

# Bioenergy Research

The **Biotechnology and Biological Sciences Research Council (BBSRC)** supports research that will help inform policy development and technological advances relevant to switching from fossil fuel-derived energy to energy from biological renewable sources.



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BBSRC is funded through the Government's Science Budget and is part of the Research Councils UK partnership (RCUK).

[www.rcukenergy.org.uk](http://www.rcukenergy.org.uk)



# Bioenergy research

BBSRC funds research that will inform policy development and technological advances for switching from fossil fuel-based energy sources to energy derived from renewable biological sources.

BBSRC's research portfolio includes:

- **BBSRC Sustainable Bioenergy Centre (BSBEC)**, a £26M investment in partnership with industry. The focus is strongly on development of second-plus generation biofuels, which are the only feasible substitute for liquid hydrocarbons in making transport fuels
- **Integrated Biorefining Research and Technology Club (IBTI Club)**, a £6M partnership between BBSRC, the Engineering and Physical Sciences Research Council, a consortium of leading companies, and the Bioscience for Business Knowledge Transfer Network
- **Research grants and institute programmes** covering a range of fundamental and applied science that underpins bioenergy (£11M pa\*)

\* This figure is BBSRC's total estimated annual spend for 2009/10 including contributions to BSBEC and IBTI Club



# BBSRC's position...

# ...explained

1

**Bioenergy** can contribute significantly to the UK energy mix. It is derived from:

- (a) converting the large amounts of energy locked up in plant cell walls (lignocellulose), including waste from food crops, into replacements for petrol, diesel and aviation fuel;
- (b) harnessing the capabilities of algae and microbes to produce liquid fuels to replace petrol, diesel and aviation kerosene.



Building on UK research strengths, bioenergy research can lead to technologies that complement other energy sources to help ensure UK energy security. Government commitments to 15% renewable energy by 2020 will require diverse sources of energy production. Bioenergy, including biomass and microbially produced biofuels will be an important contribution to UK energy because, unlike other renewables, it offers options to create liquid fuel substitutes that can be blended into today's fuels and their distribution infrastructure.

2

**Our research** addresses bioenergy production that does not conflict with **food security**. In BBSRC's Strategic Plan 2010-2015\*, both food security and bioenergy are priorities. BBSRC's bioenergy focus is on energy (heat, electricity and liquid fuels) either from non-food feedstocks or from inedible elements and waste from food crops.



We support bioenergy research in the context of global food security and are committed to ensuring research can provide options that address our bioenergy needs without jeopardising food security. For instance, a recent Rural Economy and Land Use project has shown there is sufficient land to meet the UK biomass strategy objective of 350,000 ha for electricity without significantly impacting on domestic food production. However, a suitable level of profitability and clear policy support would be essential for large-scale commercial adoption in the UK.

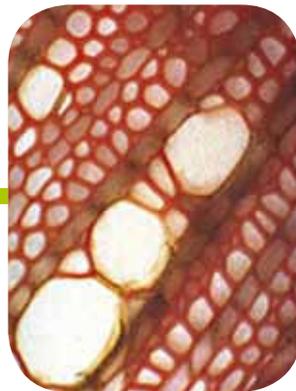
3

**We need bioenergy research now.**

It will take a decade or longer to translate research and new knowledge into feasible new sources of bioenergies.

Current focus is on biofuels from fermented plant sugars. Future biotechnological options could include biomass processing into biogas.

Research today on the underpinning biological processes will provide technological options to meet social preferences and energy requirements in the future.



The UK is a world leader in fundamental bioscience. Basic research conducted today, such as the sequencing of the model grass *Brachypodium* or research into the workings of photosynthesis and carbon partitioning, will provide us with the knowledge and understanding we need in the years to come. Developing an understanding of the limitations as well as the potential will provide advice on which bioenergy solutions are best suited to particular applications – dependent on factors such as climate, soil type and water availability.

cont'd...

4

**Sustainably** produced biofuels offer the only mid- to long-term option for replacing **liquid transport fuels**. This is why they are a major focus of current BBSRC research.



Biofuels, produced economically, environmentally and socially sustainably, can be delivered today through existing infrastructure to help meet the Government commitment to 10% of transport energy coming from renewable sources by 2020. In line with our commitment to food security. Research in BSBE is exploring second-plus generation biofuels with research looking into increasing efficiencies along the biofuel pipeline, from carbon partitioning to bacterial fermentation.

5

**Bioenergy** production must be socially, economically and environmentally **sustainable**.

Scientific and technological advances must be made in the context of wider issues such as public acceptability, regulatory frameworks and social trends.



In BBSRC's Sustainable Bioenergy Centre (BSBE) social scientists, economists and life cycle analysts work closely with bioscientists.

We have established an outreach group that brings together expertise from industry, NGOs, academics and professional communicators. Together with input from BBSRC's Bioscience for Society Strategy Panel, this helps ensure our research both informs, and is informed by, public views.

6

**BBSRC promotes networking and partnerships** between researchers and industry that will be essential for translation of research findings into commercially viable products.



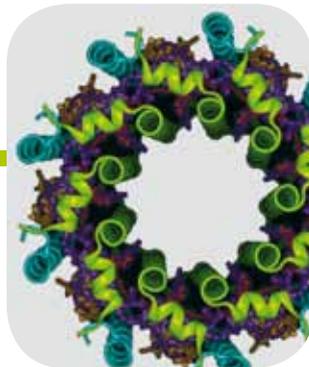
BSBE is a virtual centre linking six related scientific programmes, each of which has at least one industrial partner.

The Integrated Biorefining Research and Technology Club (IBRT) promotes high calibre academic research in response to industry's needs. Arrangements are in place to manage and protect academic publication and intellectual property.

7

**UK research on bioenergy** can contribute to and benefit from international partnerships.

Science can contribute to developing trade links that will add to, and then replace, those for oil and gas.



BBSRC-supported researchers have active links with many countries including across the EU, USA, Brazil and China.

Research proposals involving overseas collaborations, particularly in developing countries, require careful consideration of the various local applications and implications.

BBSRC is funding UK-USA collaborations on enhancing the efficiency of photosynthesis that could lead to transformative technologies in bioenergy production. We are also exploring other opportunities through European research collaborations.

# Bioenergy possibilities

- Bioenergy research harnesses a range of **technological options** both to understand the basic biology and to explore applications. These will include extensions of existing procedures and new genetic techniques.
- All options, and combinations of options, need to be explored on a case-by-case basis taking account of the wider context including aspects of, for instance:
  - International impact
  - Social acceptability
  - Effects on rural community
  - Effective and trusted regulation
  - Ownership and Intellectual Property
  - Nature of commercial interactions
  - Environmental impact
  - Infrastructure requirements



## Enhanced and new sources of bioenergy:

- Non-food crops
- Inedible parts of food crops
- Waste – e.g. agricultural, food processing and municipal
- Microbial and algal metabolism
- Photosynthesis and plant metabolites

## Enabling biotechnologies:

- Traditional and marker assisted plant breeding
- Systems biology
- Genetic modification
- Metabolic engineering
- Directed evolution
- Anaerobic digestion
- Synthetic biology

## Outputs and benefits:

- Optimised plant biomass
  - to generate heat or electricity
  - for digestion or fermentation to liquid vehicle fuels or biogas
- Biogas
  - for heat and power generation
  - for blending into gas distribution systems
  - for compression to power alternative fuel vehicles
- Algal cultures for liquid biofuels
- Waste – turning a major problem into a source of energy and petrochemical substitutes

# Some bioenergy facts and figures

- The UK Renewable Energy Strategy (2009) considers that around 30% of the UK's overall 15% renewable energy target could come from biomass heat and electricity in 2020 (DECC)
- There is sufficient land to meet the UK Government biomass strategy objective for electricity without significantly impacting on food production (RELU November 2009)
- In line with the European Renewable Energy Directive (RED) UK has indicated sourcing 10% of our transport energy from renewable sources by 2020 (DECC)
- The UK Renewable Energy Association calculated that about 80% of the UK's petrol-based, and 50% of its diesel-based RED 2020 target could be met from indigenous feedstocks (REA position paper June 2009)
- The efficiency of photosynthesis is only about 6% suggesting that it might be possible to enhance this significantly to provide higher yielding plant feedstocks for energy production. Novel ways of capturing solar energy might also be possible, using artificial photosynthetic systems.

