

Industrial Biotechnology and Bioenergy Highlight Notice 1: Generation of Hydrocarbons from Living Organisms

October 2011

Summary

Bioenergy and Industrial Biotechnology has been established as a high-level strategic research priority within BBSRC's current Strategic Plan¹. To support this strategic priority further, BBSRC aims to diversify its Bioenergy and Industrial Biotechnology portfolio by encouraging proposals that work towards the generation of hydrocarbons and similar molecules from living organisms (See **Scientific Scope**, below, for further information). To be considered under this highlight notice proposals should aim to:

- Develop novel or improved biological processes for the production and / or isolation of products from biological feedstocks that have the potential to be used for the production of advanced biofuels, lubricants, platform chemicals, high value chemicals or their biological intermediates.
- Take into consideration the energy efficiency, sustainability, environmental impacts and cost effectiveness of the biological process.

Proposals should be submitted in Responsive Mode by 16.00 on 11 January 2012.

Background

Bioenergy is a renewable form of energy generated from materials derived from biological sources. Bioenergy is increasingly being recognised as having an important role in helping the UK to maintain its energy security in the context of diminishing worldwide stocks of fossil fuels.

Industrial Biotechnology (IB) can be defined as a set of cross-disciplinary technologies that use biological resources for producing and processing materials and chemicals for non-food applications. Such resources may be derived from the tissues, enzymes and genes of plants, algae, marine life, fungi and micro-organisms.

BBSRC has identified Bioenergy and Industrial Biotechnology as a high-level strategic research priority in its Strategic Plan. It is anticipated that innovative research programmes will lead to the development of new or improved biological processes and technologies that will work towards reducing dependency on petrochemicals, thereby helping the UK to achieve its ambitious targets for reductions in greenhouse gas emissions, as set out in the Climate Change Act 2008. Moreover, increased adoption of bioenergy and industrial biotechnology will also contribute to the growth of the green economy².

Direct replacements for existing petrochemical based products are particularly important for freight vehicles including shipping, and aviation. A key challenge is to work towards production of advanced biofuels or so-called "drop-in fuels" which can be used as direct replacements for petrol based, diesel-based or aviation fuels i.e. fuels with high energy content and low hygroscopicity so as to be directly compatible with existing infrastructure.

¹ http://www.bbsrc.ac.uk/web/FILES/Publications/strategic_plan_2010-2015.pdf

² https://online.businesslink.gov.uk/Horizontal_Services_files/Enabling_the_transition_to_a_Green_Economy___Main_D.pdf

Scientific Scope

The aim of this highlight notice is to encourage proposals that work towards developing novel or improved biological processes for the production and / or isolation of hydrocarbon-like products from biological feedstocks or living organisms. Such processes should have the potential to be used for the production of advanced biofuels, lubricants, platform chemicals, high value chemicals or their biological intermediates.

Example target compounds (for illustrative purposes only) that could be generated via biological routes include:

- Longer chain hydrocarbons: including saturated, aromatic and branched chain molecules
- Linear alkanes, isoalkanes, alkenes, isoalkenes, alkylbenzenes, cycloparaffines and naphthalenes

All proposals should take into consideration the energy efficiency, sustainability, environmental impacts (e.g. using water efficiently) and cost effectiveness of the biological process. This challenge may be addressed by:

- Generating enzymes / intermediates that have increased stability and tolerance to harsh conditions and inhibitors
- Manipulating growth conditions to improve growth rates
- Establishing the costs / benefits of co-cultures and microbial contamination
- Increasing efficiency of metabolic pathways and generating more efficient and /or specific enzymes
- Developing new or improved processes for feedstock conversion
- Developing new, or improving pre-existing methodologies (including scale-up technologies) for product concentration and isolation processes
- Developing new processes towards high octane and high cetane fuels.

Appropriate biological routes suitable for study under this call include: bacteria, yeast, fungi, micro- and macro-algae and terrestrial plant-derived biomass. Applicants are encouraged to consider using a range of appropriate methodologies, which may include:

- Generation of novel molecules via heterologous expression, genetic, protein metabolic engineering and / or synthetic biology³

³ Synthetic biology aims to design and engineer novel biologically based parts, devices and systems, as well as redesign existing natural biological systems for useful purposes. It incorporates the principles of engineering e.g. modularity, abstraction and orthogonality into classical biotechnology. The following areas have been identified within this broad definition of synthetic biology:

- Minimal genomes: understanding the minimal number of parts needed for life, to serve as a basis for engineering minimal cell factories for new functions.
- Orthogonal biosystems: expanding information storage and adding coding capacity
- Regulatory circuits: e.g. designing synthetic gene circuits that may be based on standard biological parts
- Metabolic engineering: engineering modified biosynthetic pathways to yield useful products. Overcoming / removing elements that block production.
- Protocells: Bottom-up chemical design approaches to create cells de novo.
- Bionanoscience: e.g. utilising and exploiting cellular molecular machines.

European Academies Science Advisory Council Report:

http://www.easac.eu/fileadmin/PDF_s/reports_statements/Synthetic%20Biology%20report.pdf

- Manipulation or reconstruction of metabolic pathways for example by synthetic biology approaches, metabolic engineering, protein engineering, enzymology, fermentation chemistry and associated engineering
- Isolation / generation of novel strains that are biologically engineered to produce specific molecules
- Analytical tools such as the measurement of carbon flux through pathways, lifecycle analysis and mathematical / computational based modelling
- Manipulation of a plant's physiological properties and / or development of improved breeding techniques in order to make the plant or feedstock more amenable to handling or downstream processing
- Sustainable chemistry and integration of biological and chemical processing, where appropriate.

BBSRC specifically encourage proposals that:

- Apply cutting edge technological approaches including the latest genomics, synthetic biology and systems biology techniques.
- Reach across the boundaries of individual science areas and employ multi-disciplinary teams
- Include collaboration with the private sector.

Eligibility

This highlight call is subject to BBSRC's standard responsive-mode eligibility criteria. Further information relating to eligibility can be found in BBSRC Research Grants: - The Guide ⁴.

Process

Applications should be submitted through the Research Councils UK's [Je-S \(Joint electronic Submission\) system](#), before the responsive mode grant application deadline of **16:00 on 11 January 2012**.

Funding for this call is not "ring-fenced". Proposals will be assessed by BBSRC's most appropriate Research Committee in competition with other responsive-mode grant applications; however the high strategic relevance of this area of research will be taken into account in the assessment process.

Applications are eligible for uplift under three BBSRC standard schemes:

- (i) New Investigator Scheme (<http://www.bbsrc.ac.uk/funding/grants/new-investigator.aspx>)
- (ii) Industrial Partnership Award (<http://www.bbsrc.ac.uk/business/collaborative-research/industrial-partnership-awards.aspx>)
- (iii) Stand-alone LINK (<http://www.bbsrc.ac.uk/business/collaborative-research/link/link-index.aspx>)

Research in this area may address the interests of other Research Councils and may therefore be considered for co-funding. Applicants who consider that their application may

⁴ http://www.bbsrc.ac.uk/web/FILES/Guidelines/grants_guide.pdf

be of interest to additional Research Councils should contact BBSRC in advance of submitting their application.

Further information

Scientific Enquiries should be addressed to:

Natalia Gillies: natalia.gillies@bbsrc.ac.uk; tel +44 (0)1793 414666

Je-S related queries should be addressed to the Je-S Helpdesk:

Je-S helpdesk: JeSHelp@rcuk.ac.uk, +44 (0)1793 444164