SUSTAINABILITY AND THE PRODUCTION OF BIOETHANOL FROM SUGAR BEET IN THE UK

POLICY DOCUMENT BY BRITISH SUGAR GROUP

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CONTENTS

* Note: All key statements in the main report are referenced to externally verifiable sources. For brevity, references have been omitted from the Summary of Key Points.

1. INTRODUCTION TO ASSOCIATED BRITISH FOODS AND BRITISH SUGAR GROUP

Associated British Foods plc (ABF) is a diversified international food, ingredients and retail group with global sales of £6.8 billion and 85,000 employees in 43 countries[1]. It is a leading player in Europe's food and agribusiness markets, and is a substantial purchaser of agricultural raw materials in the UK.

ABF's "Sugar and Agriculture" division represents a major segment of its global activities, managed by the British Sugar Group. This is one of the largest sugar companies in the world, with operations in southern Africa (cane), China (cane and beet), UK (beet) and Poland (beet). In all these regions it is a leader in efficiency and innovation. British Sugar also has interests in renewable energy, power generation, fine chemicals, horticulture and animal feeds. In November 2007 Lord Rooker, on behalf of DEFRA, officially opened the UK's first bioethanol plant at British Sugar's Wissington facility in Norfolk, with a capacity of 55,000 tonnes/year (70 million litres/year)[2] of bioethanol from sugar beet.

In June 2007 ABF, in conjunction with BP and DuPont, announced plans for a 330,000 tonnes/year bioethanol plant[3], which would meet approximately one-third of the UK's bioethanol requirements by 2010.

ABF and British Sugar therefore have substantial operations in both the food and biofuels sectors globally.

[1] Associated British Foods plc annual report, 2007.
[2] Official opening of Wissington bioethanol plant by Lord Rooker, Minister of State for DEFRA, 22 November 2007.
[3] Public announcements by ABF and BP, 26 June 2007.

2. SUMMARY OF KEY POINTS

Bioethanol produced from sugar beet at British Sugar's Wissington plant conforms with rigorous standards for environmental protection and sustainability. It is also produced efficiently and delivers a high CO_2 emissions saving. As such, we believe it is a model example of a "good" biofuel, which alleviates climate change, contributes to national fuel security and is environmentally sustainable. A summary of this case is set out below.

Reducing Carbon Emissions

- Using our bioethanol results in a CO_2 emissions saving of 71% relative to petrol when measured on a full life-cycle basis. The carbon intensity figure reported under the RTFO for British Sugar bioethanol is 24.5 gm CO_2/MJ.
- Energy for the bioethanol plant is supplied from a high performance gas fired Combined Heat and Power (CHP) unit which delivers 85% efficiency (this compares to c 30% efficiency for coal-fired power stations).
- Energy consumption at the Wissington plant is continuously monitored and has been reduced by 17% in the last 10 years.

Contribution to the Food Chain and Land Use

- Sugar beet feedstock used to produce the bioethanol is sourced from established UK arable farmers, and is not associated with deforestation or direct land use changes.
- UK sugar beet productivity has been increased by 50% since 1987, and now averages 10 tonnes of sugar/hectare.
- This performance is consistently ranked in the top quartile of EU producers, and is comparable with sugar cane productivity in Brazil.
- A combination of increased sugar beet yields and rationalisation of the industry driven by reform of the EU sugar sector has caused a substantial net reduction in UK sugar beet area.
- The total area of sugar beet grown for food and bioethanol in 2008 is consequently 65,000 hectares (40%) lower than it was 10 years ago when only food was produced.
- There are consequently no medium-term indirect land use effects associated with bioethanol production at Wissington.
- Production of bioethanol from sugar beet also produces an equivalent amount of high energy animal feed co-product, which contributes to the food chain.
- There is no evidence that Wissington bioethanol has any effect on food prices.
- Sugar beet feedstock is sourced locally, with minimal "food-miles": average transport distance is only 50km.

Agricultural Standards and Biodiversity Protection

- Sugar beet is a valuable "break crop" in the arable rotation. This enhances soil fertility and contributes to reduced fertiliser and pesticide inputs, and enhanced biodiversity, in following cereal crops.
- Sugar beet is recognised by the RSPB and Natural England as being of considerable value for biodiversity and birdlife.
- This is further encouraged through standards in the Assured Combinable Crops and Sugar Beet Scheme (ACCSBS).

- From 2008 all growers will become accredited members of this scheme. Previous to 2008, sugar beet growers were subject to a rigorous annual crop audit scheme which evaluated crop management practices and inputs against agreed standards.
- Crop management practices are continuously improved based on research results from Rothamsted's national sugar beet research centre. Results are communicated to, and implemented with, growers via integrated industry extension services.
- All crop inputs are monitored, strictly controlled and optimised: nitrogen fertiliser has been reduced by over 30% and pesticides by over 60% since 1980.
- Crop losses associated with harvesting are audited annually, and have been reduced by more than 50% in the last 10 years.

Soil Conservation

- Fertiliser application is monitored and strictly controlled to optimise its use, and avoid over application.
- Soil erosion during harvesting is a significant source of soil movement from the farm, but has been reduced to the minimum practicable level (less than 5%) by the introduction of specialist schemes.
- All soil delivered with the crop is reclaimed and either repatriated to farmland or used in the landscaping and amenity markets.
- Wind erosion is not a significant source of soil loss.
- Water erosion in sugar beet fields is extremely rare.

Sustainable Use of Water Resources

- Over 95% of the crop is rain-fed: use of irrigation is minimal, and controlled by the Environment Agency.
- Water use at Wissington is measured and strictly controlled. Water abstraction from the River Wissey has been cut by 30% in the last 5 years.
- The Wissington bio-refinery produces almost three times as much water as it consumes – and is a net contributor to the River Wissey flows.
- Water is treated and purified to Environment Agency standards before being released from site.

Air Quality

- Burning of crop residues is not carried out.
- Emissions from British Sugar sites, including Wissington, are measured and strictly controlled under Environment Agency permits.

Employment Standards

- British Sugar employees, whether permanent or seasonal, hold contracts of employment which are annually negotiated by the UNITE and GMB unions.
- Terms and conditions for all sugar beet suppliers are negotiated annually by the NFU, and are set out in the industry's "Inter-Professional Agreement".
- The industry is subject to rigorous and transparent health and safety standards – all accidents are reported and formally investigated, and the number of accidents is continuously being reduced.
- Land ownership and tenancy rights are defined, controlled and enforced through UK legislation.
- Young people can only work if they are above the minimum working age – child labour is banned.

3. ENERGY EFFICIENCY AND CARBON SAVINGS

3.1 Carbon Calculation Methodology and Audit

- The carbon intensity figure reported under the RTFO for 2008/09 for British Sugar's bioethanol production is 24.5 $gmCO_2/MJ$,[4] equivalent to a CO_2 saving of 71% relative to fossil derived petrol.
- This analysis of carbon emissions associated with the supply of sugar beet and the production of bioethanol has been carried out by external consultants[5] in accordance with the methodology laid down in the Technical Guidance of the UK Renewable Transport Fuel Obligation.
- The calculations have been based on audited actual technical data, rather than default figures, and have been carried out on a full life-cycle basis including all related activities from crop production to final processing.
- The processes involved in the carbon calculation have been externally checked by PricewaterhouseCoopers, to verify their conformance with the RTFO methodology.

3.2 Process Plant Energy Efficiency and Carbon Emissions

- British Sugar's operations at Wissington are subject to the UK's Climate Change Agreement Scheme[6] and the EU Emissions Trading Scheme[7] to reduce energy consumption and carbon emissions.
- The bioethanol plant is supplied from a state-of-the-art Combined Heat and Power (CHP) unit,[8] fuelled primarily by natural gas, which qualifies under DEFRA's CHP Quality Assurance Scheme.
- Energy efficiency is optimised, by a combination of plant design and technology – in practice about 85% energy efficiency is achieved.[8]
- Energy use is measured and monitored, and subject to a continuous programme of improvement including on-going assessment of the use of energy from renewable sources.
- As a result of these initiatives, energy consumption at Wissington plant has been reduced by 17% in the last 10 years.[9]

[4] British Sugar data reported to obligated fuel suppliers under the RTFO, starting May 2008.
[5] North Energy consultants evaluated British Sugar's bioethanol carbon intensity during spring 2008.
[6] UK Climate Change Agreement Scheme offers specific operations tax concessions in return for planned emissions reductions, introduced 2001.
[7] EU Emissions Trading Scheme encouraging organisations to cut emissions by enabling them to trade emissions certificates, introduced 2005.
[8] Gas turbine CHP unit at Wissington factory rated at 106 MWth under the IPPC permit, which delivers 85% thermal and electrical efficiency.
[9] British Sugar technical database, 1997-2007.

4. AGRICULTURAL EFFICIENCY AND LAND USE

4.1 Contribution to the Food Chain and Land Use Changes

- Sugar beet feedstock used to produce bioethanol at Wissington is sourced from established UK arable farmers based in the East of England and East Anglia. Land used to grow the crop has been under arable cultivation for decades, and most of the suppliers are long-established farmers.
- Cultivation of sugar beet for bioethanol in the UK is therefore not associated with deforestation or direct land use change.
- Sugar beet productivity is continuously improved, driven by a combination of application of research results, seed breeding, better technology, integrated extension services and specific targeted initiatives.
- As a result, UK sugar beet yields have consistently and continuously increased – by 50% in the last 20 years.[10]
- Sugar beet yields now average c 10 tonnes of sugar/hectare. These yields are consistently ranked in the top quartile of EU producers, and are comparable with the better sugar cane regions of the world, e.g. Brazil.[11] [12]
- Reform of the EU sugar sector has driven rationalisation in all European sugar industries, including the UK's. A consequence of this has been a substantial net reduction in sugar beet produced and area grown. [13]
- The total area of sugar beet grown for food and bioethanol in 2008 is consequently 65,000 hectares (40%) lower than the area used in 1998[14], when no bioethanol was produced.
- This reduction in crop area demonstrates that there has been no medium-term indirect land use change associated with bioethanol production at Wissington.
- Bioethanol made from sugar beet also generates high energy animal feed co-product, derived from the fibrous part of the plant. This material is roughly equivalent by weight to the tonnage of bioethanol produced.[9]
- Wissington bioethanol production therefore makes a direct, and substantial, contribution to the food chain, as well as creating renewable energy.
- Sugar beet supplied to Wissington is sourced from local farms, whose average transport distance is about 50km.

4.2 Agricultural Standards

- Primary research on the UK sugar beet crop has been carried out by Broom's Barn Research Station[15] for over 40 years. The main research output is directed towards designing an optimum strategy for sugar beet cultivation in the UK, including best practices for all key crop operations and inputs. Peer reviewed research results are incorporated into technical manuals provided to sugar beet growers, including The Sugar Beet Crop – Science into Practice,[16] and the Sugar Beet Grower's Guide[17]. These define recommended agricultural, environmental and sustainability standards and practices for

[10] British Sugar crop database, 1987-2007.
[11] Brazilian Ministry of Agriculture, Livestock and Supply, 2006.
[12] USDA Economic Research Service, 2005.
[13] UK data reported to the Rural Payments Agency, 1997-2007, shows a net reduction in UK sugar production of over 200,000 tonnes/year in the last 10 years.
[14] Crop area statistics reported to the European Commission, 1998-2008.
[15] Broom's Barn Research Station is a division of Rothamsted Research, and is funded partly by the British Beet Research Organisation (BBRO), and partly from other sources.
[16] The Sugar Beet Crop – Science into Practice, DA Cooke and RK Scott, 1993.
[17] Sugar Beet: A Grower's Guide, British Beet Research Organisation, January 2002.

growing sugar beet, and are used to advise growers.

- In conjunction with the NFU, British Sugar has drawn up and applied since the late-1990s, a pioneering crop supply audit scheme,[18] in which a random selection of growers were personally audited annually on key aspects of crop production. The results from the audit have been compiled into a national database, and also fed back to individual growers. In both cases results have been compared to the national best practice standards and recommendations, and corrective action followed up as appropriate.
- From 2008 all sugar beet growers supplying to British Sugar must become accredited members of the Assured Combinable Crops and Sugar Beet Scheme (ACCSBS)[19] as part of their contract conditions as suppliers. This scheme was amended in July 2007 to introduce new standards relating to biodiversity and uncultivated land use conversion as well as incorporating sugar beet standards.
- Crop inputs are optimised using the crop database as a reference point. This practice of continuous improvement has led to reductions in nitrogen fertiliser use of over 30%, and reductions in total pesticide applications of over 60% since 1980.[20]

[18] British Sugar Food Safety Audit Scheme, first introduced in 1997.

[19] Assured Combinable Crops Scheme, as amended to include sugar beet, biodiversity and uncultivated land use conversion, July 2007.

5. ENVIRONMENTAL CRITERIA

5.1 Benefits to Biodiversity

Sugar beet supplies

- Sugar beet is widely recognised as one of the most valuable "break crops" in the English arable rotation.[20] Because its host pests and diseases are generally different from those of the following cereal crops, the cultivation of sugar beet reduces disease and pest levels in the rotation, so contributing to reduced pesticide applications.
- It also improves soil fertility.[21] Plant residues from the crop (e.g. leaves and root fragments) break down slowly releasing nutrients into the soil over a long period of time. Levels of inorganic bought-in fertiliser (especially nitrogen) applied to the following cereal crops are therefore scaled down proportionately.[10]
- The value of sugar beet to biodiversity, in particular birdlife, has been recognised by DEFRA [20], as well as by both the RSPB and English Nature (Natural England) in their submissions to the EFRA Select Committee (2004) and the DEFRA consultation on reform of the European sugar sector (2004).
- The RSPB comments that sugar beet production in the UK is *"associated with a uniquely high wildlife conservation benefit"* and supports *"internationally important populations of pink-footed geese and nationally important populations of stone-curlews".*[22]
- English Nature states that *"sugar beet cultivation is of particular importance for farmland birds"* and *"helps support internationally important bird populations"*. Because it is spring sown and harvested late, these benefits result from *"the winter stubbles left in the ground until the spring sowing; the open vegetation structure in the late spring; weeds in the crop providing a food source for breeding birds and over the following winter; and the opportunities provided by post-harvest sugar beet stubble."* [21]
- Clause 5.11 of the ACCSBS supports the value of sugar beet for biodiversity by requiring sugar beet suppliers to implement practices which minimise detrimental impact on important features of biodiversity and conservation value in and around the farm.

Process plant operations

- Ecological management assessments are carried out for all sites, including Wissington, in conjunction with external specialist consultants.
- The assessments are reviewed at least once every three years.
- British Sugar complies with UK legislation for protected species, including nesting birds, great-crested newts and bats.

5.2 Soil Conservation

Sugar beet supplies

- Fertiliser application to the sugar beet crop by growers is monitored and strictly controlled to ensure the optimum amount is used for crop production.

[20] DEFRA report on Sugar Beet and the Environment in the UK, June 2002.
[21] English Nature submission to the DEFRA consultation on reform of the CAP sugar beet regime, January 2004.
[22] RSPB evidence submitted to the EFRA Select Committee, March 2004.

- Sugar beet crop deliveries are individually analysed for nutrient status, including the content of nitrogen and other fertilisers.[23] This data is compiled together to monitor national trends, and recommendations are tailored for individual growers to avoid over-application.
- Nitrogen fertiliser applications to the UK sugar beet crop have been reduced by over 30% since 1980.[10] [20.]
- Section 5 of the ACCSBS sets out standards and recommendations for fertiliser use and crop nutrition, including a requirement to undertake regular soil analysis.
- In addition, UK producers are required to ensure that production is carried out in accordance with Good Agricultural and Environmental Conditions (GAEC)[24] standards as set out by DEFRA. UK producers are regularly audited by the Rural Payments Agency to confirm compliance with these standards.
- British Sugar conducts audits at harvest time to ensure that the amount of crop material left on the field after harvest is minimised. This has reduced losses by well over 50% since 1995.[25]
- Remaining plant material (leaves and root fragments) degrades and releases nutrients slowly, thereby enhancing soil fertility. [21]
- Like other arable crops, sugar beet can occasionally be subject to spring time wind erosion on light soil types. However, husbandry measures have been modified in susceptible areas to combat this and, in practice, it is not a significant source of soil loss.
- Water erosion only occurs where fields are steeply sloping, and at times of exceptionally heavy spring rainfall. As the majority of UK sugar beet fields are flat, this is seldom encountered.

<u>Process plant operations</u>

- In common with other root crops, when sugar beet is harvested some soil adheres to the root and is removed from the field.
- Although a relatively small proportion of the total crop deliveries (less than 5%), this constitutes a significant source of soil erosion (equivalent to about 100,000 tonnes/year at Wissington) and special measures have therefore been put in place to mitigate its environmental effects.
- Crop deliveries are analysed for the amount of soil inclusion (the “soil tare”) and prices paid to growers are reduced accordingly to encourage soil tares to be as small as possible.
- In addition, British Sugar has carried out a scheme with growers for many years to encourage good practice during harvesting including minimising each grower’s soil tare by cleaning the crop on field.
- A combination of these measures has halved the amount of soil delivered per tonne of beet over the last 25 years, resulting in the UK sugar industry having a soil tare which is at the limit achievable with dry handling equipment, and which is the lowest in the EU. [20]

[23] British Sugar analysis for N, P and K fertiliser content of deliveries, with results available for growers on-line.

[24] Good Agricultural and Environmental Conditions (GAEC) was introduced by DEFRA in 2003 to be able to demonstrate that introduction of the Single Farm Payment Scheme led to good environmental practices and public good.

[25] Harvester loss assessments are carried out each year on about 70% of the crop to assess root losses and damage, and recommend corrective action.

- All the soil delivered to factories with the crop is extracted, graded and used productively. Roughly half is conditioned and used in the topsoil market for garden centres, landscaping and amenity applications[26]. The remainder is either repatriated back to agricultural land under the supervision of the Environment Agency, or used for reclamation projects on site.
- It is not possible to return reclaimed soil to sugar beet fields, because of restrictions imposed to control crop diseases.

5.3 Sustainable Use of Water Resources

Sugar beet supplies

- Sugar beet in the UK is not normally irrigated except in severe drought conditions. Over 95% of the crop is rain-fed.
- In the few cases where irrigation is used on sugar beet, water abstraction is strictly controlled and monitored by the Environment Agency under a system of farm abstraction licenses.

Process plant operations

- Water use at Wissington is strictly controlled by a combination of internal procedures and external legal requirements. Full site water usage audits are carried out, which demonstrate that 77% of all water streams used at Wissington are derived from recycled sources.[27]
- Water abstracted from the River Wissey has been cut by 30% in the last 5 years.[27]
- The overall process is a net creator (not user) of water, as the crop is roughly 75% water by weight. The quantity of water returned to the river is therefore almost three times that abstracted.[27]
- The quality of the cleaned water returned to the river is controlled by the Environment Agency, and is required to meet the stringent environmental standards defined in the discharge permit.
- Despite these rigorous standards, due to the complex nature of operating biological treatment plants, accidental breaches of consent do occasionally occur. All incidents are subject to fully documented internal investigation and a detailed report, including actions to prevent re-occurrence, is sent to the Environment Agency.
- In practice, significant breaches are rare. Since the IPPC permit was issued there have been four minor incidents. These have been classified at the lowest "category 4" level, "*a non compliance which has no potential environment effect*", under the Environment Agency's compliance category scheme. There have been no examples of breaches causing river pollution at Wissington in the last 15 years.

[26] Conditioned soil is sold as a co-product under the brand name "Topsoil".
[27] British Sugar Wissington factory full site water usage audits and auditable water data.

5.4 Air Quality

Sugar beet supplies

- Burning of crop residues is not undertaken in the sugar beet sector.

Process plant operations

- Operations at all British Sugar sites, including Wissington, are covered by the EU IPPC Directive[28] and a permit to operate issued by the Environment Agency.[29]
- These legal restrictions include strictly enforced standards for atmospheric emissions, in terms of quantity and air quality.

[28] EU Directive 61/1996 on Integrated Pollution Prevention and Control.

[29] Permit to operate issued by the Environment Agency under the Pollution Prevention and Control (England and Wales) Regulations, 2000.

6. SOCIAL CRITERIA

6.1. Workers' Rights and Working Relationships

- *Compliance with national laws on working conditions and workers' rights.*
  British Sugar's contractual conditions with its employees are substantially above the minimum EU and national legal requirements covering employment and workers' rights (including minimum national wages, working conditions and hours, health and safety, severance terms, pension rights, training and development etc).
  British Sugar's relations with UK's sugar beet suppliers are governed by EU and UK legislation, and are set out in a detailed contract (the "Inter-Professional Agreement") negotiated regularly between the NFU (representing all UK sugar beet growers) and British Sugar.

- *Contracts*
  All British Sugar employees, whether permanent or seasonal, have employment contracts in which all the above standards are covered. Employees are represented by the UNITE and GMB Unions. Farm suppliers to British Sugar are independent (i.e. not employed by British Sugar). However, they have beet supply contracts with BS which are negotiated on their behalf by the NFU.

- *Provision of information*
  Bargaining rights are clearly defined and transparent and are communicated to British Sugar employees via their Unions (UNITE and GMB); and to sugar beet suppliers by the NFU. These communications are frequent and regular.

- *Subcontracting*
  British Sugar enforces strict conditions which contractors are expected to uphold e.g. for working practices and safety standards. These conditions are built into the contracts agreed with contractors for the assignment they are undertaking.

- *Freedom of association and right to collective bargaining*
  As stated above, British Sugar employees have full rights for collective bargaining each year through their unions; sugar beet suppliers are represented contractually by the NFU.

- *Child and forced labour*
  There is no child or forced labour in the UK sugar beet industry. Young people can only work if they are above the minimum working age (normally 16). Young employees above this age qualify for exactly the same employment rights as older employees.

- *Health and safety*
  British Sugar workplaces are subject to strict health and safety conditions set out in the company's policy. All forms of accident are reported, investigated and followed up. In the last 5 years, injuries and reportable accidents at Wissington plant have been reduced by over 60%.[30] Crop suppliers are subject to UK health and safety legislation. Accidents are required to be reported to the HSE.

[30] British Sugar safety and accident reporting procedures and database, 2002-2007.

- *Wages/compensation*
  All British Sugar employees are paid above the national minimum wage, with payments made monthly by electronic bank transfer. All payments are audited. British Sugar is well-known for the high standards of its employee contracts, including severance terms. Crop suppliers are paid a minimum beet price plus enhancements negotiated by the NFU. All grower payments are also audited.

- *Discrimination*
  All employees in the industry are protected by strict anti-discrimination legislation covering racial, disability or sexual abuse.

6.2 Land Rights and Community Relations

- *Land rights issues*
  Land ownership and tenancy rights are strictly controlled and enforceable through UK legislation. The general public also has certain rights which are independent of land ownership, for example public rights of access (e.g. footpaths) wildlife reserves, public and common land, public access to beaches, the "right to roam". Land rights issues are extremely rare with sugar beet suppliers. The new ACCSBS Operating Procedures from 2007/08 state: "*The producer must know who owns the land being farmed and must be able to confirm that he has the right to grow and sell crops grown on the land*". It is a condition of the contract between British Sugar and sugar beet growers that this is enforced.

- *Consultation and communication with local stakeholders*
  In the UK industry, consultation with local stakeholders occurs at two levels. First British Sugar is contractually required to agree any significant changes with the NFU, representing all growers; and with the Unions, representing employees. Beyond this, all planning applications are subject to approval by the local authorities and for certain issues, the Environment Agency. Also, any substantial national policy changes are subject to public consultation, as happened in the EU 2004 sugar reform negotiations, when DEFRA held two public consultations and there were two Select Committee inquiries. British Sugar also has a regular dialogue with leading NGOs, including WWF, RSPB, Friends of the Earth, Greenpeace and OXFAM.

7. REFERENCES

1. Associated British Foods plc annual report, 2007.
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23. British Sugar analysis for N, P and K fertiliser content of deliveries, with results available for growers on-line.
24. Good Agricultural and Environmental Conditions (GAEC) was introduced by DEFRA in 2003 to be able to demonstrate that introduction of the Single Farm Payment Scheme led to good environmental practices and public good.
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26. Conditioned soil is sold as a co-product under the brand name "Topsoil".
27. British Sugar Wissington factory full site water usage audit and auditable water data.
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