BIS | Department for Business Innovation & Skills

GOVERNMENT RESPONSE TO THE INDUSTRIAL BIOTECHNOLOGY INNOVATION & GROWTH TEAM REPORT TO GOVERNMENT

IB 2025: Maximising UK Opportunities from Industrial Biotechnology in a Low Carbon Economy

JUNE 2009

Contents

1. Foreword 3

2. Introduction 5

3. Response to Recommendations 7

4. Conclusions 25

5. Annex A – Recommendations of the IB-IGT Report 2009 27

Joint Ministerial Foreword

The Government welcomes the industry-led *IB 2025* report by the Industrial Biotechnology Innovation and Growth Team (IB-IGT). This report gives timely emphasis to the considerable potential of IB – as a technology – particularly in applications in the chemical and chemistry-using industries. Those are key UK sectors. The chemical sector alone is one of our most successful, with sales of £60 billion per annum, exporting £43 billion and contributing a £6.5 billion surplus to the UK's trade balance, mostly in high value chemicals. It is a sector that invests heavily in research and development, technology and its highly skilled workforce. It is also a sector of significance for its input to a number of downstream supply chains, ranging from new bio based ingredients in personal care products to bio based synthetic rubber for tyres, and bio plastics, which are being developed for use in a range of applications such as packaging, films and computer components.

However, as *IB 2025* has identified, the take-up of this promising technology in the chemical sector has been modest to-date (£1.8 billion), in contrast to its well established and highly successful use in pharmaceuticals. Clearly that needs to change if the UK is to gain a significant share of the global market for IB (estimated to grow to at least £150 billion and up to £360 billion by 2025). That will ultimately depend on the ability of businesses to operate competitively in global markets. The IB-IGT's Report highlighted some examples of that happening. But the Government has a role here too, especially in facilitating a wider and more rapid uptake of the technology, especially among smaller businesses. The case for doing so is compelling in that IB has a number of advantages in helping to move towards a low carbon economy, reducing energy demand, reducing our reliance on petroleum-based chemicals, materials security, and introducing new, better performing products. *IB 2025* includes a number of persuasive examples of those advantages.

IB is at the heart of our drive towards a greener future and greener jobs. The Government's strategic vision for recovery from the current economic conditions, set out in *New Industry, New Jobs*, identified IB as one of the priority areas of advanced manufacturing that merited attention and support. That strategic vision also committed the Government to ensuring that business opportunities were considered as part of every department's policy making, and that more cross-governmental approaches be adopted on major industrial policy issues. Turning that into action is illustrated by that fact that the Government as a whole – through our three leading departments – are accepting and will be continuing to collaborate with industry, intermediaries and academia to support the recommendations of the IB-IGT to drive, deliver and enable the change necessary to seize the strategic opportunities IB offers. We look forward to working with the IB Leadership Forum in this regard.

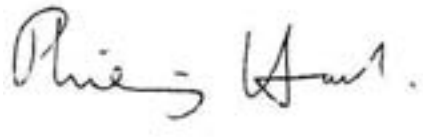
What we want to see in the longer term is the UK benefiting from the economic and environmental advantages that come with the increased use of IB. To achieve that it will be essential that we fully utilise our world class science and research base in helping to identify and deliver new processes, materials and products in partnership with business. Our wealth of ideas and skills needs to be translated into those tangible outputs within a UK environment that is the best place to conduct innovative approaches to IB. Implementing the recommendations in *IB 2025* will contribute decisively to that objective.

We would like to thank Ian Shott, Chair of the IB-IGT, and all who contributed to *IB 2025*.

Lord Drayson

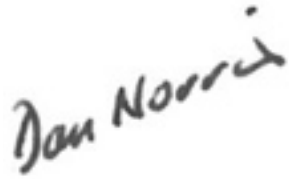
Minister for Science and Innovation
DEPARTMENT FOR BUSINESS, INNOVATION AND SKILLS

Lord Hunt



Minister of State for the Department of Energy and Climate Change
DEPARTMENT FOR ENERGY AND CLIMATE CHANGE

Dan Norris



Minister for Rural Affairs and the Environment
DEPARTMENT FOR ENVIRONMENT, FOOD AND RURAL AFFAIRS

Introduction

Industrial Biotechnology (IB) is a generic technology that provides both new market opportunities to companies and contributes to the Government's wider agenda on low carbon manufacturing and climate change.

IB can contribute to sustainable, low-carbon growth in the UK and beyond through the development of new and less carbon intensive products and processes. IB is at the heart of the Government's drive towards a greener future and greener jobs; and its wider adoption will equip companies to take advantage of new and emerging as well as established markets.

For these reasons the Government invited a group of knowledgeable stakeholders to carry out a strategic assessment of the future challenges and opportunities for IB in the UK.

The industry-led Industrial Biotechnology Innovation and Growth Team (IB-IGT), chaired by Ian Shott, published its report to Government in May 2009[1], setting out its vision for IB by 2025:

"The power and benefits of IB being fully evidenced across the UK chemical and chemistry-using industries, driven by coherent manufacturing, skills, environment and technology policies, judicious investment, and a sense of urgency, to deliver innovation, jobs and prosperity."

The IB-IGT focused on how to put the UK in the strongest possible position to gain maximum benefits from the new strategic market in renewable chemicals, and low-carbon manufacturing.

The work of the IB-IGT was delivered through an industry-led Steering Group and three sub-groups that worked to identify the innovation and growth challenges and opportunities for IB:

- Technology & Manufacturing Working Group

  Examined the current developments in IB technology and manufacturing capabilities; and identified the technological and manufacturing requirements for the future markets and existing barriers to growth

1 http://www.berr.gov.uk/files/file51144.pdf

- Finance/Investment Working Group

  Examined the finance and investment issues around establishing and growing a knowledge-based economy

- Policy Measures Working Group

  Examined how Government and industry can work to create an encouraging and enabling political and economic framework to catalyse the growth of the market for IB produced products, processes, and technologies.

The IB-IGT looked at the whole business environment affecting IB, engaging the relevant parts of Government. It worked closely with key opinion leaders in industry and identified five critical recommendations that will ensure the UK is best placed to translate the opportunities IB presents into innovations, jobs and prosperity:

- Provide leadership to promote and connect IB activities across all supply chains;
- De-risk access to new IB products, processes and technologies;
- Accelerate the innovation and knowledge transfer process for IB;
- Position IB to attract and retain high quality scientists, engineers and managers; and
- Create a truly supportive 'public' and 'business' environment for IB.

This document provides the Government's response to the IB-IGT's 21 recommendations.

Response to IB-IGT recommendations

DRIVING CHANGE

Connecting it all together

Recommendation 1: IB Leadership Forum

The IB-IGT recommends that an overarching industry/Government Leadership Forum be established by autumn 2009. This Forum would have ownership of the IB-IGT recommendations, power to oversee implementation, and responsibility for assessing and reviewing new ideas and opportunities.

Recommendation 2: IB Leadership Forum

The IB-IGT recommends that the IB Leadership Forum be responsible for raising awareness in the private and public sectors regarding the capabilities and potential of IB; as well as leading on the long-term development and promotion of IB into new and existing supply chains.

The Government welcomes these two recommendations and accepts that there is a need for an overarching body to play a strategic steering role in the implementation of the IB-IGT's findings. The different recommendations will be taken forward in separate workstreams, and it will therefore be necessary to have a single body that will have an overview of the entire programme of work, able to review progress and provide direction about any new priorities, ideas and opportunities that might emerge from the implementation process. Connected with that, the IB Leadership Forum will also be well positioned to assume responsibility for raising awareness of the considerable potential of IB, particularly in the chemical and chemistry-using sectors.

The proposal for a leadership body has successfully been applied in some other innovation and growth initiatives.

The Government proposes that the IB Leadership Forum should follow those successful models. A key feature of that will be a continuing supporting role for all of Government in what must be an industry-led programme of activities. That will take the form of joint chairmanship of the new Forum, with the Minister for Business and Regulatory Reform assuming that role with Ian Shott, who has – with the support of the IB-IGT Steering Group – agreed to continue in his leadership role for this important area of work. This ministerial engagement underlines the Government's commitment

to the effective implementation of the IB-IGT recommendations. That is further underlined by Lord Mandelson's role as the Whitehall champion of IB.

Furthermore, the alignment of Government Departments (including the Department for Business, Innovation and Skills, the Department for Environment, Food and Rural Affairs and the Department of Energy and Climate Change), the Technology Strategy Board, and the Research Councils in supporting this activity is essential to provide the catalyst to the success of IB.

The Government believes that in order to be effective the IB Leadership Forum needs to have a membership that is inclusive of the key industrial sectors that have an existing appreciation of IB as well as sectors that offer the greatest prospects for its future application. The Government will therefore work with industry stakeholders to seek to ensure that the membership of the Forum reflects that as far as possible.

To maintain momentum and continuity following the publication of the IB-IGT Report and Government Response, it is anticipated that the IB Leadership Forum will be established and meet for the first time in autumn 2009. The Department for Business, Innovation and Skills will continue to facilitate industry engagement and play a supporting role in this regard.

The implementation plans for the IB-IGT will directly drive the success of IB in the United Kingdom. The utilisation of the Technology Strategy Board's Knowledge Transfer Networks (KTNs), coupled with the continuation of industry-led activity is the minimum requirement for implementation of the IB-IGT recommendations. Optimising the connections established by the Chemistry Innovation KTN and the Bioscience for Business KTN (shortly to form the new Bioscience KTN) will ensure that the IB-IGT recommendations are viable and actionable within industry.

The Technology Strategy Board is supportive in principle of the establishment of a special interest group shared between the two KTNs – subject to funding being available – as it would be an effective working mechanism to drive implementation of the IB-IGT recommendations on the ground. IB remains a key theme of the new Bioscience KTN, which will build on the work and membership of Bioscience for Business.

DELIVERING CHANGE

De-risking access to new products and technologies

Recommendation 3: Demonstrator facilities

The IB-IGT recommends the development of an open access demonstrator facility, particularly for fermentation (up to 10 tonne capacity), with associated upstream and downstream facilities by 2010.

Recommendation 4: Demonstrator fund

The IB-IGT recommends that an IB fund (of £2.5-5 million per year for 3-5 years) should be established by the end of 2009 to allow industry, particularly SMEs, access to demonstration facilities.

The Government recognises that in order for IB to be fully exploited in the UK there is a need for practical, operational means to enable that to happen. The establishment of a demonstration facility, and an associated fund, on an open access basis, is clearly one way of achieving that.

The key issue for Government is whether or not its intervention to provide support is required in this case. The IB-IGT Report recognises that the UK has an excellent, open access facility in biocatalysis at the National Industrial Biotechnology Facility (NIBF) but lacks sufficient demonstration facilities for fermentation technology and its associated upstream and downstream processing capability at the scale highlighted by the IB-IGT. NIBF goes up to the 1000L scale, but not the 10,000L or 10 tonne scale the IB-IGT recommended.

Scale up of IB processes is more difficult than comparable chemical routes and it is difficult for SMEs to acquire the necessary capital to invest before proving the technology at large scale. In addition, the few current investments made by large companies are in production scale facilities. Such facilities may not be available to other companies to access due to scheduling of production and commercial confidentiality, or suitable for the demonstration purposes that the IB-IGT has identified as a gap in the market.

Furthermore, the Government recognises the uncertainties and risks associated with trialling new manufacturing processes and materials, and particularly the challenges that arise with up-scaling production using biological materials. There may be instances where up-scaling from small or large quantities, using new processes, fails to generate a product of the required quality or at a competitive price. That may be the case initially, and require further adaptations and investment to achieve a successful outcome.

Evidence from work carried out by the Technology Strategy Board looking at supporting and growing emerging industries, suggests that emerging industries benefit from demonstrators during their evolution. The Technology Strategy Board will soon report on a review of the network of Technology Strategy Board and Regional Development Agencies and Devolved Administrations funded Micro and Nano Technology (MNT) Centres. The review will identify how best to establish such national capability centres to promote the commercialisation of emerging technologies; and these lessons will be used to ensure emerging best practice is adopted for IB.

The Government accepts that this process of demonstration carries with it risks that the market would be unwilling to finance – especially under current conditions – the Department for Business, Innovation and Skills has therefore committed to investing in the construction of an open access IB Demonstration Facility in the UK. This will be supported by the Strategic Investment Fund announced in Budget 2009.

The Technology Strategy Board plans to publicise its Bioscience Strategy in the next few months and IB will be a strategic priority. Both the Department for Business,

Innovation and Skills and the Technology Strategy Board have agreed to reflect this priority in the upcoming Technology Strategy Board competition for applications in the area of High-Tech Manufacturing in 2010.

There is an additional opportunity for an open access pilot scale biorefining/extraction facility that would enable gram-to-kilogram samples of speciality chemicals such as oleochemicals to be provided to industrial partners for testing to aid product development.

The proposed Renewable Oils Institute (ROI) led by Yorkshire Forward[2] and the Centre for Novel Agricultural Products is an exemplar of such a facility, providing the capacity to integrate bio-based feedstock development with end user requirements and product development. Capitalising on recent advances in post-genomic technologies, such a facility would be the first of its kind in the UK and would augment the impact of IB-IGT recommendations by extending UK capability in processing to include feedstock development, biorefining and extraction alongside biocatalysis and fermentation.

> *Recommendation 5: Improving access to existing demonstration funds*
>
> ***The IB-IGT recommends that the Government should improve access to demonstration funds by broadening the remit of existing commercial-scale demonstration funds to ensure that IB is included within the scope of eligible technologies.***

IB has been recognised in the Government's *New Industry, New Jobs*[3] document and follow-up action plan as a priority for support. The Government recognises the importance of larger scale demonstration and the need for business to have access to funding to allow that.

"Solutions for Business", the Government's simplified support offer to business launched in March 2009, defines the range of business support provided by all levels of government. Budget 2009 included the commitment that all future forms of business support will be delivered through the Solutions for Business portfolio. The applicability of these existing schemes to IB is highlighted below.

The Low Carbon Energy Demonstrator Business Support Product is targeted at energy but eligibility can include IB processes with an energy generating focus. The Government will however give consideration to widening the remit of the Low Carbon Energy Demonstrator product to include a broader range of low carbon technologies which will increase its relevance to IB processes.

The Department of Energy and Climate Change's National Environmental Transformation Fund (ETF) aims to accelerate the commercialisation of low carbon energy and energy efficiency technologies in the UK. The ETF can assist IB projects which are supportive of its energy generation and efficiency objectives and it also has plans in place to support the demonstration of second generation bio-fuel production techniques.

2 Subject to final approval by Yorkshire forward

3 http://www.berr.gov.uk/files/file51023.pdf

The Collaborative R&D product provides grants to businesses and knowledge base institutions to undertake collaborative research and development of enabling technologies and large-scale demonstrator projects for innovative products, processes or services. Priority for funding is given to technologies or applications of national or regional importance as defined nationally by organisations such as the Technology Strategy Board on behalf of Government Departments, or regionally within the RDA Regional Economic Strategies.

Accelerating the innovation and knowledge transfer process for IB in the UK

Recommendation 6: Building on UK expertise

The IB-IGT recommends that the Technology Strategy Board, EPSRC and BBSRC work together to support a single, virtual, centre of excellence in IB research and development that will capitalise on, and augment, existing academic centres where biologists, biotechnologists, chemists, chemical engineers and other relevant disciplines are co-located.

IB is a key strategic priority for both the Technology Strategy Board and Research Councils, particularly in biocatalysis and biorefineries. There is no doubt about the significant and strategic value of greater connectivity between the UK's excellent science base and long-term strategic investment. The alignment of the work of the Research Councils and Technology Strategy Board is critical to knowledge transfer and to developing industrial capability.

The Technology Strategy Board, Engineering and Physical Sciences Research Council (EPSRC) and Biotechnology and Biological Sciences Research Council (BBSRC) already support means of connecting different academic centres and identifying opportunities for the commercial exploitation of university research, mainly via KTNs and Innovation Knowledge Centres (IKCs), so the recommendation for a virtual centre of excellence would need to be assessed against the existing infrastructure.

IKCs have received £32 million of funding so far, and the strategy for IKC support is currently being developed. An open call of up to £10 million of funding per IKC across a number of technologies is anticipated in the autumn.

The Technology Strategy Board, EPSRC and BBSRC believe that IKCs are a good vehicle for driving technology and market matching in high impact, broad areas of technology with a wide market potential. The Technology Strategy Board plans to increase the number of IKCs and align them more closely with emerging technology areas of major strategic importance for the UK. A proposal for an IB Centre would need to compete with those in other areas and undergo the same peer review process in order to be successful in any call.

Recommendation 7: Building on UK expertise

The Technology Strategy Board, EPSRC and BBSRC should work together through joint calls to ensure that the UK's world leading science base in genomics, fermentation, biocatalysis, plant science, marine organisms and mycology is effectively developed and translated into IB applications.

The Government accepts the importance of the UK's science base in providing the new ideas and innovations for translation into IB applications.

The BBSRC and EPSRC already carry out some joint calls for funding research projects, and will consider the scope for undertaking joint calls on IB projects in the future. Additionally, the Technology Strategy Board plans to publish its Biosciences strategy in the next few months and IB will be a strategic priority.

One example of collaborative funding is the Integrated Biorefinery Technologies Initiative Research and Technology Club (IBTI Club) launched by BBSRC in 2008.

This is a £5 million, 5-year partnership between BBSRC, a consortium of leading companies, and the Bioscience KTN aimed at developing biological processes and feedstocks to reduce our current dependence on fossil fuels as a source of chemicals, materials and fuel. The Club will provide a way for appropriate academic researchers to work on innovative, multidisciplinary, scientific areas of relevance to industry. EPSRC is committing £200,000 to IBTI in 2009 and will commit an additional £1 million in 2010, raising the total Club budget to £6 million over five years. This further demonstrates the Research Councils' commitment to support excellent multi-disciplinary research with significant industrial relevance. The Technology Strategy Board supports the KTN's involvement in the Club and is working with them to consider how opportunities for translation can be supported.

Additionally, EPSRC, BBSRC and the Technology Strategy Board have jointly funded a further 10 projects relevant to the IB sector. This represents a combined BBSRC / EPSRC contribution of £3.5 million through a targeted collaborative call for proposals in Bioscience for Industry in spring 2006.

Furthermore, the Technology Strategy Board working with the Research Councils is already considering a number of specific activities together such as Collaborative R&D competitions or European programmes such as the ERA-NET in IB.[4]

The Technology Strategy Board is currently reviewing how it supports technology priorities, in particular the type and frequency of Collaborative R&D competitions and other support mechanisms. Currently, the High Value Manufacturing competition would support some IB-type projects. The recent success of promoting this competition (to the medical bioscience community) suggests that the same could be applied to the IB community (including chemistry-using companies).

Recommendation 8: Business Support Schemes

The IB-IGT recommends that the availability and uptake of general business support schemes is facilitated by providing a single point of contact, by the end of 2009, which can give clearer signposting to schemes relevant to IB companies.

4 http://www.era-ib.net/

Solutions for Business, is the Government's streamlined package of support products to help businesses start and grow. Business Link is the main route to this support, offering information, impartial assessment of need and access to bespoke packages of support whether from the public or private sector or a mixture of both. This will make it easier for all businesses and especially SMEs to get the help they need.

Solutions for Business has emerged from the Business Support Simplification Programme and responds to the request from business for a simpler framework that provides a quick, easy and direct route to effective support. Previously, it was estimated that over 3,000 publicly funded business support schemes existed. Business said they were confused and discouraged from applying for support.

Now, for the first time, the range of support offered by Government Departments, their agencies and local authorities has been bought together in a single portfolio, easily recognisable and accessed via Business Link.

The Department for Business, Innovation and Skills will work with the IB Leadership Forum and Business Link to make sure companies in the IB sector benefit from the support Business Link can unlock. This could include working with Business Link to develop online guides and diagnostic tools for the sector as well as establishing partnering arrangements with specialist providers of information, diagnostic advice and support, including the KTNs and Centre of Excellence. This will help ensure that support is tailored and delivered in a way that meets the needs of companies in the sector.

> *Recommendation 9: Business Support Schemes*
>
> ***The IB-IGT recommends that the scope of any new business support schemes should be defined in a way that does not exclude or impede IB, and that existing funding schemes that may unintentionally exclude or marginalise IB be modified to remove this blockage.***

Solutions for Business consists of around 30 support products and services covering a range of advice, loans and grants that will be provided by all levels of government – nationally, regionally and locally. They are a mixture of existing and new products, combining the best of government support. All products are underpinned with a robust economic rationale for government intervention.

Solutions for Business is designed to help companies in all sectors address common business issues and help companies at different stages of growth. For example, a start-up IB company could benefit from a combination of products such as Starting a High Growth Business, Understanding Finance for Business and Grant for Research and Development. Larger companies can also get help in areas such as skills, exporting, innovation and investment.

Evidence of market failure would be required to broaden the scope of this product to support demonstration activities beyond the energy sector.

By 2010, the Solutions for Business product portfolio will be the only government support products business will see. On-going monitoring and evaluation will make sure

products continue to work for business and deliver the intended outcomes. If for any reason circumstances change, there is flexibility in the system to modify, add or take away products in the future.

The Department for Business, Innovation and Skills will consider any cases identified by the IB Leadership Forum of Solutions for Business products unintentionally excluding or marginalising the application of IB.

Recommendation 10: Knowledge transfer

The IB-IGT recommends that a 'sector expert' be based within the IB Leadership Forum.

The Government accepts and endorses this recommendation.

The Technology Strategy Board has suggested that the "sector expert" be based within the KTNs (and report to the IB Leadership Forum), potentially a 50:50 joint position between the Bioscience and Chemistry Innovation KTNs, perhaps as part of a proposed initiative to encourage the use of biobased processes to the chemical and chemistry-using industries.

Subject to funding, the Technology Strategy Board's Bio2Chem (B2C) scheme is a knowledge transfer activity providing seed money for chemistry-using companies to consider bio-based alternatives to their processes through desk bound or small feasibility projects. Positive outcomes could lead to further activities such as Collaborative R&D, Collaborative Awards for Science and Engineering (CASE) or a Knowledge Transfer Partnerships (KTP) application. The likely current coordinators of this knowledge transfer activity would be the Bioscience KTN and the Chemistry Innovation KTN.

Recommendation 11: Overseas promotion of UK expertise

The IB-IGT recommends that UKTI, in conjunction with the IB Leadership Forum, undertakes a co-ordinated approach to promoting UK IB capability and infrastructure overseas from 2010 onwards.

The importance of IB is recognised in the UK Life Sciences Strategy. The promotion of this capability overseas is the accepted responsibility of UKTI and they welcome working in partnership with the IB Leadership Forum to take this forward. In light of mutual interests, a formal link between the IB Leadership Forum and the UKTI Strategy Board needs to be considered.

IB-IGT's work, to which UKTI have contributed, provides an excellent platform to develop key selling messages about UK capability and assets. UKTI will deploy its IB specialist and other relevant expertise, as appropriate, in support of this work and will consider, over time, further building its capability in this area.

Extending industry engagement in retaining and developing interdisciplinary talent in science and management

Recommendation 12: Interdisciplinary talent

The IB-IGT recommends that the Research Councils, EPSRC and BBSRC, the professional institutions in chemical engineering, chemistry and biology, the Sector Skills Councils, SEMTA and Cogent, should continue to work together to develop a joint strategy by the end of 2009 for the provision of IB skills; and ensure the pipeline of talent is captured.

The Government agrees that collaborative working between these different bodies is desirable on interdisciplinary themes such as IB.

The work of the relevant Sector Skills Councils (SSCs) in support of the Bioscience and Pharmaceuticals sectors is an issue that the UK Commission for Employment and Skills is considering as part of its current work to make recommendations to Government on the re-licensing of SSCs. The two main SSCs concerned, Cogent and Semta, were both re-licensed in May 2009.

There are a number of initiatives underway that are valuable but need to be brought together with other professional bodies and be included in the oversight of the IB Leadership Forum.

Semta and Cogent agree that it is important that Semta, Cogent and where appropriate other SSCs support the IB-IGT work and recommendations. Key examples of joint working in this regard include:

- Semta already has a Bioscience Sector Strategy Group which is being broadened to include IB representation. Cogent are already a member of this group as are BBSRC, Association of the British Pharmaceutical Industry, BioIndustry Association, Prospect (Trade Union), the Department for Business, Innovation and Skills and key industrialists from the Pharmaceutical and Bioscience and Biotechnology sectors.
- Semta has already produced a comprehensive Sector Skills Agreement (SSA) which has strong synergy to the issues and recommendations already identified in the IB-IGT report, so we need to be careful to maximise outcomes.
- Semta along with other SSCs are leading on the development of the new 14 to 19 Science Diploma. Cogent has a significant lead role with regard to Higher Education Institutions (HEI) consultation and future curriculum development in science that underpins bioscience.
- In addition to the above Semta has established a Science Cluster and Forum to focus on the very issues emerging from IB-IGT. Cogent are leading the HE Group on behalf of the Science Cluster of SSCs and will be drafting a strategy and action plan for increasing SSC influence with HE.

- Cogent has successfully led a £3 million Higher Education Funding Council for England (HEFCE) bid for foundation degree frameworks for workforce development in science, including Bioscience. Semta is collaborating with Cogent on the Bioscience strand.

EPSRC and BBSRC acknowledge this recommendation but it may be difficult to meet the end-of-2009 deadline for a joint strategy with SEMTA and Cogent. However, both Councils will endeavour to interface more closely with the SSCs in order to ensure that our overall policies are joined up and address areas of national need.

Indeed, Cogent has suggested the possibility of setting up a formal mechanism between the SSCs, Research Councils and professional institutes to close the demand-supply skills loop for IB, and the professional institutes could take a lead in co-ordinating academia and industry.

The plans laid out in EPSRC's and BBSRC's Delivery Plans (2008-11) for investment in high-quality interdisciplinary and 'demand-led' training will enable the UK to meet challenges facing a complex industry such as IB. These plans include the use of flexible Doctoral Training Grants to facilitate interdisciplinarity and co-funding of training with industry. More information on these plans can be found on their respective websites:

EPSRC:

http://www.epsrc.ac.uk/Publications/Corporate/DeliveryPlan2008-11.htm

BBSRC:

http://www.bbsrc.ac.uk/publications/policy/bbsrc_delivery_plan.html

Recommendation 13: Interdisciplinary talent

The IB-IGT recommends that industry works with EPSRC, BBSRC, academia and the professional institutions to develop and fund a new taught MSc, MRes or similar type of programme for co-development of advanced practical skills in IB.

The Government supports this recommendation and recognises the value of closer work with the relevant professional bodies to develop sustainable capacity in the research community and ultimately in industry. We are looking to build on existing work by the Research Councils and models in other areas in this regard.

BBSRC will include IB as a specific priority in its 2009 Masters Degree funding competition, inviting proposals from the academic sector for Masters Degrees which demonstrably meet industry needs. BBSRC also funds the development of postgraduate Continuing Professional Development modules which are aligned to the up-skilling of the existing workforce, and would welcome proposals developed in collaboration between industry and academic centres of excellence. Details of its Modular Training for Industry scheme can be found at:

http://www.bbsrc.ac.uk/business/training/modular_training.html

EPSRC has invested £44 million in Knowledge Transfer Accounts. It was noted that none of the successful institutions included masters training as a component of their business case. As a Research Council, it has chosen to fund masters as an element of doctoral training, or as a way of exploiting research, but does not fund proposals for masters training that do not address these objectives and research career development. Details of EPSRC policy on masters training can be found at:

http://www.epsrc.ac.uk/Content/News/SupportForMastersTraining.htm

Furthermore, the Government encourages academia and industry to liaise closely over the design of appropriate courses to ensure that students receive training which both meets industry needs, and exposes them to cutting-edge thinking in this area. The IB Leadership Forum would be an appropriate mechanism to help design and review MSc provision and progress other activities in this area.

Additionally, the Department for Environment, Food and Rural Affairs is currently doing something similar through a Masters support programme focussed on the waste and resources research community with some 14 universities having taken part in the programme to date.

Recommendation 14: Industry engagement

The IB-IGT recommends that industry works with the EPSRC, BBSRC and Higher Education Institutions to identify additional mechanisms for co-funded post-doctoral researchers to allow UK Centres of Excellence to compete effectively with equivalents in the EU.

The Government will continue to build on the good work of the EPSRC and BBSRC which already supports postdoctoral researchers through responsive mode grants. The Research Councils will encourage key UK centres of excellence to submit grant applications with additional support from industry, either via cash or in-kind contributions.

In April 2009, Research Councils UK and Universities UK published the results of an independent review[5] of the "Impact of Full Economic Costing on the UK Higher Education Sector". The Review, which sought views from business and industry as well as academia, demonstrated that the objectives of full Economic Cost (fEC) are, in general, being met and that the principle of fEC was well-founded. It makes a number of recommendations intended to improve the operation of fEC. In taking these forward, consideration will also be given to the comparative international competitiveness of UK institutions, and any further actions which may be appropriate.

5 http://www.rcuk.ac.uk/review/fec/default.htm

Creating a supportive 'public' and 'business' environment for IB in the UK

Recommendations 15-17: Standards

The IB-IGT recommends the endorsement, and recommended adoption, of:

- *PAS 2050 for lifecycle GHG emissions as the standard methodology for assessing lifecycle greenhouse gas emissions in goods and services;*
- *Carbon Calculations over the Life Cycle of Industrial Activities (CCaLC) as the preferred toolkit for the calculation of a product's carbon footprint[6]; and*
- *a standard for calculating the bio-based content of a product.*

The Government welcomes the IB-IGT's support for the take-up of PAS 2050 as the methodology for measuring Greenhouse Gases (GHG) emissions across the lifecycle. The methodology published last October gives businesses a strong framework to make robust and transparent assessments, on a consistent basis.

The Department for Environment, Food and Rural Affairs and the Carbon Trust actively supported the development of this methodology by British Standards Institution and are promoting its use in manufacturing, supply chain and other operations.

The Government would like to see the experience of developing PAS 2050 being used to inform wider international developments on carbon footprinting. The UK is therefore actively involved in international steering groups of the WRI[7]/WBSCD[8] Product and Supply Chain Initiative and ISO carbon footprint of products standard.

The Department for Environment, Food and Rural Affairs is also working with the Carbon Trust and others to use case studies and other research to inform a revision of PAS 2050 (due early 2010) and relevant guidance.

By working through the IB Leadership Forum, we can agree the most effective ways of promulgating the methodology across the sector/industry. The 'CCaLC' project, which is still in progress, is a very welcome initiative to develop tools and supporting databases which can work at a practical level for specific sectors/industries. The Government is keen to encourage common approaches, through initiatives of this kind, at a sectoral level – subject of course to their meeting wider industry norms, where they exist at UK or international level.

The European Union's Lead Markets Initiative (LMI), was set up in 2008 and aims to accelerate the development of new markets within the European Union with 'high economic and social value'. In accordance with the LMI action plan, European Union Working Groups have begun to consider setting internationally accepted standards for biobased products under the European Committee for Standardisation (CEN). The UK is participating in this work through the National Non Food Crops Centre. Latest

6 Subject to trialling and confirmation that CCaLC is compliant with PAS 2050

7 World Resources Institute

8 The World Business Council for Sustainable Development

findings are looking at the scope to devise standards for bio-based content based on detecting levels of Carbon14 in bio materials.

> *Recommendation 18: Reviewing the impact of existing incentives*
>
> *The IB-IGT recommends that, where areas of concern are raised by industry, with supporting evidence, new and existing obligations and incentives be reviewed by the Government with a view to addressing any identified unintended consequences blocking the application of IB to high-value chemical usage; and, where appropriate, this evidence be used to raise relevant issues with the European Commission where the Commission holds the mandate.*

The Government acknowledges that, in some cases, there are competing demands for bio-based inputs, including feedstocks, and agrees that it must evaluate and monitor any evidence that suggests an existing policy is blocking the application of IB to high value chemical usage.

The Government will consider the different competing demands for biomass, and assess each application against a common objective of reducing GHG emissions in a cost-effective way. For example the report has already recognised that there are market opportunities and benefits in using IB to deliver a wide range of goods, including renewables such as ethanol and biodiesel. The Government believes that biofuels have the potential to deliver approximately 338 to 371 million tonnes of annual carbon dioxide savings. Transport is responsible for about 20 per cent of global GHG emissions, and we cannot afford to ignore a proven technology that can offer potential CO_2 savings on this scale.

There will be cases when spill-over effects of a policy are unavoidable – such as the need to introduce a levy on the fossil fuels suppliers for the forthcoming Renewable Heat Incentive. However, there will also be instances where steps may be possible to minimise or limit these impacts if sufficient evidence is made available to illustrate that preventative measures can be taken while still ensuring that our stringent renewable energy targets remain viable. For example the Department of Energy and Climate Change has committed to intervene on the impacts of the Renewables Obligation on users of tallow.

The IB-IGT Report also questions certain policies that have been agreed by the European Union as a whole. UK obligations and incentives for biofuels and biomass need to be compliant with the European Union's Renewable Energy Directive (RED). It is not expected that the UK will be able to change its biofuels obligations and incentives in isolation of other EU Member States.

The IB-IGT Report requests that, if appropriate, the Government should raise awareness of the issue with the European Commission. The Government will endeavour to raise any evidence provided on the unintended consequences of a policy with the European Commission and other European partners. For example, the Government responded to the "Gallagher Review of the indirect effects of biofuels production" by lobbying the European Commission to develop sustainability criteria

to address the indirect effects on land use and had a clause inserted in the Directive requiring a review of the GHG savings of tallow.

Recommendation 19: Public procurement

The IB-IGT recommends that the Government accepts and includes the role bio-based products, and products made via bioprocesses, can play in delivering sustainable public procurement across the Government Estate, and specifically acts by spring 2010 to:

- *Develop an evidence base to identify and quantify the potential of bio-based products in terms of their contribution to reducing the Government Estate's carbon footprint, GHG emissions and overall sustainability (including lifecycle analysis, carbon foot-printing and bio-based content calculations[9]);*
- *Adopt a whole lifecycle approach to decisions related to Government Estate and procurement policy;*
- *Identify where the opportunities lie for Government to lead by example through procuring, and stimulating innovation in, bio-based products and processes; and*
- *Integrate with and seek to influence the work on sustainable procurement in the European Commission, such as the Lead Market Initiative for bio-based products, the call for proposals to support lead markets public procurement networks[10], the Strategic Energy Technology (SET) Plan, and the Sustainable Consumption and Production (SCP) and Sustainable Industrial Policy (SIP) Action Plan.*

The Government strongly encourages the development of sustainable, low carbon materials, products and fuels which can contribute towards meeting climate change related targets and other environmental goals, as well as bringing new economic opportunities through the creation of 'green' jobs in rural and urban areas, and helping develop the UK science and innovation base. More specifically, the Government accepts that bio-based products, and products made via bioprocesses, could have a role to play in enabling it to deliver on sustainable public procurement commitments across the Government Estate.

Building evidence

The Department for Environment, Food and Rural Affairs and the Department of Energy and Climate Change work together on evidence collection for bio-based products and related technologies. As part of its efforts to build more comprehensive evidence on which to base policy decisions, The Department for Environment, Food and Rural Affairs is seeking further understanding on the environmental impacts, across the product lifecycle, of a range of bio-plastics. These have been promoted as a more sustainable alternative to conventional plastics on the basis of being

9 This recommendation is linked to the IGT's recommendation on Standards

10 http://ec.europa.eu/enterprise/leadmarket/public_procurement_networks.htm

either derived from renewable resources or having biodegradable and compostable properties.

The Department for Environment, Food and Rural Affairs has commissioned two complementary studies on bio-plastics over the coming months. The first aims to assess the environmental effects of bio-plastics across their lifecycle and determine the specific situations where bio-plastics are likely to offer the greatest benefits (environmentally, socially and economically). The second is focused on oxy-degradable plastics, a range of polyethylene or polypropylene polymers, which have additives that are designed to accelerate the degradation process. This project aims to establish the environmental credentials of the material by determining the extent to which it breaks down after disposal.

The Department of Energy and Climate Change is continuing to collect some evidence for products under the remit of the Non-Food Crops Strategy Action Plan which forms part of the UK Biomass Strategy. Where relevant, the outputs of this work will be fed into The Department for Environment, Food and Rural Affairs or wider Office for Government Commerce sustainable product data bases and procurement guidance. A review of the Non-Food Crops Strategy Action Plan is expected to commence later this year and will inform the future direction of evidence collection on bio-based products, taking into account the recommendations of the IB-IGT.

Adopting a LCA approach

The Department for Environment, Food and Rural Affairs, in co-operation with Office for Government Commerce and other Government Departments, sets minimum, mandatory and voluntary best practice environmental specifications for procurers in central Government Departments and their executive agencies, through the 'Buy Sustainable – Quick Wins' initiative. These standards are developed, and regularly updated, following cost-benefit analyses and market capacity evaluation, in order to identify criteria which reduce the environmental impacts of government operations, whilst taking account of 'value for money' considerations. Such assessments are conducted on a life-cycle basis, meaning the durability and energy efficiency of products, for instance, are considered in addition to the initial capital cost. Whole life-cycle assessment is recognised in the Treasury's Green Book as the appropriate means of assessing the financial costs and benefits of a product.

Leading by example and stimulating innovation in bio-based products

The Department for Business, Innovation and Skills is working closely with Office for Government Commerce in taking forward work on innovation procurement in order to ensure a link into the wider public procurement agenda. A key activity is the development of Innovation Procurement Plans by Government Departments to set out how they will encourage innovation through procurement processes and practices. The plans will help departments identify opportunities for innovation.

Office for Government Commerce and the Department for Environment, Food and Rural Affairs are engaged in the work the Department for Business, Innovation and

Skills is leading on Forward Commitment Procurement (FCP). The FCP model provides a practical and proven means to enable public sector organisations to stimulate and harness innovation for the public good and achieve a step change in environmental performance. It does this by transforming the market for innovative and sustainable solutions, making new and emerging solutions more affordable and widely available, and providing a way for the public sector to manage the risk of procuring innovative products and services.

Following successful pilots with the Department of Health and Ministry of Defence last year, the Department for Business, Innovation and Skills and the Technology Strategy Board are leading the roll out across Government of the reformed Small Business Research Initiative (SBRI). SBRI provides an opportunity for SMEs in particular to develop new products and services in response to a defined need of a public sector organisation – overcoming healthcare associated infections in the case of the Department of Health pilot.

Furthermore, one of the main intentions of the 'Buy Sustainable, Quick Wins' initiative is to drive the market towards more sustainable production and consumption practices. It is hoped that setting increasingly challenging environmental standards for suppliers, through procurement procedures, will stimulate demand in sustainable products and services, promote innovation, and enable the Government to lead by example.

Contributing to sustainable procurement in a European context

The Department for Business, Innovation and Skills is the lead co-ordinating department for the Lead Market Initiative (LMI) work in the UK. The Department of Energy and Climate Change is working closely with the Department for Business, Innovation and Skills, particularly on the bio-based products, renewable energies and sustainable construction areas, providing policy input on issues such as bio-plastics, bio-lubricants and renewable construction products and technologies, and feeding into Brussels ad-hoc advisory groups on bio-based products and other issues. The Department of Energy and Climate Change has also worked to engage industry with the LMI, ensuring the interests of the UK's renewable materials sector are presented.

The aim of the initiative is to reduce barriers and costs for firms in bringing new and competitive products to market. Key to this is encouraging competition between different products; it is not a funding initiative or a mechanism for picking specific technologies.

The Department for Environment, Food and Rural Affairs and Office for Government Commerce are continuing to work together in negotiating with the European Commission on its work on Green Public Procurement to ensure alignment with wider policies on sustainable development, product standards and public procurement.

The Department for Environment, Food and Rural Affairs has also submitted a bid under the European Union LMI on Public Procurement Networks, as part of a consortium co-ordinated by ICLEI[11]. The proposal submitted to the European Commission focuses on the area of sustainable construction but there are intentions

11 International Council for Local Environment Initiatives

to further investigate the potential, and promote the use, of bio-based products within the construction sector should this bid be successful.

Recommendation 20: Land use

The IB-IGT recommends that IB is considered as a value-creating demand factor when developing a strategy for managing sustainable land use in the context of intensification of demand for all purposes.

The Government Office for Science's Foresight Land Use Futures Project, is drawing on the work of academics across the disciplines, policymakers and a wide range of land use practitioners and agencies to develop an evidence base which will support long-term thinking about strategic land use issues. The demands being made on land are growing and a careful balancing act will be needed. Foresight welcomes the IB-IGT Report's recognition that the long-term economic, environmental and social implications will need to be carefully studied if unintended consequences are to be avoided. Foresight will examine the long-term sustainability of existing and possible land use patterns against scenarios to 2060.

Foresight works across Government, supporting strategic thinking and helping departments to formulate innovative policies. The analysis produced by Foresight will provide a broad framework for policymakers, highlighting the potential risks and opportunities of land use change. The project is led by the Government Chief Scientist, Professor John Beddington, and is sponsored by the Department for Environment, Food and Rural Affairs and Communities and Local Government. Central Government Departments such as Her Majesty's Treasury, Department for Transport, Department for Energy and Climate Change, Department for Business, Innovation and Skills, Department for Culture, Media and Sport and the Cabinet Office, and the devolved administrations, are contributing to the project. The findings are due to be published in a report in early 2010.

Whilst taking an over-arching approach to analyse the competing demands for land, as in the Land Use Futures Project, the Government acknowledges that we must also analyse the specific production pathways to ensure there is no harmful indirect land use change. For example, on biofuels, the Government intends to push as hard as possible for even more robust Europe-wide indirect sustainability standards to ensure feedstock production does not displace agricultural activity in a way which causes deforestation or food insecurity.

Recommendation 21: Public perception

The IB-IGT recommends that Government, industry*, Research Councils, NGOs, and professional institutions should develop an effective, balanced and informative communication strategy, including stakeholder and public engagement, for IB.

**** this will include brand owners and retailers***

The IB-IGT commissioned a project under the Government's Sciencewise Programme to look at the *Public Perceptions of Industrial Biotechnology*. This work identified that the main initial barrier to public acceptance of IB is a lack of knowledge or

understanding of such new technologies. However, as the IGT reports, the study also found that providing clear, balanced information helps to a large extent to increase consumer confidence and generate support for IB. This recommendation picks up the main conclusion of the study and the need for further work.

The Government recognises the importance of public engagement but it cannot do this in isolation. To ensure success, any communications strategy will need both the buy in and collaboration from a number of stakeholders, and would need to cover a wide range of applications. As the IB Leadership Forum will have the relevant representatives, it should have responsibility for developing the communications strategy and facilitating engagement with NGOs, brandowners, consumer groups, retailers and the wider public. EPSRC is currently considering including the area of IB as a next topic of discussion for the Societal Issues Panel (SIP). Chaired by Professor Lord Robert Winston, SIP aims to help EPSRC take more account of public thinking when deciding how to spend the money it invests in research. The Panel also provides advice to EPSRC on how to identify emerging social and ethical issues relevant to engineering and the physical sciences.

EPSRC and BBSRC have already worked closely together on aspects of public engagement around nanotechnology, and are currently co-leading for the Research Councils (through SIP and BBSRC's Bioscience for Society Panel) in the area of Synthetic Biology. The Councils will seize opportunities to add value by bringing together their public engagement activities in their respective areas of IB, and to build on this previous and existing work and its outcomes.

IB is an underpinning technology – not a sector in its own right – and has parallels with nanotechnology. Indeed in the future as synthetic biology is developed as a new IB tool it will have similar societal issues and will need to take further account of public engagement. The IB Leadership Forum should consider the experiences in nanotechnology communications as a model of best practice – this also involved multi-stakeholder community, academics, business, government and NGO engagement.

Conclusions

Industrial Biotechnology (IB) is a generic technology that provides both new market opportunities to companies and, contributes to the Government's wider agenda on low carbon manufacturing and climate change.

The Government needs to ensure industry is in a position to seize the opportunities for economic development offered by the move to a more bio-based economy both to develop new business but also to maintain the UK's competitiveness in global markets, where bio-based systems and processes are rapidly gaining strength and scale. IB also provides a sustainable, commercially viable route for the UK out of its dependence on fossil fuels.

The Government welcomes the robust economic evidence gathered by the IB-IGT in support of its recommendations. The estimates for the global IB market by 2025 range from £150 billion to £360 billion and similar estimates for the UK IB market range from £4 billion to £12 billion support the case presented.

The IB-IGT Report identifies the UK's strong capability in IB research and technology development in the area of high-value low-volume chemicals and identifies the potential to create a substantial market opportunity in this area. However, it identifies a number of barriers to IB uptake and realisation of the economic benefits where Government support can help to build on existing activity to deliver new industries and new green jobs.

The Government has welcomed these recommendations and through this response set out how Government as a whole intends to respond to these challenges and ensure that the UK capitalises on the economic and environmental benefits IB presents.

ANNEX A Recommendations of the IB-IGT Report 2009

Recommendation 1: IB Leadership Forum

The IB-IGT recommends that an overarching industry/Government Leadership Forum be established by autumn 2009. This Forum would have ownership of the IB-IGT recommendations, power to oversee implementation, and responsibility for assessing and reviewing new ideas and opportunities.

Recommendation 2: IB Leadership Forum

The IB-IGT recommends that the Leadership Forum be responsible for raising awareness in the private and public sectors regarding the capabilities and potential of IB; as well as leading on the long-term development and promotion of IB into new and existing supply chains.

Recommendation 3: Demonstrator facilities

The IB-IGT recommends the development of an open access demonstrator facility, particularly for fermentation (up to 10 tonne capacity), with associated upstream and downstream facilities by 2010.

Recommendation 4: Demonstrator fund

The IB-IGT recommends that an IB fund (of £2.5-5 million per year for 3-5 years) should be established by the end of 2009 to allow industry, particularly SMEs, access to demonstration facilities.

Recommendation 5: Improving access to existing demonstration funds

The IB-IGT recommends that the Government should improve access to demonstration funds by broadening the remit of existing commercial-scale demonstration funds to ensure that IB is included within the scope of eligible technologies.

Recommendation 6: Building on UK expertise

The IB-IGT recommends that the Technology Strategy Board, EPSRC and BBSRC work together to support a single, virtual, centre of excellence in IB research and development that will capitalise on, and augment, existing academic centres where

biologists, biotechnologists, chemists, chemical engineers and other relevant disciplines are co-located.

Recommendation 7: Building on UK expertise

The Technology Strategy Board, EPSRC and BBSRC should work together through joint calls to ensure that the UK's world leading science base in genomics fermentation, biocatalysis, plant science, marine organisms and mycology is effectively developed and translated into IB applications.

Recommendation 8: Business Support Schemes

The IB-IGT recommends that the availability and uptake of general business support schemes is facilitated by providing a single point of contact, by the end of 2009, which can give clearer signposting to schemes relevant to IB companies.

Recommendation 9: Business Support Schemes

The IB-IGT recommends that the scope of any new business support schemes should be defined in a way that does not exclude or impede IB, and that existing funding schemes that may unintentionally exclude or marginalise IB be modified to remove this blockage.

Recommendation 10: Knowledge transfer

The IB-IGT recommends that a 'sector expert' be based within the IB Leadership Forum.

Recommendation 11: Overseas promotion of UK expertise

The IB-IGT recommends that UKTI, in conjunction with the IB Leadership Forum, undertakes a co-ordinated approach to promoting UK IB capability and infrastructure overseas from 2010 onwards.

Recommendation 12: Interdisciplinary talent

The IB-IGT recommends that the Research Councils, EPSRC and BBSRC, the professional institutions in chemical engineering, chemistry and biology, the Sector Skills Councils, SEMTA and Cogent, should continue to work together to develop a joint strategy by the end of 2009 for the provision of IB skills; and ensure the pipeline of talent is captured.

Recommendation 13: Interdisciplinary talent

The IB-IGT recommends that industry works with EPSRC, BBSRC, academia and the professional institutions to develop and fund a new taught MSc, MRes or similar type of programme for co-development of advanced practical skills in IB.

Recommendation 14: Industry engagement

The IB-IGT recommends that industry works with the EPSRC, BBSRC and Higher Education Institutions to identify additional mechanisms for co-funded post-doctoral researchers to allow UK Centres of Excellence to compete effectively with equivalents in the EU.

Recommendation 15: Standards

The IB-IGT recommends the endorsement, and recommended adoption, of PAS 2050 for lifecycle GHG emissions as the standard methodology for assessing lifecycle greenhouse gas emissions in goods and services.

Recommendation 16: Standards

The IB-IGT recommends the endorsement, and recommended adoption, of Carbon Calculations over the Life Cycle of Industrial Activities (CCaLC) as the preferred toolkit for the calculation of a product's carbon footprint[12].

Recommendation 17: Standards

The IB-IGT recommends the endorsement, and recommended adoption, of a standard for calculating the bio-based content of a product.

Recommendation 18: Reviewing the impact of existing incentives

The IB-IGT recommends that, where areas of concern are raised by industry, with supporting evidence, new and existing obligations and incentives be reviewed by the Government with a view to addressing any identified unintended consequences blocking the application of IB to high-value chemical usage; and, where appropriate, this evidence be used to raise relevant issues with the European Commission where the Commission holds the mandate.

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- Adopt a whole lifecycle approach to decisions related to Government Estate and procurement policy;

12 Subject to trialling and confirmation that CCaLC is compliant with PAS 2050

13 This recommendation is linked to the IGT's recommendation on Standards

- Identify where the opportunities lie for Government to lead by example through procuring, and stimulating innovation in, bio-based products and processes; and
- Integrate with and seek to influence the work on sustainable procurement in the European Commission, such as the Lead Market Initiative for bio-based products, the call for proposals to support lead markets public procurement networks[14], the Strategic Energy Technology (SET) Plan, and the Sustainable Consumption and Production (SCP) and Sustainable Industrial Policy (SIP) Action Plan.

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