

Final Report of the Finance Working Group of the Industrial Biotechnology Innovation and Growth Team (IB-IGT)

19th December 2008

Purpose of this Paper

To provide the Steering Group of the IB-IGT with recommendations relating to funding and investment that will enhance the deployment of Industrial Biotechnology in the UK.

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Introduction:

a) Remit of the Working Group

The IB-IGT aims to ensure that the UK provides a supportive and internationally competitive environment for the development of industrial biotechnology. Part of the remit involves looking for ways to leverage the UK's research base and stimulate the effective transfer of industrial biotechnology into the private sector.

The availability of finance and investment was identified by IB-IGT as a potentially significant barrier to the successful development of industrial biotechnology. The Finance and Investment Working Group was established to investigate these issues and determine whether there are, in reality, investment 'gaps' which constrain specifically industrial biotechnology innovation and commercialisation. The group was also asked to consider actions that the private sector and government might take to correct any market failings in respect of industrial biotechnology financing and support in the UK.

b) Setting the Scene.

The Opportunity

The global economy is based on finite reserves of fossil feedstocks of coal, oil and gas. Notwithstanding the impending crisis of depletion of fossil reserves, it is already evident that uncontrolled use is causing serious and damaging climate change. It is generally accepted that there is an urgent need to develop renewable alternatives to fossil feedstocks for power, transport fuel, chemicals and materials. The chemicals industry faces the challenge of replacing, or at least reducing the dependence on, petrochemical-dependent processes. New technologies are already in development to enable the production of chemicals from renewable bio-based feedstocks.

While wind, solar, nuclear and tidal renewable technologies will provide power, industrial biotechnology and thermochemical technologies will process biomass to provide liquid fuels for transport, chemicals and materials. Industrial biotechnology can be regarded as an emerging subset of CleanTech.

Definitions can inform investment models.

The accepted definition (BERR, EuropaBio and BIA) of Industrial Biotechnology is 'the use of biological resources for the production and processing of chemicals, materials and energy.'

The definition of industrial biotechnology distinguishes it from medical biotechnology which is focused on delivering drugs and treatments, although the two areas interface and complement each other in practice (e.g. industrial biotechnology is essential for the manufacture of many medicines, while medical biotechnology is concerned with the discovery and development of those medicines). Some companies bridge both areas by developing and exploiting multiple applications of a platform technology.

The definitions are useful in the context of financing because they help to frame and distinguish investment models for industrial and medical applications of biotechnology.

Characteristics of investment in industrial biotechnology

Industrial biotechnology has some similarities to other biotechnology because it is capital intensive and investments are long term. Opportunities may target a specific market segment such as biofuels (e.g. TMO Renewables, BioCaldol) or may apply to multiple industries (e.g. Aquapharm BioDiscovery, Oxonica, Novacta Biosystems). Industrial biotechnology companies often depend on major downstream industrial partners/acquirers who may not be used to adopting major new technologies, though they may be used to incremental development of known commercial processes (e.g. Green Biologics). Opportunities typically involve major prototyping investment and significant scale up risks. Other important aspects include clean technology regulation and the volatility in commodity and energy prices that affect the economics of existing processes. Significant international presence is often necessary to source feedstocks and raw materials and mitigate the effects of non-harmonised regulation. In the UK, the well-developed chemicals sector provides a strong national skill base to support innovation in industrial biotechnology.

Format of this report

The Working Group has reviewed the finance and investment landscape under the four key topics of Technology Transfer, Demonstration, Large Plant and Business Support Schemes. The findings and recommendations of the Working Group are summarised in the following four annexes for consideration by the Steering Committee.

Annex 1: Technology Transfer (early-stage University research and commercialisation).

The Working Group identified technology transfer as an important topic for review because of the general view that there was currently a lack of expertise in industrial biotechnology in most University Technology Transfer Offices (TTOs).

There is a perception that many TTOs hamper deal flow because they lack sufficient resource or skills to value intellectual property (IP) or to understand the costs involved in the development process. For example, as TTOs have a remit that covers multiple technology areas they may not have sufficient knowledge of industrial biotechnology to recognise opportunities as worthy of investment. Even academic staff focused in relevant technology areas may overlook opportunities because industrial biotechnology is multi-disciplinary. Often industry input is required to recognise commercial potential ("Eureka meetings" not moments). The commercial application of some industrial biotechnology inventions might therefore be compromised through early (pre-patent) publication. A central or national supporting resource may enhance commercialisation and foster collaboration between multiple inventing groups. This might be achieved through an existing well-resourced TTO or Centre of Excellence (e.g. Centre of Excellence in Biocatalysis, Biotransformations and Biocatalytic Manufacture, CoEBIO3). The Carbon Trust has already established an Incubator Scheme to provide supporting resources for the commercialisation of 'low carbon' technologies sourced from across the UK. Some industrial biotechnologies may fall within the scope of the Carbon Trust incubator scheme. The advantage of a dedicated TTO resource that was independent of any particular university was recognised.

The University sector now has additional commercialisation resources due to the emergence of private companies providing funding and commercial management which operate alongside TTOs (e.g. IP Group, BioFusion, IPSO Ventures, H2O Venture Partners) with a variety of relationships (first option, exclusive, non-exclusive, etc). IP Group, BioFusion and H2O Venture Partners already have investments in industrial biotechnology (Bioniqs Ltd, BioHydrogen Ltd and Microbial Solutions Ltd, respectively). The models provided by these private companies have yet to prove themselves and there has already been one failure in Angle Technology plc.. In addition, these private companies typically do not have any sector-specific skills to add to those already available at well-resourced University TTOs, but any strategies to enhance early-stage commercialisation need to consider the new diversity and complexity of the sector and monitor the progress of the AIM funding model through the current financial crisis. Companies that are dependent on the public markets will find it difficult to raise funding and, in general, do not have funding horizons or access to sufficient capital to tackle Industrial Biotech in a meaningful way.

A number of University TTOs have indicated that, while industrial biotechnology inventions are generally captured in provisional patent applications, the bottleneck for the commercialisation of these technologies is a lack of demand or interest from companies, or at least the absence of an easy route to dialogue with relevant industry. Without commercial interest many provisional patent applications are abandoned after the first year. The erosion of the fine chemical manufacturing base in the UK has exacerbated these IP management issues as new inventions become more heavily dependent on "technology push" rather than the "market pull" that centres of excellence in mainland Europe (e.g. Delft, Graz, Julich) experience with large local partner companies (e.g. DSM, Lonza, BASF and Evonik). A notable

exception in the UK is Ingenza Ltd that is developing chemical manufacturing routes to meet industry needs.

The University Challenge Seed Fund (UCSF) enabled universities to access seed funds in order to assist the successful transformation of research into business. This early funding is the riskiest stage of the venture process, and many institutions experience a funding gap in the provision of finance for bringing research discoveries to a point where their commercial usefulness is demonstrated and first steps can be taken to secure their utility. £45m was allocated in the first round of the competition in 1999, (with 15 seed funds being set up) and £15m more recently in October 2001 (which provided for 4 additional seed funds, and 1 extension). 57 Institutions now have access to UCSF funds. Although no further rounds of university challenge funding are planned, seed funding is now one of the strands of the core HEIF programme funding in recognition of the continuing importance of the University challenge concept. The working group considered it difficult to successfully operate this type of fund. However, a credible case for investment could be made for a central independently managed seed fund to support "proof of concept" industrial biotechnology proposals originating from defined centres of excellence. An important determinant of success of such a fund would be to identify market pull and develop effective relationships with relevant industrial sectors. The working group considered that the fund would need to be at least £30m in size and be able to generate deal-flow from a variety of predefined sources (the pre-definition of sources guarding against "mission creep"). Models of this type of fund do exist, such as Burrell's or Syngenta's industrially targeted funds. The Working Group does not recommend recreating a number of small seed funds linked to specific institutions (ie replicating the UCSF programme), and considers that the consolidation of UCSF into the HEIF funding stream makes it more difficult to create a broader seed fund. It is suggested that new money would need to be provided to launch a seed fund in industrial biotechnology.

The Flanders Institute for Biotechnology (VIB) provides a model for integrating biotechnology of select academic groups from different Universities in a 'virtual institute' with central commercialisation and incubator resources. Though the VIB embraces both medical and industrial biotechnology, the question was raised as to whether a similar model may have value in the UK for industrial biotechnology.

A review shows that the UK has already replicated several elements of the VIB model through initiatives that bring together public and private stakeholders to integrate supply chains:

- The Integrated Biorefining Technologies Initiative (IBTI), a product development partnership with an initial £5M funding for R&D.
- "FROM renewable Platform chemicals TO high-value Products" (FROPTOP), a forum developing a national strategy for the chemicals and chemistry-using sector.

The Working Group was strongly supportive of these initiatives because they are industry-led and acknowledge the relatively high component of know-how in industrial biotechnology that requires early engagement with industry.

The UK has also established the National Industrial Biotechnology Facility (NIBF, development and scale-up facilities at Wilton) in partnership with the academic Centre of Excellence in Biocatalysis, Biotransformations and Biocatalytic Manufacture (CoEBIO3). CoEBIO3 has its main base in Manchester University but includes research groups from the Universities of Manchester, York, Strathclyde and Heriot-Watt. This partnership, founded in late 2005 and fully active from mid-2006, provides an efficient route to develop, scale-up and commercialise enzyme-based

industrial biotechnology in the UK. The relevant outcomes and learning of the first 2 years of operation of this partnership are summarized below:

- The partnership has achieved notable successes in attracting industry-sponsored R&D (CoEBIO3 has secured more than £5M of R&D funding) and industry scale-up contracts (NIBF). These successes have depended partly on the assembled critical mass of expertise and facilities, but also on the ability of CoEBIO3 to directly manage negotiations and contracts on behalf of the CoEBIO3 consortium of Universities and SMEs using experienced staff with industry backgrounds. The University remained the legal owner of IP but delegated deal-making and project management authority to CoEBIO3,, thereby providing a single, focused route for effective engagement with industry. This arrangement “worked”, but not without significant effort to communicate with the university TTO to overcome the variety of issues that emerge in any negotiation with industry.
- Within CoEBIO3 there are a number of opportunities emerging for the development and capture of IP that could become the basis for either new spin-out companies or licences, but it is too early in the life-cycle of CoEBIO3 for these inherently unpredictable outputs to be fully-formed. The main achievement of CoEBIO3 to date, apart from basic research and scientific publications, is knowledge transfer to industry, both multi-national and SME, via collaborative research and research contracts. Two examples are;
 - Collaborative research with Shell has been developed over 2 years to the point where that project is now largely an independent project within CoEBIO3, though Shell maintains a R&D team at CoEBIO3 and a connection that is likely to lead to further research contracts and knowledge transfer. Ironically this achievement has reduced the ability of CoEBio3 to offer a broad range of services to industry, due to staff movement from CoEBIO3 to the well-funded Shell project which offers better job security.
 - Oxyrane Ltd, a SME, came to CoEBIO3 from South Africa to extend and develop its R&D and IP base. Oxyrane achieved its objectives by working with CoEBIO3 and then moved out of CoEBIO3 to the Manchester Science Park where it now has its permanent main base in the UK.
- At CoEBIO3, in common with University research groups generally, the absence of easily accessible pre-seed funding for early-stage projects, coupled with the University’s need to recover the full economic costs of R&D, often means that a compromise must be struck between capturing IP and capturing industry partners and research funding. Often IP is ‘pre-sold’ to industry partners in research contracts rather than being retained and used as the basis for a spin-out company or a licence. CoEBIO3’s Bespoke Biocatalysis Team initiative provides evidence to suggest that the obligation to price research contracts at full economic cost can be a significant barrier even to securing industry contracts, let alone IP rights.
- It is arguable whether spin-outs and licences are more valuable outputs of CoEBIO3 than the knowledge transfer that is already occurring, although the breadth of unexploited potential suggests that the current balance of outputs is suboptimal. However experience at CoEBIO3 suggests that UK biotechnology could benefit from new industry-friendly funding models to support key research.
- CoEBIO3 has indicated some specific issues that may reduce their ability to capture the benefits of innovation in industrial biotechnology:

- The timescale of the original funding to support CoEBIO3, NIBF and the contracted business development staff is, at 2 years, shorter than the normal timescale for developing and exploiting IP. This has the effect of focusing resources on the short- or medium-term basic funding needs rather than a long-term strategy to enhance innovation.
- The partnering and contracting successes accumulated to date have increased resource demands such that, in the absence of more funding, the tasks of enhancing innovation and attracting new business have become more difficult.
- The original strategic goals and business plan need to be reviewed and reshaped to continue to build upon the successes to date. It was noted that the evolving roles and/or legal structures of CoEBIO3 and NIBF may require adjustment if enhancing innovation is to be a priority, for example to source and develop IP which can be scaled-up by NIBF and commercialised by a new spin-out company. CoEBIO3 believes it needs to become an independent, not for profit company (as is the Centre for Process Innovation which houses NIBF) to enable market interface and commercial exploitation. There is a need to periodically review progress and then act to redefine roles, objectives and structures and fund them as part of a stable long-term strategy. A clear goal of CoEBIO3 is to engage with all the major international companies active in industrial biotechnology (e.g. BP, BASF, CRODA) to build upon the success already achieved with Shell.

Possible government actions to enhance industrial biotechnology at the early stage of research and commercialisation:

- 1) Improve 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. The dialogue should include the new generation of private companies active in the sector alongside university technology transfer offices.
It is proposed that this recommendation be carried out by a specialist government-funded unit and that the funding be awarded through a competitive process that includes university TTOs, knowledge transfer networks and private companies, as well as centres of excellence.
- 2) Extend the UK's existing industrial biotechnology Centres of Expertise and facilities (CoEBIO3 and NIBF):
 - a. to provide a stable, expert pathway with a long-term strategy for the development, commercialisation and partnering of industrial biotechnology opportunities sourced from all UK universities. This should include the development of balanced and flexible funding models to support key research while enabling industry engagement. The emphasis should be on commercial partnership and extend beyond the UK to Europe and the rest of the world.
 - b. to bring together complementary support schemes (e.g. the Carbon Trust "Low Carbon" incubator scheme), research groups and facilities to target areas of industrial biotechnology strategic to UK industry.

Annex 2: Demonstration (funding industrial biotechnology companies at the demonstration stage of development).

The Working Group identified that there is a particular funding gap at the point where companies need to demonstrate their product or process at commercial scale. However demonstration is not the focus of publicly funded business support schemes (as outlined in annex 4 of this document), nor is it a stage that offers an attractive risk reward profile to investors or partnering propositions that are acceptable to large corporates. Moreover there is a lack of demonstration facilities in the UK, as reported by the Technology and Manufacturing Working Group.

The Working Group has noted that there have been recommendations relating to demonstration in previous Innovation and Growth Teams. For example, the Environmental Services IGT (2002) recommended the following:

“Government, industry and investors should develop a public-private co-financed fund that invests in commercial-scale demonstration projects for new environmental technologies.”

The Environmental Services IGT recommendation has not been taken forward, and the Working Group expressed concern at the continuing “gap” in funding for demonstration of industrial biotechnology and the continuing need for Government support in this area. This concern has been re-enforced by the conclusions of the Technology and Manufacturing WG. The Finance & Investment Working Group recognised the need to integrate any funding solution with the availability of demonstration facilities. One possible solution is to fund a demonstration facility to be available free of charge to eligible companies. Another possible solution is a new fund to give eligible businesses a grant to ‘buy’ the use of demonstration facilities (a fund of this type would be a novel capability for the UK and one that is not replicated elsewhere in Europe).. The Working Group recognised the need for input from the other Working Groups and the Steering Group in order to inform and develop an appropriate integrated solution.

The Stern Review (October 30th 2006) concluded that three elements of policy are required for an effective global response to the threat of dangerous climate change:

1. the pricing of carbon,
2. support for innovation and deployment of low carbon technologies, and
3. removing the barriers to energy efficiency.

As a consequence of the Stern review, some demonstration funds have been developed, but these new funds are currently of little help to industrial biotechnology companies:

- *The Environmental Transformation Fund (ETF) is the government’s response to the second policy element defined by the Stern review, creating a £1.19Bn fund for the three years of the comprehensive spending review period, to be*

applied both in the UK and internationally. However the UK elements of ETF are concentrated on low carbon energy and energy efficiency technologies. This technology focus means there is currently little or no scope for industrial biotechnology (beyond limited support for biofuels). Whilst ETF is not directly helpful to industrial biotechnology, it is Government intervention at the demonstration phase where a market failure is proven: in this case carbon emissions.

- *There is some funding available through the EU Competitiveness and Innovation programme which provides €28 million of funding in 2008 to stimulate uptake of the best environmental products, processes and services in Europe, contributing to implementation of ETAP.*

In order to overcome the current limited access of industrial biotechnology to demonstration funds the Working Group suggests that government and industry make adjustments to ensure that the positive environmental impact of Industrial Biotechnology processes is promoted and captured within existing schemes.

In this context it is encouraging that a significant new source of clean technology funds was announced in early November 2008 by the UK's Carbon Trust and Qatar Investment Authority. The carbon trust is an independent company set up and funded by government in response to the threat of climate change. A Memorandum of Understanding on a new Low Carbon Innovation Partnership was signed to set up a new £250m Qatar-UK Clean Technology Investment Fund. In common with the ETF fund, this new source will be relevant to industrial biotechnology that lowers carbon emissions

Possible government/industry actions ensure industrial biotechnology businesses are able to demonstrate their commercial applicability:

1. A public/private industrial biotechnology fund should be established to allow industry, particularly SMEs, access to demonstration facilities. This would be a novel capability for the UK and one that is not replicated elsewhere in Europe. *The mechanism by which the new fund operates needs to be developed in consultation with the other Working Groups and the Steering Group. Options include a demonstration facility that is available free-of-charge to eligible companies, or a new fund to give eligible businesses a grant to 'buy' the use of demonstration facilities.*
2. Businesses should focus on the positive environmental benefits that industrial biotechnology processes can bring when seeking public investment. This will increase the prospects of winning funds by highlighting the benefits of industrial biotechnology which directly impact an area where market failure has been accepted by Government.
3. Government should broaden the remit of existing commercial-scale demonstration funds to ensure that industrial biotechnology (whether biofuels, chemicals or materials) is included.

Annex 3: Large Plant.

The high capital cost of large plant [\$200m-\$500m] was identified as an issue for the development of industrial biotechnology in the report United States International Trade Commission on Industrial Biotechnology: Development and Adoption by the U.S. Chemical and Biofuel Industries (2008). The report cites US industry feedback that suggests that governments need to help share the risks of new facilities, especially when companies are facing a financing gap, because the private sector cannot cover the total cost of new innovation. The report also describes the considerable investment that the US is making in large scale plant for industrial biotechnology:

- The EPAct 2005 directs the USDOE to establish a \$250 million per-facility grant and loan guarantee program, and a \$250 million loan guarantee program for establishing sugar-to-ethanol facilities.
- In February 2007, the USDOE announced grants totalling \$385 million over the next four years to build six biorefineries.

Given this background the Finance and Investment Working Group has undertaken research to identify the factors that influence company decisions about the location of large plant, and to establish whether UK policy (including taxation, incentives, regulations, grants) provides adequate incentive for companies to site large plant in the UK. The research had three components –a review of general trends, interviews with senior executives from UK industry, and a comparative assessment of the US and European government approaches to supporting large plant ,.

General trends

UKTI provided the following background information relating to large scale plant generally: Over the last 30 years the trend for foreign direct investment into large scale plant generally (manufacturing) has moved away from the creation and location of new plant towards the retention and expansion of existing plant. In the 80's, large plant was attracted with the assistance of grant incentives, but these grants are now largely gone. The UK's challenge is now more concerned with preventing plant from relocating to cheaper destinations (e.g. Eastern Europe). The general proposition for the UK to retain and expand the existing large plant covers 4 main areas: 1) Market access (including to Europe), 2) Market size 3) Tax, and 4) Labour Skills and Regulation (including the general business environment).

Interviews with senior executives in UK industry.

The interviews with senior industry executives were designed to gather specific information about industrial biotechnology to complement the general background given by UKTI. The Box on the next page shows the combined feedback that illustrates the full range of issues relevant to the location of large plant :

What influences a decision about where to base large-scale plant?

a) Fundamentals - factors influencing whether large plant will be built or not.

- is there a ready market for the product in the region; are sales going to be as remunerative as elsewhere (thinking about mandation/ tariff protection/ incentives to support demand)
- what is the availability of raw materials/ process materials/ energy in the region; what is the volatility of these critical inputs

b) Choice of location

- what is the economic climate in the region; are funds available at reasonable cost; is currency volatility a problem; are hedging tools robust
- what is national and local governments orientation to the technology; does support extend beyond the intangible; are training, research, capital or ongoing incentives available; how solid are these going forward

c) Factors independent of government grants

i) Synergies

- do we have existing operations in the region that we can synergise with
- does the new facility de-risk our existing activities in the region; what's the risk/reward equation look like

ii) Ability to execute

- do we have the design, project management and operational skills necessary for successful completion and operation of the facility; can we get them locally; are there local technology centres that can assist this process
- does the necessary contracting resource exist in close proximity to the build; is it competitive relative to alternative locations

Does the UK have any particular pros and cons?

UK Pros

- There are good quality research/engineering staff available - question is can we get them working on the right things
- minimal barriers to foreign technology providers coming into the UK environment if we need them
- minimal barriers to using foreign skills in the UK if necessary
- project contracting sector fairly robust although declining
- raw materials/ process materials generally available

UK Cons

- collective agreements for the contracting sector can be penal
- UK government delivers less certainty than appears the case in other parts of the EU when it comes to mandation/ tariff arrangements/ etc - more uncertainty a consequence
- capital grants for major builds almost non-existent; focus on SMEs; US feels much better on this

A comparative assessment of US and European government approaches to supporting large plant.

When considering government support schemes, it is useful to consider industrial biotechnology as a subset of the broader theme of renewable energy. In this context it is clear that different approaches are being adopted in Europe and the US, each with their own strengths and weaknesses. Europe has given renewable energy clear goals and mandates that provide legally binding targets designed to encourage the long-term development of the sector and without bias to any technology. In contrast, the US has focused mainly on direct support for selected technologies and facilities (e.g. cellulosic bioethanol) in what might be regarded as a relatively short-term approach. In general European legislation appears to provide good incentives for large plant to be built, with the choice of location within Europe depending on the combination of government grants and tax incentives available in the different countries and regions.

In terms of the factors that influence where large plant is built, there is an important distinction to make between large plant which manufactures equipment (e.g. fermenters) and large plant that functions as a processing facility (eg bioethanol or bioplastics). The location of large plant that manufactures equipment is strongly influenced by government grants, whereas processing facilities are mainly influenced by the availability of feedstock and market demand.

It has been suggested that the UK (and also Europe) may have a gap in the financing of large-scale facilities in the specific circumstance where a technology is unproven at commercial scale (ie the gap is the bridge between pilot plant and commercial scale). A pertinent question is whether this gap should be filled by direct government grants (as provided in the US) or by general support for financing. The balance of UK opinion appears to be in favour of government action to help make finance more available, with grants being reserved for the earlier stages of technology development.

An important issue for industrial biotechnology in the UK and Europe is the fact that a range of emerging non-fuel technology areas fall outside the scope of the legislation supporting renewable energy. For example, there are no incentives equivalent to RTFOs that will support the case for investment in chemicals or bioplastics. The absence of incentives makes these technology areas unattractive for investment. While the government mandates and incentives that guarantee long-term demand for industrial biotechnology are an important stimulus for investment in the whole development cycle, they are particularly critical to encourage investment in large scale plant.

Possible government actions to enhance the ability of the UK to attract investment in large plant in industrial biotechnology:

- 1) Enhance industry confidence in the long-term stability of government policy relevant to large scale plant.** This may be achieved by;
 - a. mapping policies, tariffs, obligations, grants or schemes against their equivalents in Europe to ensure that the UK provides a stable and competitive investment landscape.
 - b. developing mechanisms to make finance more available for large plant in the specific circumstance where a technology is unproven at commercial scale.

- 2) Encourage industry to invest in UK large plant relevant to non-fuel industrial biotechnologies, such as chemicals and bioplastics. Ensure that incentives and mandates for the non-fuel technology areas match those supporting renewable energy and biofuels.

- 3) Improve access to, and promotion of, UK research and engineering capability and infrastructure to companies in the UK and overseas. This may be achieved by:
 - a. A review of policy and targets in Universities and research councils to enhance incentives for, and remove barriers to, engagement with industry.
 - b. Investing in a programme of targeted promotion, including development of a small-scale sector-focused forum for industry and academia to discuss issues and collaborative models.

It is proposed that these recommendations be carried out by an industrial biotechnology specialist within UKTI.

Annex 4: Business Support Schemes.

The working group reviewed the government funds and support schemes currently available to business. This exercise underlined the conclusions drawn in Annex 2 (funds for demonstration) where the Working Group perceive the main funding gap to be. However the goal this time was to assess whether there are any other deficiencies or opportunities for industrial biotechnology within the schemes that may require government intervention.

The collective feedback from a range of respondents indicated that most of the funds and schemes are suited to small firms and small investments. Moreover, most have structural or administrative issues which impede the larger specialist investors who are best suited to industrial biotechnology. Two examples are given below:

1) Enterprise Capital Funds (ECF) are designed to be commercial funds, investing a combination of private and public money in small high-growth businesses that are seeking up to £2 million of equity finance. The Government provides up to two thirds of the capital in each ECF, in return for a preferred return at or close to Gilt rate, and a limited share in any profits of the fund. The preferred return is intended to cover the Government's cost of capital, and the profit share from successful funds should offset any losses on unsuccessful funds. The Working Group considered the main issue with this scheme to be the uncertainty surrounding the bidding process. Matched funds have to be raised before the award is given, and with the matched funds in place there is no guarantee that an award will be made. In the current market it might take 6 to 12 months to identify matched funding and then a further and relatively long period to secure the ECF funds. An experienced investment team is therefore unlikely to want to bid for ECF money and an unproven or inexperienced team is unlikely to be able to raise the matched funding. This might explain why the ECF has mainly backed business angel investment groups. The Working Group suggests that a more institutional/venture capital friendly system would need to be developed for the ECF to work well for industrial biotechnology.

2) Regional Venture Capital Funds (RVCFs) is an England-wide programme to provide risk capital finance in amounts up to £500,000 to small and medium size enterprises (SMEs) who demonstrate growth potential. The funds, managed by experienced venture capital professionals, are commercially focused, making commercial returns. RVCFs can invest up to £250,000 in equity or debt into any qualifying business, be it a start-up, early stage, or needing development capital either for an acquisition or for organic growth. The total investment by the RVCF and any other venture capitalist must not exceed £250,000. [note this is the nationally managed programme]. The RVCF scheme is now fully invested and new rounds are not anticipated. The Working Group therefore did not assess the scheme in the IBT context.

Although there are limited case studies to indicate sector-specific strengths or weaknesses, the Working Group concluded that the potential of existing funds and schemes to enhance industrial biotechnology may be severely limited by the following factors:

- The small size of the funds (industrial biotechnology usually requires several million pounds to achieve proof of concept).
- The absence of a dedicated and expert investment team, ideally with corporate backing (industry expertise is critical).
- The absence of a clear investment remit based on a sound understanding of industrial biotechnology.
- The lack of involvement of corporate venture funds with access to industry-based IBT expertise
- Complexity.

The funds and schemes were also considered to 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.

An additional barrier may be a lack of investor awareness of industrial biotechnology. For example:

- The overall trends that point to industrial biotechnology becoming widely adopted in UK.
- The types of industrial biotechnology investments that companies seek to make (the purpose, technology, cost, benefits and risk).
- Where to look for companies with industrial biotechnology opportunities that need financing (there isn't an "industrial biotechnology sector" per se).
- There is a lack of well-known examples of UK industrial biotechnology investments (either successes or failures).

It was noted that The BioVentures special interest group organised by the Bioscience for Business knowledge transfer network is already addressing some of these awareness issues through events and publications.

Possible government actions to enhance the impact of funds and business support schemes on industrial biotechnology:

[Improve access to demonstration funds – see Annex 2 on demonstration]

1. Improve the availability of existing funding and support schemes through simplification and promotion. This is a generic issue rather than one specific to industrial biotechnology. Currently Business Link is charged with the task of promoting these schemes. The Working Group recommends that a phone contact to a sector expert would be more appropriate and cost-effective than an ongoing programme of untargeted promotion. This is because companies are generally only receptive to this type of information when they need it. It is further recommended that the sector expert be based within an innovation/incubation centre or a centre of excellence.

2. The scope of any new business support schemes should be defined in a way that does not exclude or impede industrial biotechnology.

3. Improve investor awareness of industrial biotechnology. In common with Recommendation 1 of Annex 1 (technology transfer) on page 7, it is proposed that this recommendation be carried out by a specialist government-funded unit and that the funding be awarded through a competitive process that includes university TTOs, knowledge transfer networks and private companies, as well as centres of excellence.