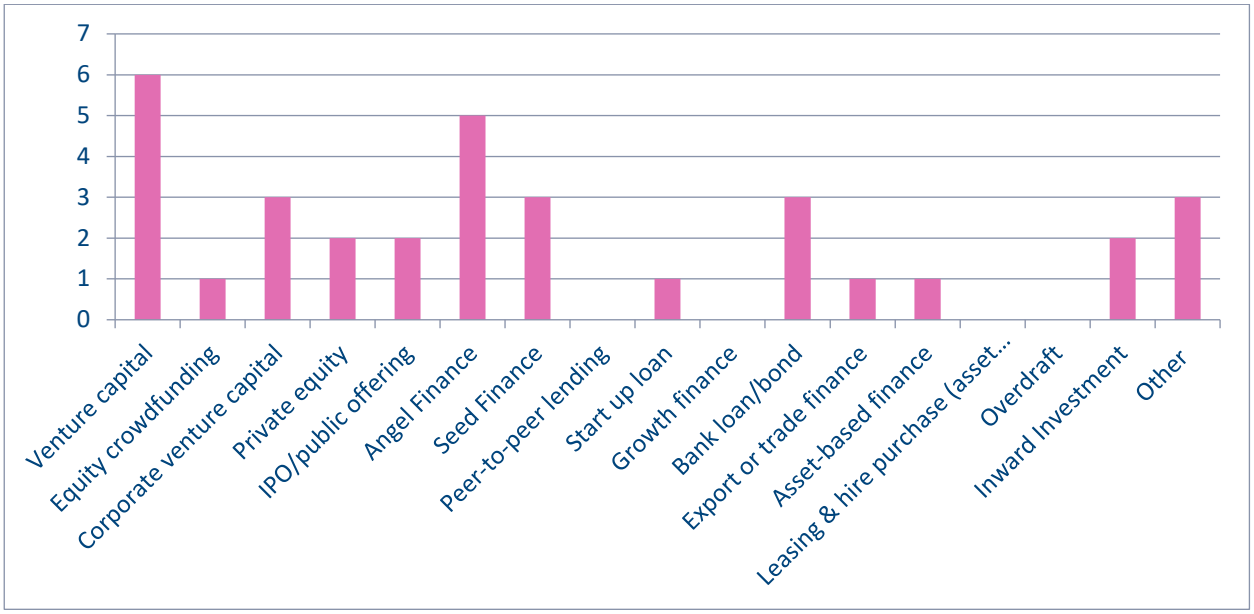


Q21: Has your organisation or businesses had difficulty in obtaining finance from one (or more) of these sources in relation to its bioeconomy activities?

There were 27 responses to this question, with respondents able to identify more than one source of funding if appropriate.

The responses are represented in Figure 5 below. The sources of funding which proved to be the most difficult to the respondents were venture capital and angel finance.

Figure 7: Difficulty in obtaining finance



Q22: More generally, does your sector, or sub-sectors within it experience difficulties in attracting investment? If so, why?

There were 62 responses to this question.

Several responses to this question raised the issue of financing “scale-up” for demonstrators, as well as highlighting that commercialisation could be quite difficult for SMEs in particular. The importance of policy stability for a healthy investment climate was also stressed, as was the need for investors to have a much better understanding of the sector. Some importance was also placed on the perceived potential of the sector. According to some of the respondents, investors saw technologies within the bioeconomy as being a high-risk venture with a longer-term return on investment. Consequently, some respondents raised the issue of investor confidence affecting the potential for growth.

Q23: What sort of challenges does your sector face in terms of financial sustainability?

There were 49 responses to this question.

Several potential challenges were outlined by respondents, including familiar concerns over political uncertainty and investor confidence. Some of the responses also highlighted the opportunities being provided by other countries, both inside and outside of the EU, which might be able to offer a more stable policy environment, greater incentives and more encouragement for investment.

Research & Innovation

Q24: What are the key areas for investment in research and development in your area of the bioeconomy?

There were 86 responses to this question.

Some of the respondents highlighted that there was potential for improvements in processing across various sectors, including the biomass and waste sectors. Synthetic biology was raised by some as a particular strength underpinning the UK's bioeconomy, and therefore presented significant potential for future R&D investment. Potential was also identified in the area of translational activities, to help move concepts up the TRL scale, including the provision of new facilities and infrastructure.

Several specific suggestions were also made on potential for investment into research in the areas of plant and crop breeding as well as crop improvement such as optimising industrial crops. A number of responses also mentioned the potential behind investment in new products, such as speciality chemicals, bioplastics and biocatalysis.

Q25: Where do you see gaps in investment in research and development in your area of the bioeconomy?

There were 73 responses to this question.

A number of responses highlighted the potential gaps within research into the bioeconomy itself; what it meant, its implication and the way it would function in terms of joined up supply chains and quantified benefits. The issue of the 'valley of death' gap between translation of research and commercialisation was also raised and has been a continuous theme throughout stakeholder discussion on the bioeconomy.

Q26: What are the most notable types of new products or technologies that can be expected in your sector in the next few years that are related to the bioeconomy?

There were 75 responses to this question.

Chemicals and pharmaceuticals from renewable sources were suggested as growth areas and a small number of respondents raised the anticipated growth of advanced therapies such as gene, cell and stem cell therapies.

Responses included a variety of opportunities for using bio-based alternatives to traditional products such as pesticides, plastics, paints and materials, which was possible due to the development of new products and processes. These new products could not only prove to be suitable alternatives to fossil-based products, but some could offer novel functions not found elsewhere.

Q27: What are the barriers and opportunities for bioeconomy related research?

There were 72 responses to this question.

Financial support featured prominently amongst the issues identified. In particular, a number of responses suggested an effective lack of funding for translational activities, commercialisation and “scale-up”. Respondents noted a clear lack of skills and training available particularly in some more technical areas. While several responses praised the strength of UK research in the bioeconomy, describing it as ‘world leading’, they also highlighted that applying it in practice was still not at the level it should be.

Q28: Are you aware of difficulties in commercialisation or translating R&D outputs into the marketplace in your area of the bioeconomy?

There were 66 responses to this question.

Lack of support through inefficient funding and regulatory hurdles in translation and scale-up both featured prominently amongst the responses. Several respondents had also pressed the need for consistent, long-term policy planning.

Sectoral Cooperation

Q29: What strong links does your sector have with the other sectors of the bioeconomy?

There were 62 responses to this question.

Some responses to this question pointed out the link to the Circular Economy approach and highlighted that links were wide-ranging across sectors. Specifically this included those with energy production; between agriculture and food and drink; between waste and water; and between pharmaceuticals and chemicals. It was pointed out that some links were stronger than others.

Further responses mentioned methods of collaboration and co-operation such as sector councils working closely together, such as the collaborative approach of the Industrial Biotechnology Leadership Council, Medicines Manufacturing Industry Partnership, Chemistry Council, Agri-Food Technology Leadership Council and Synthetic Biology Leadership Council in developing the Bioeconomy Strategy.

Respondents also highlighted a range of commercial and academic projects that existed; examples of which include:

- Biofuel development which can link to sectors including forestry, waste and agri-tech
- Platform chemicals from waste treatment processes
- How biochemical processing can improve resource efficiency in pharmaceuticals, textiles and food production

Q30: To what extent is your sector reliant on links to other sectors?

There were 49 responses to this question.

Those who responded stressed the importance of links across sectors and how they were essential in supporting business activity and the development of supply chains. Links with academia were also described as being important and essential for commercial sector research collaborations, exchange of knowledge and development of skills.

The bioenergy and biomass sectors were described as being extremely reliant on feedstock availability for energy production. Other individual points raised included the strong links with the farming / agricultural sector and the power sector with respect to outputs from anaerobic digestion (biogas, compost, digestate, etc) as well as the links with agriculture in the management of water resources.

Q31: Are there potential ways in which your sector would benefit from more cooperation with other bioeconomy sectors?

There were 45 responses to this question.

Responses suggested better cross-sector cooperation would be helpful and that considerable value was gained from international collaboration. Related to this, there was a call for the level of support received from existing EU funding schemes (such as Horizon 2020) to be maintained after exiting the EU and that the UK continue collaborating across international borders.

There was also a call for more collaboration across scientific disciplines and across sectors to grasp future potential opportunities and synergies. A further key point was that bioenergy was often portrayed as competing for feedstock or land use with the food and forestry sectors, when these things could often be complementary by making productive use of economically marginal land and using waste products from other forestry industries. Other suggestions included the need for more overlap with the agri-tech sector to design more suitable industrial crops to ensure minimum waste/maximum effect.

There was also a request for coordination across bodies such as NERC, BBSRC and Innovate UK to create a specific research and innovation programme targeting the bioeconomy which would benefit accelerated exploitation of cross-sectoral opportunities.

Q32: Is there anything we could learn on sectoral cooperation from other sectors of the economy?

There were 20 responses to this question.

Suggestions here included looking at collaboration in the oil industry and oil refinery clustering, which successfully exploits potential for resource efficiency across different processes. Other examples of cooperation were in the aerospace and automotive industries where there has been strong leadership from individual groups of companies (manufacturers, supply chains and their academic support networks) which have worked together to develop compelling economic benefits cases and investment strategies.

It was pointed out that these routes have leveraged product development investments and created a focus for new standards and regulation. It was also said that it was the companies themselves that took the leadership initiative in these areas, which aided progress.

Q33: Are there any barriers to collaboration with other bioeconomy sectors? If so, what are they?

There were 35 responses to this question.

Suggestions received included the need to balance the benefits of Intellectual Property protection against the benefits of encouraging openness to foster collaborations. Replies also brought out how the need for sufficient funding and resources were important. A further barrier mentioned was where “silo” approaches and narrowly defined objectives could limit sector collaboration.

Another suggestion was that the lack of knowledge and skills related to other relevant sectors was hindering collaboration, as was a general lack of understanding about what the bioeconomy is and how it could be of benefit to some sectors. A specific example of where collaboration can be difficult was between networks, researchers and farmers, where interaction is not commonplace and potential benefits not well understood.

Q34: How can Government ensure that bio-resource is used in the best way across the different sectors, taking into account the objectives and impacts of use in these sectors?

There were 56 responses to this question.

Suggestions here included the need for financial stability with focused and targeted support that benefits the bioeconomy as a whole. A range of incentives are in place to encourage renewable heat, electricity and transport fuel, whereas there is no targeted support to replace fossil-based materials or chemicals with bio-based alternatives.

There was a call for the development for an integrated, clear and long-term strategy and cross-sectoral policy framework, including alignment with the government’s bioenergy strategy and the direction set by the Fifth Carbon Budget. One response went further to suggest a process that would help identify where the UK could add most value to the global bioeconomy, a series of actions would be required; starting with a thorough life cycle analysis, this would include global competition analysis, help with establishing and supporting bio-based supply chains and clear mapping of bio-resource availability.

Supply Chain Cooperation

Q35: What strong links does your business have with others in the supply chain, including links to overseas companies?

There were 53 responses to this question.

There were many individual examples provided here, but no single clear link emerged that featured in the responses. Among the examples provided, the most frequent references were to research collaboration (including with EU partners or funding consortia), import of feedstocks / raw materials, strengthening supply chains, technology transfer and links to end users.

Q36: Are there potential ways in which your business would benefit from more cooperation with others in the supply chain?

There were 29 responses to this question.

Respondents suggested that there was a clear opportunity to strengthen and develop new links across the supply chain through greater networking and collaboration. It was also suggested that product perceptions could be improved by working across the supply chain (e.g. feedstock suppliers, manufacturers and customers).

Q37: Are there any barriers to collaboration with other businesses in your supply chain? If so, what are they?

There were 33 responses to this question.

Common barriers raised by respondents included:

- A lack of understanding and communication between sectors
- Insufficient support in bringing companies together
- Lack of awareness of potential business partners

Government & Policies

Q38: Please tell us about any programmes, policies, regulations, laws or taxes which are helping the growth of the bioeconomy.

There were 71 responses to this question.

The responses highlighted a number of different policies and programmes that were helping the growth of the bioeconomy. In particular, R&D tax credits and increased research funding were mentioned extensively as having a positive impact on the bioeconomy, as well as the support for renewable energy and fuels offered by the Renewable Heat Incentive and Renewable Transport Fuel Obligation.

A summary of the main policies and programmes that have a positive impact on various parts of the bioeconomy is set out in Figure 6 below.

Figure 8: Programmes and policies helping to grow the bioeconomy

Policy / Programme	Agri-food tech	Chemical	Health	Industrial Biotech	Synthetic Biology	Bio energy	Other
R&D Tax Credits	✓	✓	✓	✓	✓	✓	✓
Innovate UK funding	✓	✗	✓	✓	✓	✓	✓
KTN services	✓	✓	✓	✓	✗	✓	✓
IB Catalyst	✓	✓	✓	✓	✗	✓	✗
iBioIC	✓	✓	✓	✓	✗	✓	✗
Landfill Tax	✓	✓	✗	✓	✗	✓	✓
NIBBs	✓	✓	✓	✓	✗	✓	✗
Patent Box	✓	✓	✓	✓	✓	✗	✗
Renewable energy / fuel incentives	✓	✓	✗	✓	✗	✓	✓
Seed Enterprise Investment Scheme	✓	✗	✓	✓	✓	✗	✓

Q39: Please tell us about any new programmes, policies, regulations, laws or taxes that you would like to see introduced in order to help the growth of the bioeconomy.

There were 65 responses to this question.

A number of different suggestions were made in this area. The most commonly raised issue was the need for mandatory food waste collection across the UK, which would provide a valuable resource to stimulate the bioeconomy. Other issues raised (albeit by five respondents or less each) included the continuation of the RHI after 2021, specific support for SMEs, the general necessity to maintain a stable policy environment and the use of public procurement to stimulate demand of bio-based products.

Q40: Please tell us about any programmes, policies, regulations, laws or taxes that are holding back the growth of the bioeconomy.

There were 60 responses to this question.

Responses to this question were extremely varied, representing a broad range of views which often depended on the type of organisation answering the question. An unstable, uncertain and unclear political environment was a key concern raised by several respondents. Mention was also made of the lack of positive market-based initiatives in place, such as the USDA BioPreferred procurement programme, which could drive demand for bio0based products.

Q41: How could the government further assist collaboration or research cooperation between the public and private sectors?

There were 55 responses to this question.

The most common suggestions amongst the responses to this question involved the continuation of support for networks that encouraged collaboration, such as the Industrial Biotechnology catalyst, the Biotechnology and Biological Sciences Research Council Networks in Industrial Biotechnology and Bioenergy (NIBBs), the BBSRC collaborative research scheme LINK, the Energy Technologies Institute and the SUPERGEN bioenergy programme, referenced by eight respondents. Six respondents also believed it was important to support increased private – public sector collaboration.

Q42: How could the government further assist the growth of the bioeconomy, in a way that accounts for any impacts on other objectives?

There were 34 responses to this question.

No clear consensus emerged from the responses to this question. Suggestions included the implementation of regional strategies and actions, better integration between government departments and a focus on increasing public awareness and understanding.

European Issues

Q43: Can you tell us about any European Union initiatives or programmes that affect your sector of the bioeconomy?

There were 71 responses to this question.

There was an overwhelming support for the Horizon 2020 programme, with around half of the respondents to this question highlighting it as a priority. Other commonly mentioned responses included the positive impact of the Renewable Energy Directive, Energy Regulatory Commission as well as REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals) and the Common Agricultural Policy.

Q44: Are there European Union laws or regulations which affect your sector in a positive way? If so, what are these laws or regulations, what is their impact, and would you like them to be kept for the UK after we leave the EU?

There were 51 responses to this question.

Of the total respondents to this question, 14 directly raised the importance of keeping the Renewable Energy Directive (RED) – although one respondent did advise against it. Amongst other responses, EU funding programmes, and waste directives / regulations as well as climate change and environment regulations featured prominently, though overall there was a wide range of differing views.

Q45: Are there European Union laws or regulations which affect the bioeconomy in a negative way unnecessarily? If so, what are these laws or regulations, what is their impact, and how could they be improved?

There were 34 responses to this question.

Whilst there was no clear general consensus on specific EU regulations that had a negative impact on the bioeconomy, EU policy on GMOs, state aid and the limitations of the RED directive (see Q 44) were amongst the examples suggested by respondents.

Q46: Where do you see the greatest UK bioeconomy opportunities that will arise outside of the European Union?

There were 52 responses to this question.

Of the respondents who answered this question, nearly half suggested that the biggest opportunities would arise from trade and trade deals with a range of countries including some Eastern European states with underutilised land (e.g. Belarus, Ukraine, Moldova and Russia), developing countries such as Brazil and India, technological partners such as Canada and the US and various Commonwealth countries. Some respondents also raised the opportunities offered by GM food, where a number of countries outside of the EU have different regulations in place that would allow for greater market growth.

International Issues

Q47: Are you aware of any government policies or regulations in other countries that are more or less supportive to growth in the bioeconomy?

There were 41 responses to this question.

Although the responses to this question were quite widely spread between various countries, the US BioPreferred Programme was particularly prominent, with several respondents supporting its benefits to the bioeconomy. Various recycling strategies, especially across EU and EEA countries, were also mentioned widely – mostly in a positive light. Countries such as Germany, Italy and Finland are seen to have positive measures in place to stimulate their bioeconomies, as well as others such as France and Spain which have recently introduced national bioeconomy strategies.

Q48: Are there any barriers to collaboration with organisations in other countries? Is so, what are they?

There were 28 responses to this question.

The most commonly mentioned potential barrier was exiting the European Union, with almost half of respondents highlighting this. Respondents stressed its potential negative effect on collaboration, worries about research funding after exit, and the need to maintain a presence within the international scientific community. Some also expressed their concern over the difficulty of future collaboration with non-EU countries – for SMEs in particular.

Q49: How does UK policy and funding environment compare with other countries?

There were 37 responses to this question.

Generally the responses acknowledged the UK's favourable performance in comparison to other EU countries, receiving a high level of funding from EU programmes as well as offering support at a national level through, for example, Innovate UK and BBSRC. However, around a third of respondents also highlighted that the UK did not compare so well with some non-EU countries such as the United States. A common theme among a smaller number of respondents was the need for long-term policy stability and further investment.

Q50: What is the degree of reliance on overseas supply chains (for example raw materials) in UK companies?

There were 38 responses to this question.

Around 70% of the respondents to this question expressed a concern regarding the UK's reliance on overseas supply chains, particularly in relation to the high level of biomass imports for power generation, which some thought was related to a lack of home-grown supply in the UK.

Q51: Please describe any trade problems you are aware of that are causing obstructions for imports or exports.

There were 15 responses to this question.

Whilst responses to this question were limited in numbers, most responses were evenly split between the uncertainty surrounding the potential consequences of exiting the EU and current currency fluctuations.

Q52: Are there global pressures such as changes in demand or supply that affect your sector?

There were 23 responses to this question.

There was a mixture of responses here raising different sources of global pressures such as scarcity of materials and a rising demand for water, fertile land and natural resources. However the most common suggestions were that fluctuation in oil prices and changes in demand for bio alternatives were key factors.

Standards

Q53: How do you think standards could be used to help promote growth in the bio-economy?

There were 54 responses to this question.

There were a number of suggestions raised amongst the responses to this question. The most common suggestion, from nine respondents, was the importance of standards to boosting consumer confidence whilst building trust. Quality assurance was also mentioned by some, although no other issue featured prominently amongst responses.

Q54: What types of standards are best suited to support the bioeconomy?

There were 34 responses to this question.

Suggestions were made here around the quantification of embedded carbon in products, taking into account land and water use in production, as well as the introduction of agreed sustainability criteria. One respondent also suggested a standard to define the bioeconomy and explain its relevance.

It was also suggested that synthetic biology could benefit from common technical and engineering standards especially around data formats, process automation procedures and tools, and component characterisation.

Other Questions

Q55: Are there any relevant work studies, case studies or reports that you would like us to be aware of? Please provide a link if you can.

There were 46 responses to this question.

There were a variety of contributions in response to this question, including reports on the uses of innovative technology as well as academic, consultative and other papers containing supporting evidence. A list showing a selection of these is included as an annex to this report.

56 Are there any other points on the subject of the bioeconomy that you would like to make?

There were 22 responses to this question.

Those who replied to this question did so most commonly as a way of cross-referring a response to an earlier question or reinforcing a policy position.

Public Insight into the Bioeconomy

Communicating the benefits of a thriving bioeconomy will be critical to its success. The term ‘bioeconomy’, however, is not necessary something that resonates with people outside of the industry itself. Whilst there may be an understanding of some of the more familiar parts of the bioeconomy, such as the benefits of bioenergy or bio-based medicines, the bioeconomy is not as familiar a concept as, say, the digital economy.

Public Engagement in the Call for Evidence

Several responses to the Call for Evidence highlighted the role that public engagement can play in helping to grow the bioeconomy. Respondents suggested that there was a need to raise public awareness of the bioeconomy as a concept and to embed the “notion of the bioeconomy… in the vocabulary of the general public”. Several responses suggested highlighting how the bioeconomy can help address key societal challenges such as climate change, food and energy security, and increased prosperity for all.

Responses also considered the role of the general public in driving the development and uptake of bio-based products, and suggested that the benefits of bio-based products and the use of bio-based processes in manufacturing are not well understood. This includes both specific benefits to the individual and broader societal benefits around sustainability and carbon emissions reduction.

There was a concern from some respondents that consumers may associate ‘green’ or ‘bio-based’ products with those that carry a price premium, such as organic foods. Without consumer pull, companies lack an incentive to create innovative new bio-based products. Some respondents also suggested that certain parts of the bioeconomy, such as gene editing and genetic modification, were not always understood or perceived in a positive way by the public. This could present a barrier to developing new products and taking them to market, and transparent data around the costs, benefits and use of such technologies would be beneficial.

A number of mechanisms were suggested by respondents to increase awareness of the bioeconomy, including consumer education programmes, creation of case studies to showcase benefits and savings, or even embedding discussion of sustainability in school curricula. Further research to understand consumer needs would help target actions, and positive media coverage of successful businesses or research would raise the profile of the bioeconomy.

Consumer Insight

To gain a greater understanding of these issues, a survey was commissioned by BEIS and BBSRC to look into public perceptions of the bioeconomy. This work was undertaken by the social research specialists Kantar, under contract to BEIS. The survey was conducted in February / March 2017 and a summary of the methodology is set out in the box, right.

There were two common themes that emerged from this work – the need to raise public awareness of the bioeconomy as a concept, and whether public opinions could form barriers to growth in particular areas of the bioeconomy.

Consumer Insight into the Bioeconomy

Representative sample of 1,000 consumers from a total of 150,000 panellists were asked for their perceptions of the bioeconomy.

The online survey was split into 3 sections:

- Unprompted answers: Initial awareness, knowledge and attitudes towards the bioeconomy – no definitions provided
- Post definition attitudes: More detailed questions on aspects of the bioeconomy, following a short 2 minute video providing information on the bioeconomy
- Final opinions: Final understanding and attitudes to the bioeconomy after viewing a range of information during the survey

Main Findings

Around a fifth of participants claim to have heard of the bioeconomy, prior to being given any information on the subject. Considering that this is not yet a term that has entered the mainstream, this is an encouraging sign, even if recognition is just based on a simple comprehension of the term. The highest awareness levels are amongst young people, and those in higher social grades.

Whilst not many had an initial opinion on the bioeconomy, due to the relatively low level of recognition, those that did tended to be positive. The survey results also showed that providing some basic information around the bioeconomy was successful at both increasing understanding of what the bioeconomy is and increasing levels of positive feeling towards it.

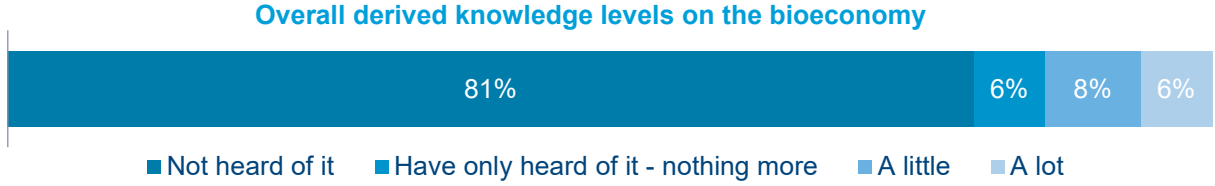
The benefits of a strong bioeconomy that resonated most with the public were around food supply, better use of waste, reducing reliance on fossil fuels, and development of new vaccinations. Similarly, the most popular opportunities presented by the bioeconomy were those that had the clearest impact on people's lives, including the development of new vaccinations, and using waste to create fuel. Further survey results are set out below.

Key Questions

Knowledge of the bioeconomy

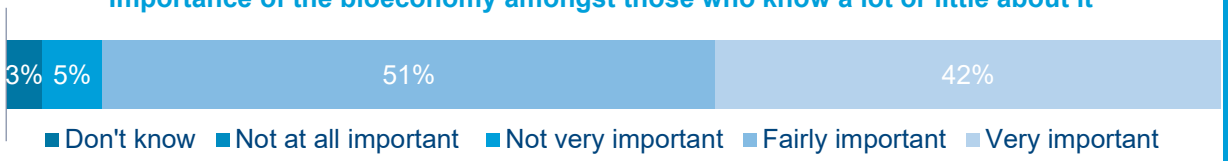
Without providing any information, the panel were asked whether they had heard of the bioeconomy, and how much they thought they knew about it. As a proportion of the whole population, 14% have at least a little knowledge of the bioeconomy.

Overall derived knowledge levels on the bioeconomy



Almost all (94%) of those with some prior knowledge about the bioeconomy felt it was important to the UK

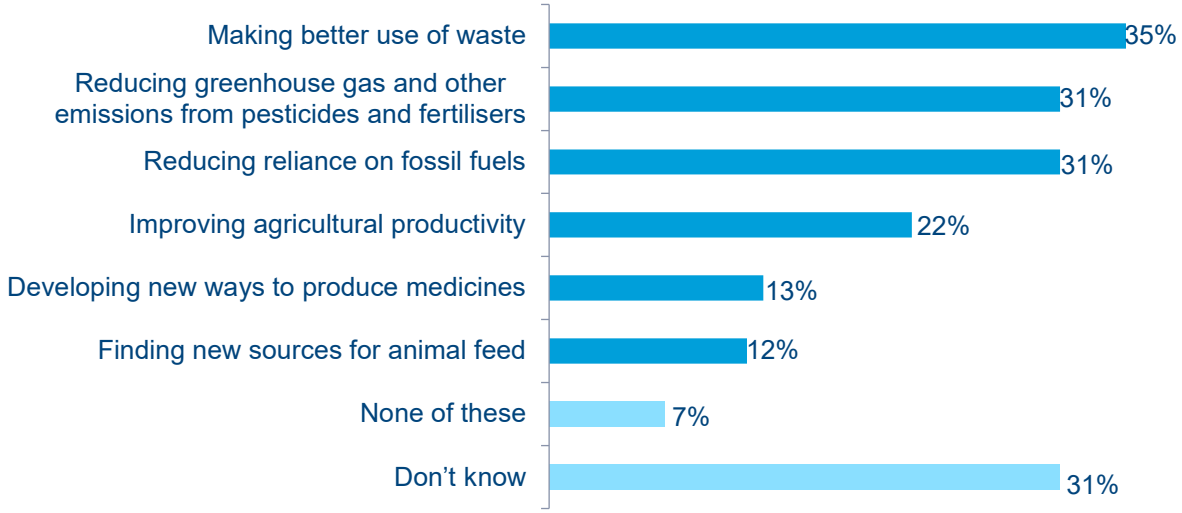
Importance of the bioeconomy amongst those who know a lot or little about it



Associations with the Bioeconomy

When provided with a range of outcomes, the bioeconomy was most often associated by the panel with making better use of waste, reducing emissions, and reducing reliance on fossil fuels

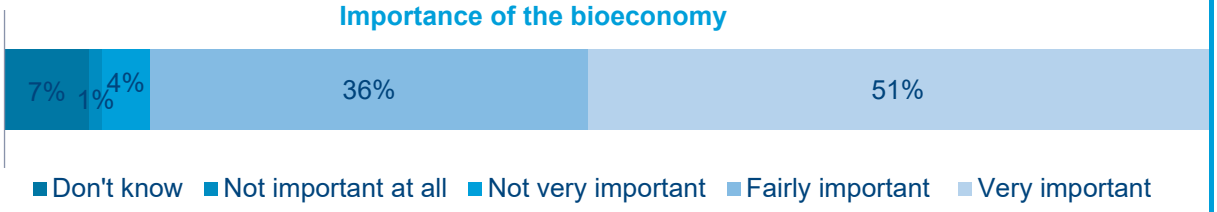
% of people who associated the following statements with the 'bioeconomy'



It can be difficult and sometimes misleading to gather opinions on an issue that most participants are uninformed about. Part way through the session, therefore, panel members were shown a short two minute video[7] produced by the Bioeconomy Directorate in the European Commission. The video provided respondents with an explanation of what the bioeconomy is, how it works and what opportunities it could bring. When the participants understood more about the bioeconomy, more than half thought it was very important to the UK.

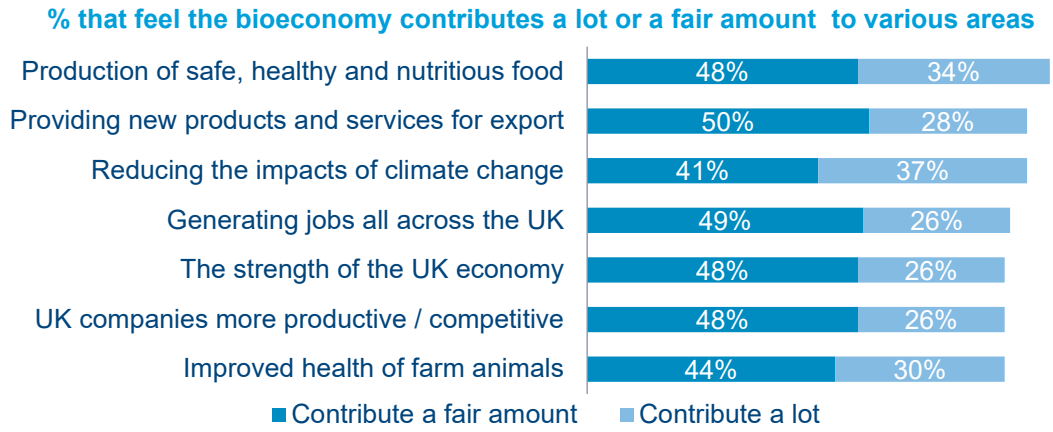
Informed Attitudes to the Bioeconomy

After watching the video, almost 9 in 10 respondents felt that the bioeconomy is important to the UK.



Contribution of the bioeconomy

When faced with a range of topic areas, almost three quarters of participants felt that the bioeconomy contributed 'a fair amount' or 'a lot'.



After having received information on the bioeconomy, participants could see clear links to productivity and growth as well as the benefits to the environment and food/agriculture. In

[7] See www.youtube.com/watch?v=2xvXkOMRTs4

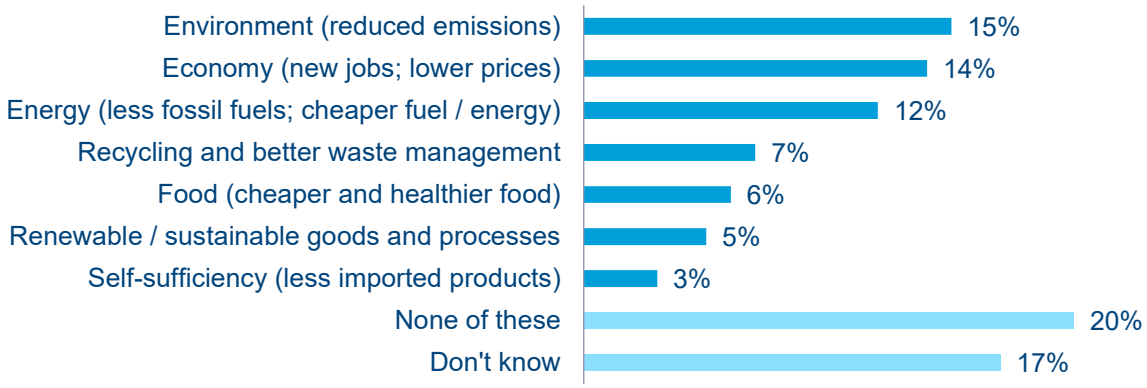
terms what benefits the public would like to see from the bioeconomy, the environment, energy and the economy were the most popular options.

When asked, most respondents had difficulty identifying any concerns over negative impacts of the bioeconomy; the third that did mentioned issues such as the need for investment, untested technologies and the impact on agriculture and the environment as well as how animal were treated.

Public benefits of the bioeconomy

A wide range of aspirations for the bioeconomy were provided to participant, but the most common fell under the impact on the environment, the economy, and clean affordable energy.

Benefits the public would like to see from the bioeconomy



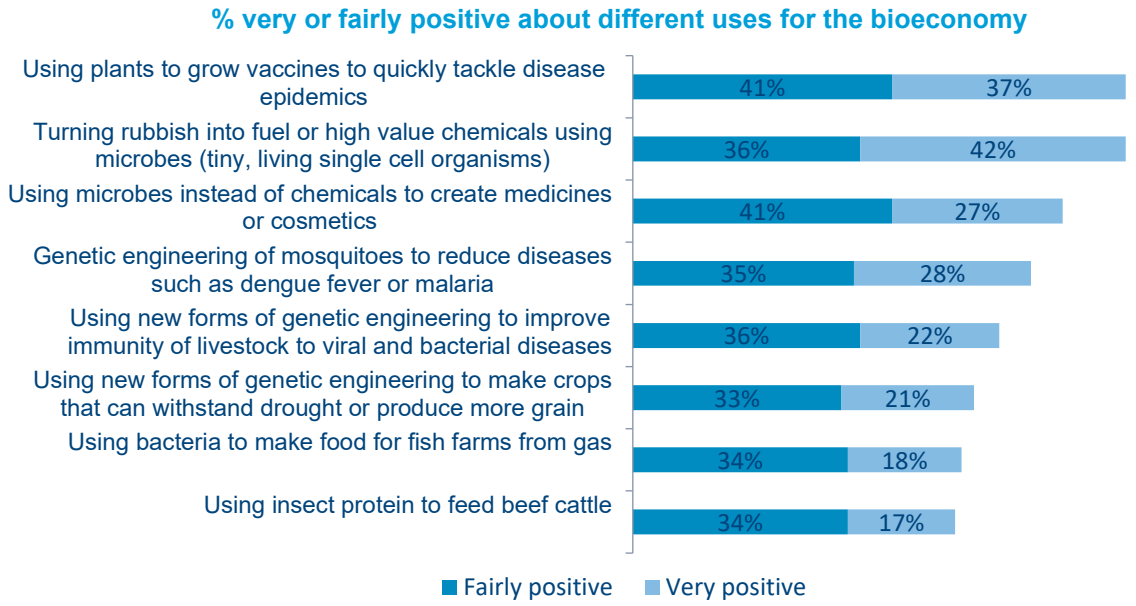
Most important priority for the UK

When presented with a range of possible benefits from the bioeconomy, and pressed on which single area is most important to the UK, reduced reliance on fossils fuels and a secure and resilient food supply were seen as the most important.

% viewing each item as the most important

Examples of bioeconomy outputs

When posed with a range of possible outputs from the bioeconomy, the panel were asked to state how positively they thought about each option.



Communicating the Bioeconomy

The results of this survey provide a good evidence base which can be used to develop further communications plans and conversations around the bioeconomy. It is clear that while understanding of the sector at the moment is low, when provided with more information on the sector the public does understand the potential benefits and recognises the potential of the bioeconomy to change lives in a positive way.

There is considerable potential to increase public awareness and understanding of the bioeconomy, which would help embed these notions in the vocabulary of the general public. One way to approach this would be to set out how the bioeconomy could address key societal challenges such as health, climate change, food and energy security, as well as increasing productivity.

Building trust in new products and services needs a conversation with the very broadest range of stakeholders involved at all stages of a supply chain. It is therefore important that this task involves government, industry and the research community as well as NGOs and consumer bodies.

Consumers can play a key role in driving the development and uptake of bio-based products, but that rests on the social, economic and environmental benefits being well understood. Without consumer pull, companies lack an incentive to create innovative new bio-based products.

A clear and ambitious bioeconomy strategy that is supported by government and industry, combined with engagement at a local level, could help boost public engagement with (and ownership of) bioeconomy goals. . A first step to achieve a position where the bioeconomy commands a position of trust in the market place is to build a clear and open engagement plan. This exercise must be based on an unbiased and comprehensive evidence base, and can be built on the results of the public attitudes survey, bringing stakeholders into the conversation at the earliest opportunity. Next steps on increase public awareness are set out in the accompanying Bioeconomy Strategy.

Annex I: List of accompanying information

This is a list of links to reports, resources and websites supplied by respondents as part of the Call for Evidence. It has been summarised here without comment or view on content.

Description	Link
Case study on using microbes to generate energy and clean water from urine	http://www.gatesfoundation.org/Media-Center/Press-Releases/2013/12/Gates-Foundation-Awards-Grants-to-Waterless-Toilets http://www.brl.ac.uk/researchthemes/bioenergyselfsustainable/urine-tricity.aspx
An assessment of the potential for the establishment of lignocellulosic biorefineries in the UK, October 2016	https://lb-net.net/lbnet-feasibility-study-an-assessment-of-the-potential-for-the-establishment-of-lignocellulosic-biorefineries-in-the-uk-is-now-available/
Miscanthus studies	https://optimisc.uni-hohenheim.de/
Studies on workforce and apprenticeships *Note: Access to files requires setting up a user account.*	https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2894834 https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2895677 https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2530874
Examples of structures that encourage collaboration between the Biosciences and other disciplines	https://www.dur.ac.uk/research/bioeconomy/ http://prospect.rsc.org/MiB_NIBB/ http://www.bbsrc.ac.uk/research/programmes-networks/research-networks/nibb/ https://www.dur.ac.uk/dccit/
Supporting evidence on Biorefining and Biotechnology	https://www.uk-cpi.com/services/economic-evaluation-life-cycle-analysis https://www.uk-cpi.com/technology-casestudy/industrial-biotechnology-and-biorefining-case-studies/ https://www.uk-cpi.com/industrial-biotechnology-and-biorefining/ https://www.uk-cpi.com/services/innovation-integrator https://www.uk-cpi.com/blog/why-biorefineries-will-turn-waste-into-resource

Decarbonisation options for the Tees Valley area	https://www.nepic.co.uk/wp-content/uploads/2016/05/TVPI_High_Level_Analysis_Report_To_Stakeholders-April-2016.pdf http://www.nebr.co.uk/reports/
BEACON ERDF project case studies	http://beaconwales.org/en/case-studies/
Selected reports on impacts of biomass and bioenergy on the natural environment	https://www.rspb.org.uk/Images/biomass_report_tcm9-326672.pdf http://www.rspb.org.uk/Images/energy_vision_summary_report_tcm9-419580.pdf https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/349024/BEAC_Report_290814.pdf http://www.birdlife.org/europe-and-central-asia/black-book https://europeanclimate.org/wp-content/uploads/2014/02/WASTED-final.pdf https://www.dogwoodalliance.org/wetland-investigation-3-16/ https://www.nrdc.org/sites/default/files/bioenergy-modelling-IB.pdf
Waste and resource industry reports	http://www.esauk.org/reports_press_releases/esa_reports/20160801_RESOURCEFUL_Delivering_a_strong_and_competitive_UK_resource_economy.pdf http://www.esauk.org/esa_reports/20140916_ESA_Circular_Organics_Biotreatment_Strategy.pdf
Commercial and strategic opportunity offered by gas fermentation in the UK	http://www.c1net.co.uk/documentation/Opportunities%20for%20gas%20fermentation%20in%20the%20UK%20-%20Final%20Report%20-%20July%202016.pdf
Information related to skills for the bioeconomy	http://www.scienceindustrypartnership.com/resources/ http://scienceindustrypartnership.com/skills-strategy/ http://scienceindustrypartnership.com/skills-strategy/ http://www.scienceindustrypartnership.com/resources/ http://www.gatsby.org.uk/education/reports http://www.bbsrc.ac.uk/about/reviews/consultations/1501-vulnerable-capabilities-report/ http://www.abpi.org.uk/our-work/library/industry/Pages/101115.aspx http://www.abpi.org.uk/media-centre/newsreleases/2016/Pages/Action-Plan-for-UK-to-capture-the-next-generation-of-medicines-manufacturing-jobs.aspx

Jobs and growth generated by industrial Biotechnology in Europe, 2016	https://www.europabio.org/industrial-biotech/publications/jobs-and-growth-generated-industrial-biotechnology-europe
Tees Valley as a Biorefinery Cluster	http://www.nnfcc.co.uk/publications/reports-tees-valley-assessment
Reports relating to circular economy and waste policies	http://www.europarl.europa.eu/EPRS/EPRS-Briefing-573936-Circular-economy-package-FINAL.pdf http://www.eunomia.co.uk/reports-tools/residual-waste-infrastructure-review-11th-issue/ http://www.eunomia.co.uk/reports-tools/investment-in-advanced-conversion-technologies-act/
Towards a Resourceful Belfast: Materials Strategy Proposition Document	Pdf document supplied – no web link available.
Publications relating to the bioeconomy and bio-based products	http://innprobio.innovation-procurement.org/home/ http://www.europabio.org/industrial-biotech/publications/bioeconomy-vision-reality
UK road map to Algal Technologies	https://connect.innovateuk.org/documents/3312976/3726818/AB_SIG+Roadmap.pdf/66496154-60b3-43e3-a1a2-78cde6f81bb0
Responses to the Dowling review and additional information	https://www.rsb.org.uk/images/Society_of_Biology_Response_-_DOWLING_REVIEW_2015.pdf http://www.ncimb.com/ http://www.superbroccoli.info/
Information on food waste and GHG emissions reduction, and a case study on alternative feed sources for salmon	http://www.wrap.org.uk/content/courtauld-commitment-2025 http://scottishaquaculture.com/salmon-feed-innovations-set-to-boost-scotlands-biggest-food-export-market/
Information regarding the transport energy task force	http://www.lowcvp.org.uk/projects/transport-energy-task-force.htm
Biorenewables Development Centre Annual Report 2015-16	http://www.biorenewables.org/wp-content/uploads/2016/10/BDC-Annual-Report-2015-16_spreads-emailer.pdf
Reports focusing on bioenergy and biomass	http://www.eti.co.uk/programmes/bioenergy http://www.eti.co.uk/insights/the-evidence-for-deploying-bioenergy-with-ccs-beccs-in-the-uk http://www.eti.co.uk/library/an-eti-perspective-bioenergy-crops-in-the-uk-case-studies-of-successful-whole-farm-integration

	http://www.eti.co.uk/library/delivering-greenhouse-gas-emission-savings-through-uk-bioenergy-value-chains http://www.eti.co.uk/insights/bioenergy-enabling-uk-biomass
A UK Roadmap for Algal Technologies 2013	https://www.ifm.eng.cam.ac.uk/uploads/Roadmapping/UK-Roadmap-for-Algal-Technologies.pdf
Case study: Yorkshire and the Humber: an innovation cluster for the bioeconomy	https://www.biovale.org/
Various informative reports relating to the bioeconomy	http://innprobio.innovation-procurement.org/home/ http://www.europabio.org/industrial-biotech/publications/bioeconomy-vision-reality https://ec.europa.eu/energy/sites/ener/files/documents/EC%20Sugar%20Platform%20final%20report.pdf http://www.publications.parliament.uk/pa/ld201314/ldselect/ldsctech/141/141.pdf http://www.europarl.be/resource/static/files/evenementsbibrussels_2016/ep_john_bell_170316_lp_final_short.pdf
Governance and regulation of innovative (bio)technologies	http://www.sepa.org.uk/media/219333/environmental-regulation-of-advanced-innovative-biotechnologies-anticipating-future-regulatory-oversight.pdf http://www.bsigroup.com/research-pagit-uk
Reports and studies relating to biomass	https://ec.europa.eu/energy/sites/ener/files/documents/EU%20Carbon%20Impacts%20of%20Biomass%20Consumed%20in%20the%20EU%20final.pdf http://www.fs.fed.us/climatechange/documents/SouthernRegionCarbonAssessment.pdf http://www.srs.fs.usda.gov/pubs/47281 http://stacks.iop.org/1748-9326/9/i=2/a=024007 http://dx.doi.org/10.5849/jof.14-009 http://www.foresteurope.org/docs/fullsoef2015.pdf
Reports on waste, low carbon solutions and transport climate action	http://europeanclimate.org/wp-content/uploads/2014/02/WASTED-final.pdf http://lctpi.wbcsdservers.org/wp-content/uploads/2015/11/LCTPi-LCTF-Final-Report.pdf http://lctpi.wbcsdservers.org/wp-content/uploads/2015/12/LCTPi-LowCarbonFreight-LeaderStatement.pdf https://epublicatie.minienm.nl/gth#/slide_aroundtheworldineightydays

Annex II: Suggested Quick Wins

This section sets out the various 'Quick Wins' that were suggested by respondents to the Call for Evidence, summarised into broad categories. These actions are the views of respondents and are provided for information only, without views or comments regarding the effectiveness of such measures. It is not an indication of government policy, nor an endorsement of any specific actions.

Research / collaboration

- Ensure that the UK still has access to EU funding for collaborative research and demonstration of UK capability
- Creation of a bioeconomy council to ensure delivery of the bioeconomy strategy
- Targeted funding calls for projects in the bioeconomy covering R&D / innovation / commercialisation
- Establish bioeconomy hubs and work with existing catalyst centres to grow expertise and skills
- Develop and support bioeconomy enterprise zones that enable quick transition of innovative ideas into novel technologies or products
- Set up and resource BioPilotsUK and support swift routes for commercialisation of research capital
- Set a specific research focus for anaerobic digestion, through a centre for anaerobic biotechnology and bio-resources

Skills and Training

- Ensure skilled workers can migrate easily to the UK in the short and medium term, to meet demand for roles across new bioeconomy industries
- Training in the UK needs to be addressed at all levels, via formal education as well as in-company training programmes, including:
    - STEM subjects at school
    - Degree and postgraduate qualification and training
    - Technical support and evaluation skills

Policies and incentives

- Policy stability – vital for investment in novel technology
- Policy support for the low carbon economy, linking to existing financial incentives
- Revision of the existing incentive systems to support expansion of the bioeconomy
- Policy intervention to stimulate specific areas of the bioeconomy, including:
    - Aquaculture and the marine bioeconomy
    - Perennial biomass crops
    - Use of residues as feedstocks
    - Management of manures and on-farm resources
    - Anaerobic digestion of waste and biomass
- Set targets for the use of advanced biofuels
- Consider policy options to increase the market for synthetic biology products and processes

Regulations and standards

- More effective enforcement of the waste hierarchy
- New approach / clarity around the definition of waste
- Clear definitions and standards for bio-based products
- Ban materials or substances that disrupt the circular economy
- Legislate for the mandatory inclusion of bio-based components in products
- Particular requirement to use biodegradable materials in sensitive environments, such as lubricants oils and greases in ports, forests and national parks
- Ban single use plastic bags apart from certified compostable bags, and encourage the use of compostable packaging more generally
- Revision of regulations around the use of animal by-products to enable more efficient use of resources

Procurement

- Mandatory public procurement of bio-based products, particularly biodegradable packaging, such as the USDA Bio-Preferred programme.
- Ensure sustainability criteria are considered in all procurement contracts

Feedstocks

- Mandate separate collections of domestic (and commercial) waste, ban the disposal of food waste to landfill
- Taxation on incineration and energy from waste technologies
- Enhance packaging recycling by improving labelling, separation technology etc
- Re-shore currently exported waste derived fuels
- Specific ask around making the most of wool waste

Investment and financing

- Ongoing financial support via renewable energy and fuel incentives
- Provision of low cost financing for early movers and start-up companies
- Help to bridge the gap between demonstrating feasibility and commercialisation
- Set up collaborative enterprise zones / scaling up facilities and demonstration pilot capability
- Tax breaks and VAT adjustments for bio-based materials and products
- Attract inward investment from global innovative companies in the field

Annex II: List of Relevant Policies, Programmes and Bodies

This section sets out the various policies, programmes and organisations that were suggested by respondents to the Call for Evidence as being relevant to – or having an impact on – the bioeconomy. It has been summarised in broad categories and is provided for information without views or comments.

UK Policies and Legislation

Policy / Programme	Brief Description	Lead Organisation
UK Climate Change Act	The Climate Change Act sets legally binding targets to reduce carbon dioxide emissions in the UK by at least 80% by 2050, from 1990 levels.	Department for Business, Energy & Industrial Strategy (BEIS)
UK Bioenergy Strategy	A strategy designed to encourage a world leading bioeconomy which is appropriate to the UK's industrial structure and availability of natural resources.	Department for Business, Energy & Industrial Strategy (BEIS)
Patent Box	The Patent Box enables companies to apply a lower rate of Corporation Tax to profits earned after 1 April 2013 from its patented inventions. The relief will be phased in from 1 April 2013 and the lower rate of Corporation Tax to be applied will be 10%.	HM Revenue & Customs
Industrial Decarbonisation Action Plans	Action plans setting out government and industry commitments to reduce greenhouse gas emissions and improve energy efficiency. These follow on from the Industrial 2050 Roadmaps project, which set out potential pathways for the eight most heat-intensive industrial sectors to reduce greenhouse gas emissions and improve energy efficiency.	Department for Business, Energy & Industrial Strategy (BEIS)
Single Use Carrier Bag Directive	Directive designed to reduce the consumption of plastic carrier bags.	Department for Environment, Food and Rural Affairs (Defra)

Note – Call for Evidence was concluded before launch of 2017's Industrial Strategy and Clean Growth Strategy as well as 2018's 25 Year Environment Plan.

European Programmes and Policies

Policy / Programme	Brief Description	Lead Organisation
Renewable Energy Directive	Establishes an overall policy for the production and promotion of energy from renewable sources in the EU. It requires the EU to fulfil at least 20% of its total energy needs with renewables by 2020 – to be achieved through the attainment of individual national targets	European Commission
EU Circular Economy Directive and Framework	Contributes to "closing the loop" of product lifecycles through greater recycling and re-use, and bring benefits for both the environment and the economy. The plans will extract the maximum value and use from all raw materials, products and waste, fostering energy savings and reducing Green House Gas emissions.	European Commission
Common Agricultural Policy	The European Union's farm policy ensures a decent standard of living for farmers, at the same time as setting requirements for animal health and welfare, environmental protection and food safety.	European Commission
Horizon 2020	Horizon 2020 is the biggest EU Research and Innovation programme ever with nearly €80 billion of funding available over 7 years (2014 to 2020) – in addition to the private investment that this money will attract. It promises more breakthroughs, discoveries and world-firsts by taking great ideas from the lab to the market.	European Commission
EC's Lead Market Initiative	Lead Markets Initiative for Europe' (LMI) proposed by the Commission fosters the emergence of six innovative markets by notably improving legislation, encouraging public procurement and developing interoperable standards	European Commission
EU/ERC funding (including ERDF)	Various funding methods, including the European Development Fund.	European Commission
GMO regulation	The European Union's legal framework to ensure that the development of modern biotechnology, and more specifically of GMOs, takes place in safe conditions.	European Commission
Marine framework and water directives	The Marine Directive aims to achieve Good Environmental Status (GES) of the EU's marine waters by 2020 and to protect the resource base upon which marine-related economic and social activities depend. The EU Water Framework directive focuses on keeping a clean, pollution-free aquatic environment.	European Commission
Standards for bio-based products (CEN TC411 committee)	Aims to develop standards for bio-based products covering horizontal aspects. This includes a consistent terminology for bio-based products, sampling, bio-based content, application of and correlation towards LCA and sustainability of biomass used, and guidance on the use of existing standards for the end-of-life options.	BioBased Economy

UK Funding and Incentives

Policy / Programme	Brief Description	Lead Organisation
Renewable Heat Incentive (RHI)	Provides financial reimbursement for homes using renewable heat sources.	Department for Business, Energy & Industrial Strategy (BEIS)
Renewable Transport Fuel Obligation (RTFO)	The Renewable Transport Fuel Obligation Order regulates biofuels used for transport and non-road mobile machinery.	Department for Transport (DfT)
Renewables Obligation (RO) / Contracts for Difference (CfD)	Contract enabling an electricity generator to claim the difference between the price for electricity reflecting the cost of investing in a particular low carbon technology and average market price for electricity in the GB market.	Department for Business, Energy & Industrial Strategy (BEIS)
R&D tax credits	Provides tax relief to companies involved in certain R&D projects.	HM Revenue & Customs
Landfill tax	A tax for businesses using landfill sites to get rid of their waste.	HM Revenue & Customs
Biomedical Catalyst	Partnership between the MRC and Innovate UK, providing responsive and effective support to the most innovative life sciences opportunities.	Medical Research Council / Innovate UK
Innovate UK funding streams	Various funding streams available.	Innovate UK
Newton Fund	Promotes economic development and social welfare of countries through collaboration and strengthening partner country science and innovation capacity.	Managed by the Department for Business, Energy & Industrial Strategy (BEIS)

Note – Call for Evidence was concluded before launch of the Industrial Strategy Challenge Fund and other innovation programmes launched in 2017/18.

UK Standards and Guidance

Policy / Programme	Brief Description	Lead Organisation
BS8001 Standard for the circular economy	Seeks to decouple economic growth from resource consumption to help overcome pressures on resources arising from the estimated growth of the global middle class.	British Standards Institution
BS EN 16575:2014 and BS EN 16751:2016	Bio-based products standards	British Standards Institution

BSI PAS standards (100/110/600)	Improved re-usage of valuable energy and fertiliser sources.	British Standards Institution
Biomass Sustainability Standards	Biomass electricity generators over 50KW are required to report against certain sustainability criteria.	Department for Business, Energy & Industrial Strategy (BEIS)
Kitemark	A quality mark confirming prior testing and checks and proving that the product or service meets the recognised industry standards.	British Standards Institution
Green Gas certification	Tracks biomethane, or 'green gas', through the supply chain to provide certainty for buyers.	GreenGas Certification Scheme
Biomethane Certification Scheme (BMCS)	Provides the biomethane industry with a means of certifying and trading the "green" or "bio" value of biomethane.	Green Gas Trading
Quality Protocols	Set out when a waste derived material can be regarded as a non-waste product, no longer subject to waste controls. Aims to produce high quality products from waste materials to promote greater recovery and recycling.	Environment Agency

Programmes and Policies – Local, Regional and Devolved Administrations

Policy / Programme	Brief Description	Lead Organisation
Biorefinery Roadmap for Scotland	Outlines required actions with details of the fiscal supported needed to fulfil these economic opportunities.	Scottish Enterprise
National Plan for Industrial Biotechnology	Aims to transform the competitiveness and sustainability of multiple industries in Scotland, which will grow industrial biotechnology-related turnover.	Scottish Enterprise
Zero Waste Plan Scotland	Sets out Scottish Government's vision for a zero waste society where all waste is seen as a resource.	Scottish Government
Bioeconomy of the North of England – SIA	Aims to maximise the potential of Bioeconomy in the North-East and North-West of England.	University of York
BioVale	A non-profit company seeking to build Yorkshire's capability and reputation as an innovation cluster for Bioeconomy.	Supported by regional industry, research organisations, higher education and government

Industry Networks, Councils and other bodies

Policy / Programme	Brief Description	Lead Organisation
Biotechnology and Biological Sciences Research Council (BBSRC)	BBSRC is the UK's main agency funding research in bioscience, promoting innovation in the bioeconomy and realising benefits for society within and beyond the UK.	UK Research and Innovation
Engineering and Physical Sciences Research Council (EPSRC)	EPSRC is the UK's main agency for funding research in engineering and the physical sciences.	UK Research and Innovation
Natural Environment Research Council (NERC)	NERC is the UK's leading public funder of environmental science.	UK Research and Innovation
Networks in Industrial Biotechnology and Bioenergy (NIBBs)	Fosters collaborations between academia, industry, policy makers and NGOs to find new approaches to tackle research challenges, translate research and deliver key benefits in IBBE.	
Bioeconomy knowledge transfer networks	A comprehensive system of knowledge transfer networks.	Knowledge Transfer Network
Medicines and Healthcare products Regulatory Agency (MHRA)	Regulates medicines, medical devices and blood components for transfusion in the UK.	Government agency
National Institute for Biological Standards and Control (NIBSC)	Assures the quality of biological medicines worldwide through the provision of biological reference materials, by testing products and carrying out research.	MHRA (see above)
Agri-Food Technology Council (AFTC)	The AFTC provide insight and leadership to improve the food and agriculture sectors.	Industry Body
Chemistry Council	A joint industry / Government initiative, being led by industry for industry.	Industry Body
Industrial Biotechnology Leadership Forum (IBLF)	IBLF is an industry-led stakeholder group which helps shape and deliver national strategy for industrial biotechnology in the UK	Industry Body
Medicines Manufacturing Industry Partnership (MMIP)	Represents the voices of medicine manufacturers in the UK.	Industry Body
Synthetic Biology Leadership Council (SBLC)	The SBLC provides leadership for the UK's interests in the rapidly developing field of Synthetic Biology.	Industry Body

Annex III: List of Respondents

In addition to 10 individuals and 15 confidential replies, the following organisations responded to the Call for Evidence:

3fbio Ltd.

ABC, the Agricultural Biotechnology Council

Aberystwyth University

Aberystwyth University / IBERS

Advanced Plasma Power Ltd

Alliance for Beverage Cartons and the Environment (ACE UK)

Andigestion Ltd

Arup

Battelle UK limited

Belfast City Council Waste Management Service

Bio Based and Biodegradable Industries Association

Bio-bean

Bioladies Network

Biopharmaceutical Consulting

BioPilotsUK Alliance

Bioplastic and biochemical producer

Biorenewables Development Centre Limited

BioVale

BrisSynBio

British Antarctic Survey

British Glass

BSI

Calor Gas Limited

Carbon Trust

Centre for Process Innovation Limited

cgp consult limited

Chartered Institution of Wastes Management

Chemical Sciences Scotland

Cogent Skills

Confor: Confederation of Forest Industries

Confederation of Paper Industries

Croda International PLC

Delta-T Devices Ltd

Dr Reddy's

Drax Group plc

Durham University

Ecosurety

Energy 2050, University of Sheffield

Energy Technologies Institute (ETI)

Environmental Services Association

EuropaBio

FABRA UK

Fiberight Ltd

Food Ethics Council

Fujifilm Diosynth Biotechnologies

Greener Power Consulting

Highlands and Islands Enterprise

Industrial Biotechnology Innovation Centre (IBioIC)

Industrial Biotechnology Leadership Forum

Institute of Food Research / Quadram Institute

Johnson Matthey Plc

King's College London

LanzaTech

Low Carbon Vehicle Partnership

Lutra Ltd

Microbiology Society

Mineral Products Association

National Grid Gas Distribution Ltd

NFU

NNFCC

Northeast of England Process Industry Cluster (NEPIC)

Northumbria University

Orthios Group Holdings Ltd

Oxford University

Progressive Energy

Queen's University Belfast

Renewable Energy Association

Resources Efficiency Services (RES)

Royal Society for the Protection of Birds

Royal Society of Biology

Royal Society of Chemistry

Scottish Aquaculture Innovation Centre

Scottish Association for Marine Science (SAMS)

Scottish Enterprise

ScottishPower

S'Investec LLC

Society of Chemical Industry (SCI)

SUEZ recycling & recovery UK

SynbiCITE Innovation & Knowledge Centre for Synthetic Biology

Tees Valley Combined Authority

Tetra Pak

Thames Water Utilities Limited

The Anaerobic Digestion and Bioresources Association (ADBA)

University College London

University of Aberdeen

University of Bristol

University of Edinburgh

University of Leeds

University of Lincoln

University of Manchester

University of Nottingham

University of Oxford

University of Portsmouth

University of Warwick

University of York

Wood Panel Industries Federation

WWF-UK

York, North Yorkshire and East Riding LEP

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www.gov.uk/beis