The Policy Measures Working Group Final Report

The Policy Measures Working Group has addressed how Government and industry can create an encouraging and enabling political and economic framework to catalyse the growth of the market for IB produced products, IB process solutions to societal needs, and IB technologies.

Realising the potential of Industrial Biotechnology (IB) can contribute to Government aspirations about sustainable growth and UK competitiveness specifically through contributions to the UK's ability to live within environmental limits; and achieve a sustainable economy. The UK's Low Carbon Manufacturing Strategy should have IB as one of its key strengths. IB can also help the Government meet its existing requirements, Green house gas emission reductions through action in the UK and abroad of at least 80% by 2050, and reductions in CO_2 emissions of at least 26% by 2020, against a 1990 baseline as outlined by the UK Climate Change Act 2008[1].

A report commissioned by the BERR[2] for the IGT concluded that the indications are that there is potential for primary energy and GHG savings from IB products, processes and technologies; particularly for integrated processes where the waste biomass is fermented into a fuel.

Moreover, IB shows considerable potential within the chemistry-using sector of manufacturing by:

- Enabling more-sustainable manufacturing processes for a range of materials such as chemicals, through;
    - Biocatalysts that reduce the consumption of energy and water in the manufacturing process and which reduce both the quantity and environmental burden of process
    - Improved effluent treatment
    - Enhancing the ability to use renewable biomass feedstocks for chemicals in preference to fossil-derived raw materials (partially in the context of biorefineries.
- Offering real prospects for novel high performance, high value products that are either not possible or not viable from conventional chemical processes.

The technical advances that IB represent are sufficiently compelling that the predicted markets for IB are significant:

The 2007 paper En-Route to the Knowledge-Based Bio-Economy[3] sees biotechnology - including biomaterials and bioprocesses, bioenergy, biomedicine and emerging technologies - as a key pillar of Europe's economy by 2030. It also suggests that one-third of chemicals and materials will be produced from biological sources, including biopolymers and bioplastics by 2030.

McKinsey and Co estimated[4] value of the novel global market by 2030 is US$300 billion; and; predicted that by 2010, €125bn worth of chemical sales will involve

[1] http://www.defra.gov.uk/environment/climatechange/uk/legislation/
[2] Study into the Potential Energy and Greenhouse Gas Savings of Renewable Chemicals and Biocatalysts
[3] http://www.europabio.be/articles/cologne_paper.pdf
[4] McKinsey & Co - White Biotechnology: Gateway to a More Sustainable Future

the use of biotechnology – this figure was already €77bn in 2005 (a 7% share) and up from €53bn in 2000.

However, in order to exploit the potential of IB in the UK and enjoy its impact on sustainability and economic output, there are barriers and issues that need to be addressed. Dealing with these will both better position UK companies to leverage and generate IB wealth-creation opportunities and accelerate the adoption of IB within the UK.

The Policy Measures Working Group has identified the key outcomes that will make a real difference to the extent and speed of IB uptake in the UK and has recommended a framework of policy objectives and delivery mechanisms that should work to solve or ameliorate the identified issues

The issues, outcomes, policy objectives and policy delivery mechanisms are set out below.

The Policy Measures Working Group recommendations

Taking a lead in communicating the benefits of, IB

There is only limited familiarity with IB even in the Chemistry-using industries where there is great promise for its application. Likewise those working to further develop IB products and processes have as yet an incomplete understanding about which sectors and companies may best benefit from their technology. Additionally, the opportunities that IB could bring to strategies for the development of the manufacturing, sustainability and competitiveness in the UK are not fully visible to policy makers in Government and in business who could deploy them.

This lack of familiarity and understanding is acting as a brake on the diffusion and uptake of IB technology in the UK. Hence, there is a need to promote the wider benefits of IB more generally and foster greater advocacy of IB across academia, the public, industry, and Whitehall. As well as developing trusted governance arrangements and consistency across Whitehall towards IB.

This recommendation is aimed at joining up the various sources of information and expertise to provide one authoritative 'voice' to and from the industrial biotechnology sector.

Issue	Objective (s)	Delivery	Outcome
An under-developed appreciation of the potential for IB in the UK and limited awareness of how businesses and individuals can find out more	To provide a coherent voice across the IB developer and user sectors by September 2009 The strategic alignment of IB's potential in the low carbon manufacturing strategy by policy makers Greater awareness by the public of the importance of IB in a low carbon society	Industry bodies, networks and clusters come together to deliver the industry strategy for IB Through the development of a sustained and long-term 'forum[5]' (to present a single outward face to the private and public sectors regarding the needs, capabilities and potential of the respective sectors (IB and Chemical-Using Industries [CUI])[6]) Proposed approaches for this forum include: • 3-yearly cycle for strategy refresh • Champions (Ministers and Business) are nominated and supported in the role • The development [and the publicity] of iconic products, processes and	An authoritative industry strategy for IB that is maintained and continually developed A wider understanding of: • The benefits IB can bring • The industrial contexts in which IB can be successfully deployed • Where to go to find out more about IB

[5] This 'forum' will be a co-ordinated and focussed group drawn from the KTNs, Trade Associations, and clusters organisations active and interested in IB

[6] Note: The PMWG members from the CIA, BIA, BfBKTN, CiKTN, BACS, and IChemE are working up a defined proposal for the structure scope and remit of this 'forum'

		research Government agrees ongoing process with the Strategic Forum	

Skills

Effective exploitation of IB requires specific high level skills at the graduate and post-graduate level. Not only are deep scientific and engineering skills required but also the abilities to understand and link the conventional subject areas of biology, chemistry and chemical and biochemical engineering.

This recommendation is aimed at ensuring that the development of IB is not hampered by a lack of skills and skilled personnel.

Issue	Objective (s)	Delivery	Outcome
The development and exploitation of IB in the UK is considered to be at risk because too few graduates are emerging from our universities with the right blend of skills	The growth of IB is supported by the availability of the right skills base Increasing the effectiveness of private and public spend on IB training by 2010	Transparent and co-ordinated programmes across the EPSRC and BBSRC Iterated New MSc course Increased collaboration and coordination between the Semta and Cogent Industry to promote IB and the best Departments by funding of studentships Endorsement of the STEM agenda from the QCA[7]	The availability of the specific high level skills set required for the commercialisation and development of IB Increased business involvement in studentships, KTps and in design and delivery of MSc studentships increased retention of graduates in science and flow of people with the necessary inter-disciplinary skills into the chemicals sectors

[7] Qualifications and Curriculum Authority - http://www.qca.org.uk/qca_9653.aspx

Standards

One of the fundamental benefits of IB lies in its potential to improve the environmental footprint of many industrial processes. Understanding the degree to which this applies is a vital influence on the adoption of IB technology.

There are manifold current methodologies that attempt to measure this through for example Life Cycle Analysis, carbon footprinting and bio-based content. However, not only can these be complex to apply and interpret, but to date there are no widely accepted and reliable standards. Hence for any IB product or process there remains a lack of precision about its environmental benefits.

Additionally, the BERR study into the potential energy and greenhouse gas savings of renewable chemicals and biocatalysts recommended that a single agreed methodology be identified.

The aim of this recommendation is to set out a clear recommendation for the preferred methodologies for Life Cycle Analysis, carbon foot-printing and bio-based content.

Issue	Objective (s)	Delivery	Outcome
Recognition of, and confidence in, the full environmental benefits of IB is undermined by the absence of widely accepted standards for important measures such as lifecycle analysis (LCA), carbon footprints and bio-based content	By 2010 industry and government have agreed the standard framework for life cycle analysis, carbon footprint and bio-content; communication, training and support will be in place.	The endorsement, and recommended adoption, of PAS 2050[8] as the standard framework for LCA calculations The endorsement, and recommended adoption, of CCaLC[9] as the preferred methodology for the calculation of carbon footprints[10] The endorsement, and recommended adoption, of a standard for calculating the bio-based content of a product[11].	Confidence of suppliers and users in the market is underpinned by 100% acceptance and adoption of appropriate standards and methodologies

[8] Publicly Available Standard 2050 for lifecycle GHG emissions [PAS 2050]
[9] Carbon Calculations over the Life Cycle of Industrial Activities [CCaLC]
[10] Subject to trialling and confirmation that CCaLC is compliant with PAS 2050
[11] In the US, the biobased content is determined by testing to ASTM Method D6866. However, there is no ISO or European standards on "percentage of renewable", the US standard could set an example

The use of financial incentives to encourage, not discourage, the uptake of, and investment in, sustainable IB technology and processes

It is thought that current financial incentives are affecting the investment in IB (through the price and use of feedstocks for example). Additionally, there is a risk that new business support schemes are missing the role IB could have in achieving its overall aims and objectives.

Therefore, there is a need to ensure that there is overall incentivisation for developing, and investing in, sustainable IB technologies.

This recommendation is aimed at ensuring that both incentives and business support schemes are amended or designed to remove any disincentive to invest in IB technologies.

Issue	Objective (s)	Delivery	Outcome
That currently financial incentives discourage and not encourage, the uptake of, and investment in, sustainable IB technology and processes	A supportive policy environment for developing and investing in sustainable IB technologies is created. IB is viewed as a low carbon sustainable technology across Government	Improving the knowledge of existing funding and support schemes through simplification and promotion. Highlighting and recommending modifications to any "blockers" to IB identified in existing incentives and obligations Ensuring the scope of any new business support schemes should be defined in a way that does not exclude or impede industrial biotechnology.	The policy environment in the UK encourages the development of, and investment in, sustainable IB technologies and is funded appropriately IB is included under the Environmental Transformation Fund

De-risking access to new products and technologies

Long-term funding R&D to allow the development of centres of excellence with critical mass and self-sustaining capability is considered essential. There is also a need to ensure that the right support is in place to support those wishing transform a new IB process into a viable business. The funds and schemes currently present a complex picture to prospective applicants. Companies may be unaware of many of the sources of funding, or smaller companies may simply be unable to resource the task of interfacing with them

Furthermore, reducing the level of risk throughout the IB innovation process is an important criterion influencing increased adoption of IB routes to products. Whereas small-scale proof of concept fermentation and product recovery equipment exists and is available on an open access basis at a number of centres, when scale up is necessary there is only a very limited availability of pilot scale fermentation equipment and the associated suite of product recovery options. Coupled to this is a particular funding gap at the point where companies need to demonstrate their product or process at commercial scale.

Finally, the high capital cost of large plant [$200m-$500m] has been identified as a potential issue for the future development of industrial biotechnology

This recommendation is aimed at ensuring that the long-term development of IB products and processes is adequately funded and resourced.

Issue	Objective (s)	Delivery	Outcome
Ensuring access to funding streams for R&D and business support in IB	Business has access to integrated centres of excellence, with access to advice and funding to develop new IB products and processes UK's science base is exploited and commercialisation opportunities developed	The development of centres of excellence with critical mass and self sustaining capability Capitalising on existing academic centres with biologists, biotechnologists, chemists, chemical engineers etc co-located The Technology Strategy Board, EPSRC and BBSRC working together to resolve key cross-disciplinary science and skills challenges and to support translation of IB to downstream sectors Improving the availability of existing funding and support schemes through simplification and promotion Improving the dialogue between the UK knowledge base and industry about needs, research capability, inventions/IP and infrastructure; the responsibility for this should be shared by industry and academia. • Proposed that this recommendation be carried out by setting up a by a specialist unit, through a competitive process	The UK continues to build- upon its internationally renowned research and knowledge base to develop the full range of technologies and mechanisms required to capitalise on the opportunities Industrial Biotechnology presents Acceleration of innovation and knowledge transfer from academia to SME biotechnology companies and on the chemicals and chemistry-using sectors

Poor access to demonstrator facilities is a major hurdle the development on new IB products and processes	Companies are able to demonstrate their product or process at commercial scale and attract investment UK's infrastructure is better co-ordinated and expanded to take IB concepts to market	Develop a new public/private IB fund to allow industry access to demonstrators Provision of a national flexible "GTT" demonstrator facility with capacity to go from "Genes To Tonnes" Government to broaden the remit of existing commercial-scale demonstration funds to ensure that industrial biotechnology is included The development of an open access 0.5 – 10 tonne capacity fermentation capability[12], that builds on existing centres of excellence and equipment[13]	The UK continues to build upon its internationally renowned research and knowledge base to develop the full range of technologies and mechanisms required to capitalise on the opportunities Industrial Biotechnology presents Investors have confidence to back IB processes
The high capital cost of large plant [$200m-$500m] is deterring companies from locating and retaining large plant in the UK	UK policy (including taxation, incentives, regulations, grants) provides adequate incentive for companies to site and retain large plant in the UK	Map policies, tariffs, obligations, grants or schemes against their equivalents in Europe to ensure that the UK provides a stable and competitive investment landscape. Improving the access to, and promotion of, UK research and engineering capability and infrastructure to companies in the UK and overseas[14]	The UK is not at a relative disadvantage when compared to other EU countries Industry confidence to invest in the UK enhanced

[12] The Technology & Manufacturing WG defined the 0.5 – 10 tonne fermentation capacity to mean – fermentation assets with aligned up and downstream process capability for specialty and higher value chemicals

[13] This would provide value for money

[14] The Finance & Investment WG proposed that these recommendations be carried out by an industrial biotechnology specialist within UKTI

Further facilitating the link up and communication between new and existing upstream and downstream supply chains

Effective links within the supply chain and user communities are critical. Future feedstocks for IB products could potentially come from existing sectors as varied as agriculture, marine, food and waste sectors. Therefore links need to be fostered between the IB supply chain (upstream) and potential users (downstream) in both the target chemicals and chemistry-using sectors and new currently unaware sectors.

This recommendation is aimed at ensuring that the task of facilitating the link up is both defined and assigned.

Issue	Objective (s)	Delivery	Outcome
The perceived poor link up and communication between new and existing upstream and downstream supply chains	Collaboration across new supply chains for maximum productivity, profitability and sustainability	The development of the 'forum' set out in the PMWG initial recommendation will have a critical co-ordinating role to play here and ensure that the sectors involved understand the benefits and opportunities of IB. Additional aims are to: • Promote and recognize the potential of industrial symbiosis – in terms of people, resources and equipment • The development of new business models and new supply chains • Encourage the KTNs to create new and expanded networks of users and providers • Extending the UK's existing industrial biotechnology centres of expertise and facilities	UK companies are better positioned to leverage and generate IB wealth-creation opportunities on a global scale

Sustainable Public Procurement

Biobased products, and products made via bioprocesses are often similar to "conventional" products (bioplastic is plastic, biofuel is fuel, biochemicals are chemicals, etc.), and they are often be produced in a more sustainable way.

The UK Government Sustainable Procurement Action Plan highlights that, within the wider context of sustainable development, climate change mitigation and natural resource protection are the highest priorities. The use of biobased products, and products made via bioprocesses has considerable potential to address these priorities.

Public Procurement "pull" provides vital market certainty that can play a catalytic role in encouraging successful commercialisation of innovation. This recommendation is aimed at ensuring that the Government exerts the full potential of public procurement to accelerate the development of new IB products and processes. This requires the Government to accept and proactively increase the role biobased products, and products made via bioprocesses, play in delivering Sustainable Public Procurement across the government estate and in wider public procurement

Issue	Objective (s)	Delivery	Outcome
The potential for public procurement to increase uptake for IB products and processes	Sustainable Public Procurement acts to pull through IB products and processes and encourages innovation in development of new IB products and processes for use in the Government Estate and wider (e.g. NHS, Schools)	That the Government accepts and includes the role biobased products, and products made via bioprocesses can play a part in delivering Sustainable Public Procurement across the government estate, and specifically acts to: • Develop an evidence base to identify and quantify the potential of bio-based products (including LCA calculations) • Identify where the opportunities lie for Government to lead by example and stimulate innovation in and for bio-based products and processes • Integrate and influence this work with work on sustainable procurement in the European Commission, such as the Lead Market Initiative for biobased products, the call for proposals to support lead	The Government commits to procure more sustainably, build capacity and lead by example in achieving their own sustainable operations targets through procurement of biobased products, and products made via bioprocesses Public Procurement "pull through" of IB products and processes accelerates growth of new environmental markets. Government sets standards for intelligent procurement across the public sector

		markets public procurement networks[15], and the Sustainable Consumption and Production (SCP) and Sustainable Industrial Policy (SIP) Action Plan	

Access to genetic manipulation techniques

Whether the need is to increase crop yields or to produce plant variants which express high concentrations of valuable products, it is arguably clear that GM needs to be added to the armoury of techniques available to the plant breeder and developer particularly for innovations linked to industrial product development.

This recommendation is aimed at ensuring that Genetic manipulation techniques are available to researchers, plant breeders, enzyme producers and developers particularly for innovations linked to industrial product development

Issue	Objective (s)	Delivery	Outcome
The availability of genetic manipulation as a tool for the development of feedstocks, biocatalysts and novel micro-organisms	The adoption, by government, of a supportive policy for the application of genetic manipulation technology when aimed specifically at industrial (rather than human) uses of products	The IGT supports the regulatory framework for co-existence, seed thresholds and labelling is completed to allow the use genetic modification as a tool in industrial product development[16].)	Genetic manipulation techniques are available to researchers, plant breeders, enzyme producers and developers particularly for innovations linked to industrial product development in order for the full benefits of IB to be available to the downstream sectors

Land-use management strategy

The issue of the land-use has become critical for the development of industrial biotechnology for a number of reasons, and so needs to be addressed head-on, and strategically. Whether biomass is used for feedstocks for materials and chemicals, or for biofuels, increasing demands for land for these purposes is competing with increasing demand for use for land for food.

The main considerations are land conversion and impacts on global climate change; threats to biodiversity; increased demand for water resources; the

[15] http://ec.europa.eu/enterprise/leadmarket/public_procurement_networks.htm

[16] NOTE: Access for researchers to undertake this kind of basic research is not a problem. However, the regulatory framework for co-existence, seed thresholds and labelling is incomplete (and this alone would be a significant lever in terms of de-risking genetically modified variety development

geographical location of 'available' land; and suitability of land for different agricultural uses. All these issues are controversial and sensitive.

Overall, the issues of land use for biomass for industrial biotechnology need to be addressed. Criteria for sustainability need to be established and implemented in relation to global climate change, biodiversity, and water use, on the one hand, and economic sustainability with regard to competing demands for agricultural uses on the other. Strategic management of land use is necessary to ensure production of food and energy and chemicals and materials from biomass.

This recommendation is aimed at ensuring that the recommendations and their implementation do not have any as yet unforeseen consequences especially in terms of land use.

Issue	Objective (s)	Delivery	Outcome
There could be increased utilisation of land to produce raw materials for biofuels and for IB processes. The estimated direct and indirect impacts of changes in land use should be integrated into the Government's Land-Use Strategy	Policy makers across Government take the potential land use impacts of IB into account	Strategic assessment of land use impact to ensure production of food and energy and chemicals and materials from biomass.	Ensure IB is considered as a value-creating demand factor in developing strategy for managing sustainable land use in the context of intensification of demand for all purposes The recommendations of the IGT do not have any unintended consequences as well as any indirect effects