



July 2010

Better Sugar Cane Initiative Production Standard



Principles and Criteria

Members recognize that there are sound business reasons to identify and adopt sustainable sugarcane production and processing practices and these Principles and Criteria (P&C) provide a framework within which such practices can be demonstrated. The P&C address sugarcane production in the field and processing issues in the mill, including all sugarcane derived products, as they incorporate economic, financial, environmental and social dimensions and reflect good industry practices for the sugarcane sector.

We believe that adoption of these P&C's will generate business benefits and opportunities, as well as providing safe and secure employment and protection of the environment. To be effective the P&C's need to be delivered in the context of long term economic and financial viability for individual companies and the sector as a whole, and through timely and transparent disclosure of information on company environmental and social performance to stakeholders.

We further believe that the implementation of these P&C's across the sugarcane industry is an important undertaking given the significance and growth of sugarcane and all its derived products.

Specific tools will be developed in order to detail the procedures that producers will have to follow to proceed to a self-assessment of their performances against the production standard.

The standard is intended to constitute an auditable document and not merely a reporting framework, according to ISO 65. All Indicator Notes have been amplified in the accompanying BSI Standard Audit Guidance document

Accordingly, Members undertake to:

- PRINCIPLE 1. Obey the law.**
- PRINCIPLE 2. Respect human rights and labour standards.**
- PRINCIPLE 3. Manage input, production and processing efficiencies to enhance sustainability.**
- PRINCIPLE 4. Actively manage biodiversity and ecosystem services.**
- PRINCIPLE 5. Continuously improve key areas of the business**

In order to achieve compliance with BSI Standards and therefore be entitled to BSI certificates, 80 % of the indicators contained in principles 1 to 5 must be satisfied. In addition, there are a number of core criteria which must be fully satisfied before compliance will be considered. The core criteria are:

- 1.1 To comply with relevant applicable laws.
- 2.1 To comply with ILO labour conventions governing child labour, forced labour, discrimination and freedom of association and the right to collective bargaining.
- 2.4 To provide employees and workers (including migrant, seasonal and other contract labour) with at least the national minimum wage.
- 4.1 To assess impacts of sugarcane enterprises on biodiversity and ecosystems services.
- 5.7 For greenfield expansion or new sugarcane projects, to ensure transparent, consultative and participatory processes that address cumulative and induced effects via an environmental and social impact assessment (ESIA).

All abbreviations used are listed in Appendix 1.

July 2010

The Production Standard is the outcome of a multi-stakeholder process, www.bettersugarcane.com Technical Consultants to the project were Dr Peter Rein, Peter Turner and Maryline Guiramand.

* The BSI is a not for profit company limited by guarantee, registered in the United Kingdom

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Introduction to 'BSI EU'

For the production of ethanol intended to be put onto the European Union market, the following additional requirements and rules apply:

In order to obtain a 'BSI EU certificate' from the Better Sugarcane Initiative, compliance with BSI standard must be met, that is to say 80% compliance with indicators contained in principles 1 to 5 and full compliance with the core criteria. In addition, full compliance with the additional requirements listed under section 6 of the production standard is mandatory.

Section 6 covers the requirements for biofuels under the EU Renewable Energy Directive (RED) 2009/28/EC and the revised Fuel Quality Directive (FQD) 2009/30/EC. References in the BSI documentation to EU requirements refer to the Renewable Energy Directive. Where the Fuel Quality Directive contains a corresponding provision, they apply equally to that Directive.

Pending recognition by the European Commission in the form of a Decision published in the Official Journal of the European Union, the BSI scheme intends to cover:

- accurate data for the purposes of measuring greenhouse gas savings for the purpose of Article 17(2);
- mandatory land use sustainability criteria in the EU legislation within Article 17(3) to (5);
- other sustainability issues covered in the second subparagraph of Article 18(4), namely measures taken for the conservation of areas that provide basic ecosystem services in critical situations (such as watershed protection and erosion control), for soil, water and air protection, the restoration of degraded land, the avoidance of excessive water consumptions in areas where water is scarce;
- issues listed in article 17(7)

Verification System

Attached to the BSI Production Standard, the Certification Protocol covers the verification and audit requirements for BSI EU certificates' claims. In particular, it specifies

- the documentation management;
- how the yearly retrospective audit on a sample of claims is planned, conducted and reported upon;
- the procedure for the auditors selection, accreditation and training to ensure they are independent, external, have both the generic and specific skills to undertake the tasks required;
- the validity of a BSI EU certificate, as defined in the BSI Certification Protocol.

Attached to the BSI Production Standard, the Chain of Custody Standard and its guidelines are designed to ensure that a warrant, compiling the sustainability characteristics, remains assigned to a biofuel consignment. BSI arranges for a Mass Balance check and balances of claims made under the scheme, that ensures that among these characteristics are:

- a description of the raw material used (sugarcane)
- the proportion of production/processing residues (molasses) used in the production, if possible;
- the country of origin;
- evidence showing compliance with the required criteria;
- the sugarcane was obtained in a way that complies with the mandatory land use restrictions criteria;
- a GHG emissions figure derived from criteria 6.1.;
- a statement that the produce was awarded a certificate of type 'BSI EU' from the Better Sugarcane Initiative (BSI).

Mills and their cane supply area wishing to become BSI EU compliant must implement and demonstrate compliance to both the this Production Standard AND the Chain of Custody Standard, including their additional EU RED requirements.

CRITERIA	INDICATOR	Processing & Milling	Agriculture	Verifier	Standard	NOTES
1.1 To comply with relevant applicable laws.	Relevant national laws and international conventions complied with	•	•	Yes/No	Yes	Relevant legislation includes laws and international conventions, but is not limited to: regulations governing land tenure and land-use rights, labour, agricultural practices, environment, transportation and processing practices, acting with integrity. A list of relevant international conventions is included in Appendix 2. The more strict regulation or convention ratified by the country - national or international - should prevail unless otherwise specified. The principles and criteria in this standard provide some guidance for defining the relevant laws.
1.2 To demonstrate clear title to land in accordance with national practice and law.	The right to use the land can be demonstrated and is not legitimately contested by local communities with demonstrable rights.	•	•	Yes/No	Yes	Those rights can be related either to legal ownership or lease of the land or to customary rights. Legal ownership shall be the official title in the country (e.g. notary, government agency or other). Guidance for customary rights is provided in ILO conventions 169 and 117. See also Criterion on participation and Criterion on Environmental and Social Impact Assessment 5.7.

KEY TO INDICATORS:

- Symbol indicates to whom it applies



PRINCIPLE 2. Respect Human Rights and Labour Standards

CRITERION	INDICATOR	Processing & Milling	Agriculture	Verifier	Standard	NOTES
2.1 To comply with ILO labour conventions governing child labour, forced labour, discrimination and freedom of association and the right to collective bargaining.	Minimum age of workers	•	•	Years	18 for hazardous work 15 for non hazardous work	Definition of Child labour in Appendix 1 & Appendix 2 (Convention 138 and C182). As per ILO Art 3 C 138 and C182, the minimum age for admission to any type of employment or work which by its nature or the circumstances in which it is carried out is likely to jeopardise the health, safety or morals of young persons shall not be less than 18 years (see also art 16, Convention 184 Health and Safety in Agriculture). Work by children on family small holdings is only acceptable under adult supervision and when work does not interfere with the child's schooling and does not put at risk his or her health.
	Absence of forced or compulsory labour	•	•	Yes/No	Yes	Forced or compulsory labour as defined per ILO Convention 29 and ILO 105. The major forms of forced or compulsory labour are defined in Appendix 1. Verification shall address all male and female workers.
	Absence of discrimination	•	•	Yes/No	Yes	Discrimination as defined by ILO C111 (see full definition in Appendix 1). Verification to be done by interviewing workers
	Respect the right of all personnel to form and join trade unions and/or to bargain collectively in accordance with the law.	•	•	Yes/No	Yes	Employers should respect such rights and should not interfere with workers' own efforts to set up representational mechanisms in accordance with the law.
2.2 To apply BSI human rights and labour standards to suppliers and contractors.	Percentage of contractors and major suppliers who have demonstrated compliance with human rights and labour standards	•	•	%	95	Labour contractors and major suppliers to the mill and to cane growers shall demonstrate compliance with basic human rights (e.g. no forced labour, no child labour, no discrimination, freedom of association and labour standards, etc.). Effective compliance will be verified by auditors by sampling at mill and farm level. The existence of codes of conduct in contracts will be considered as proof of compliance. Sampling method based on volume provided by supplier to the mill

2.3 To provide a safe and healthy working environment in work place operations.	Lost time accident frequency	•	•	number per million hours worked	Mill <15; Agric < 45	A lost time accident is defined as an incident involving an employee which causes him to be unable to carry on with his/her normal duties on the next day or next shift due to injury. Where a fatal injury occurs, this to be noted separately
	Assessment of the main health and safety risks and measures implemented for mitigation of risk	•	•	Yes/No	Yes	Key health and safety risks to be known and assessment formalized. Assessment to be performed at least once a year. Measures to be taken to either eliminate risk, prevent risk or reduce risk in agreement with national laws if existing. The recommendations 192 of ILO Convention 184, or national laws if any provide guidance for the list of key potential areas of risks to assess.
	Appropriate personal protective equipment supplied to and used by all workers.	•	•	Yes/No	Yes	Regular maintenance and effective use of personal protective equipment.
	Training for health and safety.	•	•	%	90	The standard is an average measure, of the % of new employees receiving training, and the % of existing employees getting updated training at least every 5 years (e.g. promotion and participation in health and safety seminars, lectures, campaigns, etc). Employees and workers (including migrant, seasonal and other contract labour) to have basic training in health and safety measures related to their operation upon starting work and then with regular updating. Effective compliance can be verified by sampling.
	Availability of sufficient safe drinking water to each worker present on the field and/or mill.	•	•	Yes/No	Yes	Visual check of access to sufficient drinking water especially under high temperature conditions, and of absence of contamination sources near the drinking water source.
	Access to first aid and provision for emergency response.	•	•	Yes/No	Yes	Access to first aid and proximity as defined by national legislation or in absence by ILO
2.4 To provide employees and workers (including migrant, seasonal and other contract labour) with at least the national minimum wage.	Ratio of lowest entry level wage including benefits to minimum wage and benefits required by law.	•	•	\$/ \$	>=1	Mimimum wage as fixed by legal requirement and in the absence of same, ILO C131 can serves as a basis for the definition.
2.5 To provide clear, equitable and comprehensive contracts.	Existence of a contract or equivalent document.	•	•	%	100	All workers to be provided with a contract or equivalent document (e.g. national working card), to be aware of their rights, and to be paid in a form and at a frequency convenient to them.If not specified by the law the contract shall include at least the following elements: hours of work, overtime payment, notice, holidays, wages, and mode of payment. Payment of wages in conformity with ILO Convention no. 95 and ILO C110.

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CRITERION	INDICATOR	Processing & Milling	Agriculture	Verifier	Standard	NOTES
3.1 To monitor production and process efficiency; to measure the impacts of production and processing so that improvements are made over time.	Total raw materials used per kg product	•		kg/kg	< 11 if no ethanol produced; <20 for full ethanol production	Sustainability measure includes cane as major raw material as well as material amounts of chemicals, fuels etc. Standard required varies between 2 limits depending on proportions of sugar and ethanol produced. If a mill exports power, any fuels purchased will not be recorded as raw materials consumed.
	Sugarcane yield		•	tc/ha harvested/y	See Appendix 1	Standard values depend on whether rain-fed or irrigated. Value for reporting period or 5 year rolling average can be used.
	Working hours lost as percent of total hours worked	•		%	< 5	This represents working hours lost through absence (all unplanned causes - strikes, sickness, absenteeism etc. but not holiday, legal time off such as maternity leave, or training)
	Mill overall time efficiency	•		%	75	Processing time as a percentage of total time. Value for reporting period or 5 year rolling average can be used.
	Factory Performance Index	•		%	90	Used if sugar and not ethanol is produced. Ratio of actual sugar recovery to theoretical recovery of sugar from cane. In rare cases where high grade molasses is exported for fermentation, industrial efficiency can be used instead.
	Industrial Efficiency	•		%	75	Used if ethanol only or sugar and ethanol are produced in the same mill. It is the ratio of (sugar+equivalent ethanol+eq.sucrose in molasses)/(sucrose in cane+RS in cane converted to sucrose+RS in molasses converted to sucrose+yeast eq to sucrose), expressed as a %.
3.2 To monitor global warming emissions with a view to minimizing climate change impacts.	Global warming burden per unit mass product	•	•	t CO ₂ eq/t sugar	Total <0.4	Field-to-gate emissions. Environmental Burden is t carbon dioxide equivalent.
		•	•	g CO ₂ eq/MJ	Total < 24	Only used if ethanol is produced. Environmental Burden is g carbon dioxide equivalent.

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PRINCIPLE 4. Actively manage biodiversity and ecosystem services

CRITERION	INDICATOR	Processing & Milling	Agriculture	Verifier	Standard	NOTES	
4.1 To assess impacts of sugarcane enterprises on biodiversity and ecosystems services.	Aquatic oxygen demand per unit mass product	•		kg/t	1 kg COD or 0.5 kg BOD ₅	Oxygen demand by calculation of quantity and analysis of runoff. Environmental burden can be expressed in terms of either COD or BOD ₅ , depending on routine measurements available.	
	Percent of areas defined internationally or nationally as legally protected or classified as High Conservation Value areas (interpreted nationally and officially as described in Appendix 1) planted to sugarcane after the cut off date of 1 January 2008.		•	%	0	To prevent expansion or new sugarcane development into areas of critical biodiversity (including HCVA categories 1-4). National definitions of HCVA to take precedence over international where both exist. In the absence of national HCVA maps or data base, credible documentary evidence required that no HCVA converted after 1 Jan 2008.	
	Existence and implementation of an environmental management plan (EMP) taking into account endangered species, habitats and ecosystems as well as reference to ecosystem services and alien invader plant and animal control. Coverage of issues required in Appendix 4.		•		%	90	To protect any existing riparian areas, wetlands or other significantly affected natural habitats in a satisfactory state, to provide habitat corridors and to conserve any rare, threatened or endangered species.
	Use of co-products does not affect traditional uses (e.g. fodder, natural fertilizer, local fuel) or affect the soil nutrient balance or soil organic matter	•		•	Yes/No	Yes	Use of agricultural co-products as inputs must not jeopardize local uses or adversely affect soil quality
	Fertilizer applied according to soil or leaf analysis			•	Yes/No	Yes	
	Nitrogen and phosphorus fertilizer (calculated as phosphate equivalent) applied per hectare per year			•	kg/ha/y	<120	Environmental burden is kg phosphate equivalent as defined in Appendix 1 - measuring risk (i.e. amounts applied) rather than level in downstream water. Quantities of nitrogen and phosphorus fertilizer applied calculated as the phosphate equivalent as a measure of potential effects on eutrophication per hectare per year. To minimise losses from over application and consequent ground water or downstream contamination.
	Herbicides and pesticides applied per hectare per year			•	kg active ingredient/ha/y	5	To minimise air, soil and water contamination. Quantities of pesticide (including herbicides, insecticides, fungicides, nematicides, ripeners) applied calculated as a measure of potential toxic effects on environment. Also note the requirement to use only products registered for use and at registered rates and to comply with the Stockholm convention on persistent organic pollutants and requirements in relation to agrochemicals rated as 1a, 1b or 2 under World Health Organisation (WHO) classification.
4.2 To implement measures to mitigate adverse impacts where identified.	Documented plan and implementation of mitigation measures	•	•	Yes/No	Yes	Existence of a list of identified adverse impacts such as smoke, fallout from fires, water pollution downstream, drift from agrochemical spraying and noise. Existence of a mitigation plan, and verification of the implementation of mitigation measures, including consultation with affected stakeholders. Programs with objectives developed at the sectorial level can be considered.	

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PRINCIPLE 5. Continuously improve key areas of the business

CRITERION	INDICATOR	Processing & Milling	Agriculture	Verifier	Standard	NOTES
5.1 To train employees and other workers in all areas of their work and develop their general skills.	Training expense of workers as a percentage of payroll expense.	•	•	%	1.0	Total training expenses for all personnel, split between factory and basic workers, intermediate management and upper management.
5.2 To continuously improve the status of soil and water resources.	Net water consumed per unit mass of product	•	•	kg/kg	Mill, 20 kg/kg sugar or 30 kg/kg ethanol. Agric <130 kg/kg cane	In agriculture, water captured/bought for use in irrigation; in processing, water used less water returned from mill to water courses.
	% Ground cover of tops or leaves after harvest		•	%	>20	To ensure the continuous improvement of soil organic carbon
	Soil surface mechanically tilled per year (% of area under cane)		•	%	<20	To minimise the opportunity for erosion. Soil surface tilled per year. Hectares tilled as a percentage of area under cane.
	Percent fields with samples showing analyses within acceptable limits for pH.		•	%	> 80	To ensure the maintenance of acceptable soil pH. Sampling to be carried out at least once per crop cycle.
5.3 To continuously improve the quality of sugarcane and products from the sugar mill.	Theoretical recoverable sugar content of cane	•	•	%	>10	The theoretical recovery normalized for juice purity and cane fibre content calculation shown in Appendix 1. Value for reporting period or 5 year rolling average can be used. Used only if ethanol not produced
	Fermentable total sugars content of cane, expressed as invert (TSAI).	•	•	kg/t cane	>120	Used if ethanol is produced, on its own or in conjunction with sugar production. Based on a 90.5 % utilization of Total Sugars As Invert (TSAI). Known as ATR in Brazil. Value for reporting period or 5 year rolling average can be used.

5.4 To promote energy efficiency.	Total Net Primary Energy Usage per kg product	•	•	kJ/kg	Total <3000	Direct and indirect energy inputs. See Appendix 3 for details
	Energy used in cane transport per tonne cane transported	•	•	MJ/t cane	<50	See Appendix 3 for details
	Primary energy use per tonne of sugarcane		•	MJ/t	<300	See Appendix 3 for details.
5.5 To reduce emissions and effluents. To promote recycling of waste streams where practical.	Atmospheric acidification burden per unit mass product	•	•	kg/t	< 5	Environmental Burden is kg sulphur dioxide equivalent.
	Non-hazardous solid residues per tonne cane	•	•	t/t cane	< 1.0	By-products of processing, namely stillage, compost, filter cake, soil/mud, boiler ash, bagasse.
5.6 To foster effective and focused research, development and extension expertise.	Research and extension costs as a % of sales.	•	•	%	>0.5	Includes levies to research institutes for research and extension.
5.7 For greenfield expansion or new sugarcane projects, to ensure transparent, consultative and participatory processes that address cumulative and induced effects via an environmental and social impact assessment (ESIA).	Compliance with a recognized ESIA	•	•	Yes/No	Yes	Cut-off date 1 January 2008. The ESIA shall cover all aspects related to baseline surveys and assessments, implementation, mitigation, monitoring and evaluation plans as required. Transparency and participatory consultation with all relevant stakeholders required. Where an impact assessment is required by national, regional, and/or local laws, the process shall be integrated to avoid duplication of effort.
	High Conservation Value areas (interpreted nationally as described in Appendix 1) used as a % of total land affected by a new project or an expansion	•	•	%	0	Cut-off date 1 January 2008. NB This indicator duplicated in 4.1.2 but here it includes HCV categories 5 and 6.
5.8 To ensure active engagement and transparent, consultative and participatory processes with all relevant stakeholders.	Existence of a recognized grievance and dispute resolution mechanism for all stakeholders	•	•	Yes/No	Yes	Existence of an official dispute resolution mechanism recognized by all stakeholders. Channel of communication (eg ombudsman, dedicated phone line) can be considered if recognized by all stakeholders.
	Percentage of meetings of stakeholder engagement where agreement has been reached by consensus driven process	•	•	%	90	Establish whether a process exists for consultation where all the stakeholders (gender sensitive and including indigenous people) are provided with information in advance of consultation and which results in consensus-driven negotiated agreements. Evidence of negotiated agreements to be demonstrated.
5.9 To promote economic sustainability.	Value added / tonne cane	•	•	\$/t cane	Mill >4; agric >2	Value added by the operation is the value of sales less the price of goods, raw materials (including energy) and services purchased.

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CRITERION	INDICATOR	Processing & Milling	Agriculture	Verifier	Standard	NOTES
6.1 To monitor global warming emissions with a view to minimizing climate change impacts.	Global warming burden per unit of energy	•	•	g CO ₂ eq/MJ	Total <50	<p>To calculate the greenhouse gas emissions from the production and use of sugarcane ethanol, the disaggregated default values provided in point D of the annex V of the EU Directive must be used. The calculation of actual values is not permitted at present.</p> <p>The default value is the sum of the default value for cultivation: 14 g CO₂eq/MJ + the default value for processing (including excess electricity): 1 g CO₂eq/MJ + the default value for transport and distribution: 9 g CO₂eq/MJ.</p> <p>In addition, greenhouse gases emissions resulting from changes in land carbon stocks must be added to the default values from the production and use of sugarcane ethanol. Emissions from carbon stocks changes must be calculated in accordance with Appendix 5 of this standard and Appendix 4 of the Audit guidance. Emissions from the manufacture of machinery and equipment shall not be taken into account.</p> <p>In future revisions of section 6 of the Standard, the possibility of using actual values will be offered. The methodology to calculate actual values will follow the rules established by the Directive 2009/28/EC and the procedures will have to be submitted to the European authorities for formal approval.</p>
6.2 To protect land with high biodiversity value, land with high carbon stock and peatlands.	Percentage of land with high biodiversity value, high carbon stock or peatlands planted to sugarcane after the cut off date of 1 January 2008.		•	%	0%	<p>Land with high biodiversity value. Land that had one of the following statuses in or after January 2008, whether or not the land continues to have that status:</p> <p>(a) primary forest and other primary wooded land, namely forest and other wooded land of native species, where there is no clearly visible indication of human activity and the ecological processes are not significantly disturbed;</p> <p>(b) areas designated by law or by the relevant competent authority for nature protection purposes; or for the protection of rare, threatened or endangered ecosystems or species recognised by international agreements or included in lists drawn up by intergovernmental organisations or the International Union for the Conservation of Nature, subject to their recognition by the European Commission; unless evidence is provided that the production of that raw material did not interfere with those nature protection purposes;</p> <p>(c) highly biodiverse grassland that is: (i) natural grassland that would remain grassland in the absence of human intervention and which maintains the natural species composition and ecological characteristics and processes; or (ii) non-natural grassland that would cease to be grassland in the absence of human intervention and which is species-rich and not degraded, unless evidence is provided that the harvesting of the raw material is necessary to preserve its grassland status.</p> <p>(d) new nature protection areas derived from a published European Commission decision</p> <p>Land with high carbon stock: Land that had one of the following statuses in January 2008 and no longer has that status:</p> <p>(a) wetlands, namely land that is covered with or saturated by water permanently or for a significant part of the year;</p> <p>(b) continuously forested areas, namely land spanning more than one hectare with trees higher than five metres and a canopy cover of more than 30 %, or trees able to reach those thresholds in situ (It does not include land that is predominantly under urban or agricultural use, understood as tree stands in agricultural systems, such as fruit tree plantations and agroforestry systems when crops are grown under tree cover);</p> <p>(c) land spanning more than one hectare with trees higher than five metres and a canopy cover of between 10 % and 30 %, or trees able to reach those thresholds in situ, unless evidence is provided that the carbon stock of the area before and after conversion is such that when GHG emissions savings is calculated, it complies with the minimum threshold established in criterion 6.1 of BSI standard.</p> <p>Peatland. crops for biofuels cannot be grown on land that was peatland in January 2008 unless the soil was completely drained in January 2008 or there has been no draining of the soil since January 2008.</p>

		Reference																
Company	The entirety of any organization or business entity responsible for implementing the standard.	SA 8000																
Supplier/contractor	A business entity which provides the company with goods and/or services integral to, and utilized in/for, the production of the company's goods and/or services.	SA 8000																
Subcontractor/sub-supplier	A business entity in the supply chain which, directly or indirectly, provides the suppliers with goods and/or services integral to, and utilized in/for, the production of the suppliers's and/or company's goods and/or services.	SA 8000																
Agricultural Worker Categories	There is a lack of clear-cut distinctions between different categories of workers. Consequently, there are numerous types of labour relations and different forms of labour force participation. The different categories of workers also vary within each country and, in certain cases, a single farmer may be grouped in more than one category. Many smallholders supplement their income with wages earned by working in large commercial farms during harvesting periods.	ILO																
	Summary of broad categories of agricultural workers:																	
	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="background-color: #f4a460;">NON WAGED</th> <th style="background-color: #d9ead3;">WAGED</th> </tr> </thead> <tbody> <tr> <td style="background-color: #f4a460;">Large and Middle Scale Farmers</td> <td style="background-color: #d9ead3;">Permanent Workers</td> </tr> <tr> <td style="background-color: #f4a460;">Small Scale farmers</td> <td style="background-color: #d9ead3;">Temporary and Seasonal workers</td> </tr> <tr> <td style="background-color: #f4a460;">Subsistence farmers</td> <td style="background-color: #d9ead3;">Migrant workers</td> </tr> <tr> <td style="background-color: #f4a460;">Unpaid Family workers</td> <td style="background-color: #d9ead3;">Subcontracted Workers</td> </tr> <tr> <td style="background-color: #f4a460;">Collective farmers</td> <td style="background-color: #d9ead3;">INFORMAL SECTOR</td> </tr> <tr> <td style="background-color: #f4a460;">Tenants and Share Croppers</td> <td style="background-color: #d9ead3;">Squatters</td> </tr> <tr> <td></td> <td style="background-color: #d9ead3;">Land-less workers</td> </tr> </tbody> </table>	NON WAGED	WAGED	Large and Middle Scale Farmers	Permanent Workers	Small Scale farmers	Temporary and Seasonal workers	Subsistence farmers	Migrant workers	Unpaid Family workers	Subcontracted Workers	Collective farmers	INFORMAL SECTOR	Tenants and Share Croppers	Squatters		Land-less workers	ILO. <i>Safety and health in Agriculture</i> document
NON WAGED	WAGED																	
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Unpaid Family workers	Subcontracted Workers																	
Collective farmers	INFORMAL SECTOR																	
Tenants and Share Croppers	Squatters																	
	Land-less workers																	
Child	Any person less than 15 years of age, unless local minimum age law stipulates a higher age for work or mandatory schooling, in which case the higher age would apply. If however, local minimum age law is set at 14 years of age in accordance with developing country exceptions under ILO convention 138, the lower age will apply.	ILO																
	The ILO Minimum Age Convention, No. 138 (1973) states that the minimum age of employment should not be less than the age of completion of compulsory schooling and, in any case, shall not be less than 15 years. However a Member country whose economy and educational facilities are insufficiently developed, may under certain conditions initially specify a minimum age of 14 years.	ILO																
Child labour	Any work by a child younger than the age (s) specified in the above definition of a child, except as provided by ILO recommendation 146	ILO																
Young worker	Any worker over the age of a child as defined above and under the age of 18.	ILO																
Worst forms of child labour	Whilst child labour takes many different forms, a priority is to eliminate without delay the worst forms of child labour as defined by Article 3 of ILO Convention 182.	ILO																
Hazardous child labour	Hazardous child labour is defined by Article 3 (d) of the ILO Convention concerning the Prohibition and Immediate Action for the elimination of the worst forms of child labour, 1999 (182) 3D work which, by its nature or its circumstances in which it is carried out is likely to harm the health, safety or morals of children.	ILO																
Occupational accident	An Occupational accident is an unexpected and unplanned occurrence, including acts of violence, arising out of or in connection with work which results in one or more workers incurring a personal injury, disease or death. Included in occupational accidents are travel, transport or road traffic accidents in which workers are injured and which arise out of or in the course of work, i.e. while engaged in an economic activity, or at work, or carrying on the business of the employer. Occupational injury: any personal injury, disease or death resulting from an occupational accident; an occupational injury is therefore distinct from an occupational disease, which is a disease contracted as a result of an exposure over a period of time to risk factors arising from work activity.	ILO Resolution/Convention 155 on statistics of occupational injuries (resulting from occupational accidents), adopted by the Sixteenth International Conference of Labour Statisticians, (Oct.1998)																
Occupational disease	A disease contracted as a result of an exposure to risk factors arising from work activity	ILO																
Reporting period	This will be one year unless otherwise agreed. The period should include a single complete milling season.																	
Theoretical recovery of sugar	The theoretical OR (Overall Recovery) normalized for juice purity and cane fibre content is calculated as:																	
	$OR^* = F^* \cdot SHR^* = 0.98 \cdot \left[100 - \frac{20 \cdot W_{FC}}{100 - W_{FC}} \right] \cdot \left[4.5 - \frac{50}{P_j} \right]$																	
	where W_{FC} is the fibre content of the cane in g/100 g and P_j the purity of the raw juice. In addition, refining all white sugar in a white end refinery is expected to increase the undetermined loss by 0.4 % of the sugar in raw juice. Then the factor 0.98 becomes 0.976.																	
Sugarcane yield	Irrigated - 85; Supplementary 65; Rainfed 45 (total yield per year/total ha cut/weighted average age at harvest) for each category of water regime. Value for reporting period or 5 year rolling average can be used. Seedcane production (yields and area) should be excluded and non cane areas and roads and contours should be excluded from area harvested. (Supplementary = areas where irrigation is necessary to guarantee continuous sugarcane production).	GD Thompson, SA Sugar J. 61,3,126-131 and 4, 161-174.																

Phosphate equivalent as a measure of eutrophication	Since phosphorus and nitrogen differ in their eutrophication effects, a phosphate equivalent conversion is used based on potency factors of 3.06 for phosphorus and 0.42 for nitrogen. Using 120 kg N /ha/y and 20 kg P /ha/y, the figure would be (120 x 0.42) + (20 x 3.06) = 112 kg phosphate/ha/y.	IChemE (2002). Sustainable development progress metrics. Inst. Chem. Engrs. London.
High Conservation Value	<p>High Conservation Value (HCV) areas are defined as natural habitats where conservation/ biodiversity values are considered to be of outstanding significance or critical importance based on factors such as the presence of rare or endemic species, sacred sites, or resources harvested by local residents (see www.hcvnetwork.org). For implementation of the BSI standard each country is required to provide a country specific and official interpretation of High Conservation Value which will be used for audits in that country. A cut off date of 1 January 2008 will apply.</p> <p>The six High Conservation Values (HCVs):</p> <p>HCV 1 Areas containing globally, regionally or nationally significant concentrations of biodiversity values (e.g. endemism, endangered species, refugia)</p> <p>HCV 2 Areas containing globally, regionally or nationally significant large landscape level forests, contained within, or containing the management unit, where viable populations of most if not all naturally occurring species exist in natural patterns of distribution and abundance</p> <p>HCV 3 Areas that are in or contain rare, threatened or endangered ecosystems</p> <p>HCV 4 Areas that provide basic services of nature in critical situations (e.g. watershed protection, erosion control)</p> <p>HCV 5 Areas fundamental to meeting basic needs of local communities (e.g. subsistence, health)</p> <p>HCV 6 Areas critical to local communities' traditional cultural identity (e.g. areas of cultural, ecological, economic or religious significance identified in cooperation with such local communities).</p>	
	Also includes soils with a large risk of significant soil stored carbon such as peat lands, mangroves, wetlands and certain 100% native and natural grassland (that were never modified by human activities).	
Significantly affected	A significant impact would be apparent if the operations of sugarcane farms or mills resulted in changes to the environment that resulted in (1) the quality and / or quantity of habitat supporting an endangered or threatened species being affected to the extent that the numbers and viability of the species (the classification from the IUCN red list) was adversely affected; (2) conversion, diminution or degradation of the integrity of an endangered habitat such that there was a measurable adverse impact on its ecological status in the opinion of a competent ecologist (3) ecosystem service (such as water supply) being sufficiently changed as to cause material adverse impacts to local communities or ecosystems (for example, flows contain additional nutrients that change downstream ecology or affect the availability of drinking water for downstream communities).	
Conducting business with integrity	Businesses should work against corruption in all its forms, including extortion and bribery.	Principle 10 UN Global Compact
Forced or compulsory labour	This shall mean all work or service which is exacted from any person under the menace of any penalty and for which the said person has not offered himself voluntarily	ILO Convention C29
	Most common forms of forced or compulsory labour: Forced labour can take many forms – some imposed by the State, but the majority in the private economy.....Forced labour can be an outcome of trafficking in persons and irregular migration... Mechanisms of force applied include debt bondage, slavery, misuse of customary practices and deceptive recruitment systems. Some of the most common forms of forced labour include (for a full list see ILO Handbook):	Combating forced labour: A handbook for employers and business, booklet 2
	Debt-induced forced labour: Commonly referred to as "bonded labour" in south Asia, where the practice is most common, but also known as "debt bondage". ... Debt bondage arises when a person mortgages his or her services or those of his family members to someone providing credit in order to repay the loan or advance.	
	Forced labour as an outcome of human trafficking: Trafficking in persons, or human trafficking, is often linked to forced labour. It is fuelled by organised criminal networks or individuals and can involve deceptive recruitment, racketeering and blackmailing for the purpose of labour exploitation.	
	Forced labour linked to exploitation in labour contract systems: This can be found almost everywhere in the world today. For example, migrant workers can find themselves "bonded" to a labour contractor because excessive fees have been charged and with limited if any possibility to change the employer once they arrive in the destination country.	

Discrimination	<p>1 The term discrimination includes—(Art 1 C111)</p> <p>(a) any distinction, exclusion or preference made on the basis of race, colour, sex, religion, political opinion, national extraction or social origin, which has the effect of nullifying or impairing equality of opportunity or treatment in employment or occupation;</p> <p>(b) such other distinction, exclusion or preference which has the effect of nullifying or impairing equality of opportunity or treatment in employment or occupation as may be determined by the Member concerned after consultation with representative employers' and workers' organisations, where such exist, and with other appropriate bodies.</p> <p>2. Any distinction, exclusion or preference in respect of a particular job based on the inherent requirements thereof shall not be deemed to be discrimination.</p> <p>3. For the purpose of this Convention the terms employment and occupation include access to vocational training, access to employment and to particular occupations, and terms and conditions of employment.</p>	<p>ILO Convention C111</p>
Symbols and Abbreviations	<p>BOD biological oxygen demand</p> <p>COD chemical oxygen demand</p> <p>EMP environmental management plan</p> <p>ESIA environmental and social impact assessment</p> <p>g grams</p> <p>GHG greenhouse gas</p> <p>ha hectares</p> <p>HCV high conservation value</p> <p>kg kilograms</p> <p>kJ kilojoules</p> <p>kWh kilowatt hours</p> <p>L litres</p> <p>MJ megajoules</p> <p>RS reducing (invert) sugars</p> <p>t metric tonnes</p> <p>tc tonnes cane</p> <p>TSAI total sugars expressed as invert</p> <p>y year</p>	



APPENDIX 2: List of Relevant International Conventions

<http://www.ilo.org/ilolex/english/subjectE.htm>

ILO Core Conventions cover the following issues: Abolition of Child labour (C 138 and C 182), Elimination of forced or compulsory Labour (C 29 and 105), Equal remuneration (C100) and elimination of discrimination in occupation and employment (C111), Freedom of Association (C87) and right to collective bargaining (C98),

Principles	International Standards	Key provisions	Summary of protections
No forced labour	ILO Convention 29 (1930) Forced Labour	Article 5	No concession to companies shall involve any form of forced or compulsory labour
	ILO Convention 105 (1957) Abolition of forced Labour	Article 1	Not make use of any form of forced or compulsory labour.
Protection of children	ILO Convention 138 (1973) Minimum Age	Article 1-3	Abolition of child labour and definition of national minimum age for labour not less than 15-18 years (depending on occupation).
	ILO Convention 182 (1999) Worst Forms of Child Labour	Articles 1-7	Abolition of child slavery, debt bondage, trafficking and procurement for prostitution; suitable methods to monitor and enforce compliance
	UN declaration on Rights of the Indigenous Peoples (2007)	Articles 17 (2), 21, 22 (2)	No exploitation or exposure to hazard or discrimination against indigenous women and children
Freedom of Association and Collective Bargaining	ILO Convention 87 (1948) Freedom of Association and Protection of Right to Organise	Articles 2-11	Freedom to join organisations, federations and confederations of their own choosing, with freely chosen constitutions and rules; measures to protect the right to organise
	ILO Convention 98 (1949) Right to organise and collective bargaining	Articles 1-4	Protection against anti-union acts and measures to dominate unions, established means of voluntary negotiation of terms and conditions of employment through collective agreements.
	UN Declaration of the Rights of Indigenous Peoples (2007)	Article 3	Indigenous peoples have the right to self-determination and to freely pursue their economic, social and cultural development.
Non discrimination and equal remuneration	ILO Convention 100(1951) Equal Remuneration	Articles 1-3	Equal remuneration for men and women for work of equal value
	ILO Convention 111 (1958) Discrimination (Employment and Occupation)	Articles 1-2	Equality of opportunity and treatment in respect to employment and occupation; no discrimination on the basis of race, colour, sex, religion, political opinion, national extraction or social origin.
	UN Declaration on Rights of Indigenous Peoples (2007)	Articles 2, 8 (2e), 9, 15 (2), 16 (1), 21 (2), 22, 24 (1), 29 (1), 46 (3)	No discrimination based on origin or identity; free to express identity based on custom; special attention to full protection of rights of indigenous women.
Just employment of migrants	ILO Convention 97 (1949) Migration for Employment		Provision of Information; no obstacles to travel; provision of health care; non discrimination in employment; accommodation, social security and remuneration; no forced repatriation of legal workers, repatriation of savings.
Protection of small holders	ILO Convention 117 (1962) Social Policy (Basic Aims and Standards)	Article 4	Alienation with due regard to customary rights, assistance to form cooperatives, tenancy arrangements to secure highest possible living standards.
Just land acquisition	ILO Convention 169 (1989) on Indigenous and Tribal Peoples	Article 13-19	Respect and safeguard rights to lands and natural resources traditionally occupied and used; respect for customs of inheritance; no forced removals; compensation for loss and injury
	UN Declaration on the Rights of Indigenous Peoples (2007)	Articles 25, 26	Right to distinctive relationship with land; right to own, use, develop and control their lands, territories and other resources
	UN Convention on Biological Diversity (1992)	Article 10 (c)	Protect and encourage customary use of biological resources in accordance with traditional practices

Fair Representation and Participation of Indigenous and tribal peoples	ILO Convention 169 (1989) on Indigenous and Tribal Peoples	Articles 6-9	Represent themselves through their own representative institutions; consultations with objective of achieving agreement or consent; rights to decide their own priorities, retain their own customs and resolve offences according to customary law (compatible with international human rights)
	UN Declaration on the Rights of Indigenous Peoples (2007)	Articles 10, 11 (2), 19, 28 (1), 29 (2) and 32.(2).	Right to free, prior and informed consent to any project affecting their lands as expressed through their own representative institutions.
	Convention on the Elimination of All Forms of Racial Discrimination, International Covenant on Economic, Social and Cultural Rights, InterAmerican Human Rights System	UN CERD Committee, UN Committee on Social Cultural and Economic Rights, InterAmerican Commission on Human Rights	Free, prior and Informed consent for decisions that may affect indigenous peoples.
Health & Safety	ILO Convention 184 (2001) Safety and Health in Agriculture	Articles 7-21	Carry out risk assessments and adopt preventive and protective measures to ensure health and safety with workplaces, machinery, equipment, chemicals, tools and processes; ensure dissemination of information; appropriate training, supervision and compliance; special protections for youth and women workers; coverage against occupational injuries and disease.
Control or Eliminate Use of Dangerous Chemicals and Pesticides	Stockholm Convention on Persistent Organic Pollutants (2001)	Article 1-5	Prohibit and/or eliminate production and use of chemicals listed in Annex A of the Convention (eg Aldrin, Chlordane, PCB); restrict production and use of chemicals in Annex B (eg DDT); reduce or eliminate releases of chemicals listed in Annex C (eg Hexachlorobenzene).
	FAO International Code of Conduct on the Distribution and use of Pesticides (1985, Revised 2002)	Article 5	Curtail use of dangerous pesticides where control is difficult; ensure use of protective equipment and techniques; provide guidance for workers on safety measures; provide extension service to small holders and farmers; protect workers and bystanders; make available full information on risks and protections; protect biodiversity and minimize impacts on environment; ensure safe disposal of waste and equipment; make provisions for emergency treatment for poisoning.
	Rotterdam Conventions on Prior and Informed Consent Procedure for certain Hazardous Chemicals and Pesticides in International Trade (1998)	Article 1, 5, and 6	Curb trade in banned and hazardous chemicals and pesticides; develop national procedures for control of their use and trade; the Convention lists banned and hazardous chemicals and pesticides.
	UN Declaration on Rights of Indigenous Peoples (2007)	Articles 21 (1), 23, 24, 29 (3)	Improvement of livelihood in sanitation, health and housing; participate in health delivery; maintain traditional health systems; effective monitoring of health.
Preserve wetlands	Ramsar convention on wetlands of International Importance	www.ramsar.org	
Cultural and natural heritage protection	World Heritage Convention concerning the Protection of the World cultural and Natural heritage	whc.unesco.org/	
Conservation of biological diversity	Convention on Biological Diversity	www.cbd.int	



BSI Scheme for calculation of greenhouse gas emissions from sugarcane growing and processing

<p>1. System Boundary</p> <p>The operational boundary includes growing and processing of sugarcane. It considers the boundary to include each individual mill and its growers as a unit, rather than a company owning and operating more than one mill. In the case of IPPs (Independent Power Producers) providing steam and power to a mill from bagasse that has been provided by the mill, the IPP is considered together with the mill concerned. The system boundary includes in addition the energy embedded in the manufacture and supply of all fertilizers and chemicals, but excludes the energy embedded in agricultural and milling capital equipment. All the activities of a plant on one site are considered, to reflect the sustainability of the total system producing food, fuel, energy and chemicals.</p> <p>This analysis represents a B2B analysis, considering the operation of a cane sugar processing facility, producing raw sugar and/or ethanol at the factory gate. Stand-alone refineries are not considered to be within the boundary. It accounts for the provision of products to a third party that is not the end user (cradle-to-gate).</p>
<p>2. Direct and indirect effects</p> <p>The energy and GHG calculations are associated with direct energy inputs and at a second level by indirect inputs. Direct inputs are mainly fuel and power inputs, expressed in terms of their primary energy value. Indirect inputs include, in addition, the energy required for the production of chemicals, fertilizers and other materials used. The indirect inputs do not include the additional energy necessary for the manufacture and construction of farm, transport and industrial equipment and buildings.</p>
<p>3. Land Use Change</p> <p>Land use change can be separated into direct and indirect components:</p> <ul style="list-style-type: none">• Direct land change refers to a change from the original state of the land to use for sugarcane production. Depending on the previous use of the land in question, it is surmised that the land use change can unlock some of the carbon in the existing soil and vegetation.• Indirect land use change concerns secondary effects induced by large scale expansion. This displaces existing crops, leading to expansion of crop land elsewhere, either in the same country or in other parts of the world. The effects of these changes are very difficult to estimate. <p>If the product's supply chain directly caused non-agricultural land to be converted to agricultural use on or after 1 January 2008, then GHG emissions associated with the land use change are included in the carbon footprint calculation, consistent with the EU directive. The latest advice from the EU on their RED is used in calculating changes in carbon stock. This is detailed in Appendix 5 and outlined in full in the Audit Guidance for this Standard.</p> <p>Because the methods and data requirements for calculating emissions from indirect land use change are not fully developed, the assessment of emissions arising from indirect land use change is not included here, or in fact in any current estimation system. This could change in the future if indirect effects can be calculated with more certainty and accuracy.</p> <p>The EU Renewable Energy Directive allows for a substantial credit of 29 g CO₂eq/MJ for a period of 10 years if severely degraded or contaminated land is used for biofuel crop purposes. It is suggested that this be allowed for. In addition an allowance for improved agricultural practice can be included, as suggested in the EU RED.</p>
<p>4. Handling of co-products and multiple products</p> <p>Two approaches are possible:</p> <ul style="list-style-type: none">• The "substitution" or "displacement" method attempts to model reality by tracking the likely fate of by-products. Each co-product generates an energy and emission credit equal to the energy and emissions saved by not producing the material that the co-product is most likely to displace.• The "allocation" method allocates energy and emissions from a process to the various products according to mass or energy contents or monetary values. <p>In the case of sugarcane processing, a factory exporting power or bagasse achieves a credit in terms of energy and emissions saved, according to the displacement of energy in that country. Some standards recommend the use the grid average GHG intensity to calculate the GHG credit for the exported power, although it may be more realistic to use the marginal energy mix. Since the marginal energy provision is likely to be from fossil fuels, the saving estimate is conservative when using the average generation mix. In this case, the approach aligned with the EU RED is adopted, which states that for calculating exported power credits, the average factor should be used. The country specific table of values used is given in the Annexure.</p> <p>Where a factory produces only sugar and molasses, the allocation in proportion to market value is adopted; in most cases the allocation to molasses is less than 10 % of the total. Although the prices will change over time, the relative values will be far more stable. It is possible to use a displacement calculation, assuming that molasses displaces certain ingredients in an animal feed. However this is likely to vary significantly in different countries.</p> <p>In the case of a factory producing more or less equivalent quantities of sugar and ethanol, the split of energy input and GHG emissions between the two products becomes a more difficult issue. The EU RED requires that allocation should be by energy content of the products. Sugar has a calorific value of 16500 MJ/t and ethanol 21 MJ/L; on the basis that 600 L of ethanol are produced from one tonne of sucrose, this implies a sugar equivalent value of 27.5 MJ/L for sucrose. On this basis, 57 % of the emissions should be allocated to sugar and 43 % to ethanol. As an alternative, the calculation procedure also allocates the energy use and emissions on a mass basis on equivalent sugar, on the basis that 1 tonne sugar is equivalent to 600 L ethanol.</p> <p>In the case of an autonomous distillery, where the only product is ethanol, energy use and emissions are related to litres of ethanol produced or to MJ in ethanol.</p>

5. Components contributing to emissions

CO₂ from sugarcane emitted in combustion and in ethanol fermentation is considered zero CO₂ emission to the air, because this is the carbon taken in from the air during sugarcane growth. CO and VOCs emitted in combustion are assumed to be converted to CO₂ fairly rapidly, but methane and nitrous oxides from burning bagasse are accounted for in GHG emissions. CO₂ emissions arising from biogenic carbon sources are excluded from the calculation of GHG emissions from the life cycle of products, except where the CO₂ arises from direct land use change.

The greenhouse gases covered are CO₂, N₂O and CH₄. Methane and N₂O have global warming potentials 23 and 296 times that of CO₂ respectively (IPCC 2007). Greenhouse gas emissions are aggregated on a carbon dioxide equivalent (CO₂eq) basis.

Non-CO₂ emissions arising from both fossil and biogenic carbon sources are included in the calculation of GHG emissions. In the case of burning bagasse in sugar mill boilers, it is assumed that 30 g CH₄ and 4 g N₂O are produced per 1000 MJ of energy in the bagasse burnt, based on IPCC data for burning of biomass. Changes in the carbon content of soils, either emissions or sequestration, other than those arising from direct land use change, are excluded from the assessment of GHG emissions. Any GHG emissions arising from transport required during the product and raw materials life cycle are included in the carbon footprint assessment. Emission factors for transport include emissions associated with creating and transporting the fuels required.

6. Calculation method

A materiality threshold of 1 % has been suggested to ensure that very minor sources of life cycle GHG emissions do not require the same treatment as more significant sources.

Both the energy usage and emissions are calculated in the same spreadsheet, since the latter are largely determined by the former. The calculation includes the effects of the manufacture of fertilizer. Farming operations include chemicals application, irrigation, tillage and harvesting (and preparation of cane setts for planting). Cane transport covers getting the cane to the mill. The cane is processed to sugar and molasses or ethanol, and may include export of electric power or bagasse. The energy embedded in the manufacture of milling and other equipment is excluded. Inclusion of energy embedded in capital goods and equipment generally has an effect of less than 10 % on calculated emissions and is excluded. No allowance for transport of products from the factory is allowed for. Transport of workers is not included.

The primary energy is calculated. It differs from the direct energy input in that it takes into account the efficiency of generation and supply of the secondary energy source e.g. using a conversion factor from energy in the fuel used to generate electricity to the energy in the power produced. This applies to power, fuel, steam and any other energy input.

The GHG balance is particularly uncertain because of fertilizer nitrous oxide emissions and error margins can be enormous. The use of nitrogen fertilizers results in GHG emissions in two stages: fertilizer manufacture (primarily CO₂ emissions from energy used) and fertilizer application (primarily N₂O emissions from nitrification and denitrification processes in the soil). The assumption is made that 1.325 % of N in nitrogen fertilizer is converted to N in N₂O through nitrification and denitrification, following the IPCC recommendations.

In addition, agricultural lime application results in GHG emissions from both production energy use and in-soil reactions that release CO₂. These latter emissions are a further source of uncertainty. The model uses the IPCC factor of 0.44 kg CO₂eq/kg lime, which assumes that all C in lime becomes CO₂. This is the upper limit; it is possible in weakly acidic soils that limestone results in a net sink of CO₂.

The calculation approach adopted in this study is similar to that used in the EBAMM model (Farrell et al. 2006), which itself is similar to the GREET model (Wang et al. 2008). These models have been used in the past mainly to model the production of biofuels from corn, and they have had to be modified for sugarcane to incorporate additional issues as follows:

1. Modifications to incorporate sugar manufacture as the major activity. This includes power, fuels and lubricants.
2. Emissions due to cane burning. This is based on IPCC emission factors for burning biomass of 0.07 kg N₂O/t dry matter and 2.7 kg CH₄/t dry matter.
3. Allowance for N₂O emissions from filter cake, vinasse and cane residue left in the field. This assumes 1.225 % of N in the residue is converted to N in N₂O (Macedo et al. 2008).
4. Emissions of CH₄ and N₂O in burning bagasse in sugar mill boilers; values of 30 and 4 g /1000 MJ energy in bagasse respectively are used (Wang et al. 2008).
5. Energy value of process chemicals.
6. A credit for molasses (where produced) based on its economic value relative to that of sugar.
7. Emissions from anaerobic treatment of effluent in the case that methane is not captured and used as a fuel. IPCC guidelines suggest 0.21 t CH₄ produced per t COD removed.
8. Allowance for any imports of molasses, bagasse and/or other biomass.

7. Default and secondary data

Secondary data (obtained from sources other than direct measurement) are used to calculate emissions where primary data are not available or inappropriate, to enable consistency and, where possible, comparability:

- Global warming potential of greenhouse gases
- Electricity emissions (in kg CO₂eq/kWh) from various energy sources
- Energy content of fertilizers per kg
- Energy use of pesticides and herbicides per kg
- Fuel emissions per litre
- Waste emissions per kg
- N₂O and CH₄ emissions from burning bagasse
- N₂O and CH₄ emissions from burning cane
- Energy embedded and emissions for process chemicals
- Direct land use change
- Agriculture emissions from soils

Default values used are given in the Annexure.

8. Presentation of results

The agricultural and processing phases are dealt with separately. Thus outputs are available as:

Net energy use in agriculture	MJ/ha or MJ/t cane
Energy used in cane transport	MJ/t cane
Net energy use in processing	MJ/t cane of MJ/t sugar
Total net energy use	MJ/t sugar or MJ/L ethanol
Agricultural GHG emissions	kg CO ₂ eq/t cane
Processing GHG emissions	kg CO ₂ eq/t cane or kg CO ₂ eq/t sugar
Total net GHG emissions	g CO ₂ eq/g sugar
	g CO ₂ eq/L ethanol and/or g CO ₂ eq/MJ ethanol

References

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ANNEXURE
DEFAULT VALUES USED

It is expected that some of these default values will change as more accurate or realistic values are published. Further fine tuning may also be incorporated in future e.g. in allowing for different emissions from different types of nitrogenous fertilizer. It may also be necessary to introduce country specific default values where they are seen to make a material difference to the calculations.

Most of the default values are obtained from the EBAMM model (Farrell et al. 2006), often based on the GREET model using data from Shapouri et al. (2004) and Graboski (2002), or from Macedo et al. (2008).

Fertilizer and agricultural chemicals, in MJ/kg:

	Energy Demand (MJ/kg)	Emissions Factor (kg CO ₂ eq/kg)	Emissions on Application (kg CO ₂ eq/kg)
Nitrogen (elemental)	56.9	4	6.2
Potash (K ₂ O)	7	1.6	
Phosphate (P ₂ O ₅)	9.3	0.71	
Lime (CaCO ₃)	0.12	0.07	0.44
Herbicide	355.6	25	
Insecticide	358	29	

Data from EBAMM

Primary energy inputs and emissions:

	Energy Demand (MJ/MJ fuel)	Total emissions (g CO ₂ eq/MJ)
Gasoline	1.14	85
Diesel	1.16	91
Fuel Oil	1.24	96
Natural Gas	1.12	66
Coal	1	107
Electricity	2.5	150*

Energy demand data from Macedo et al. (2008), emissions from EBAMM

*Average value; country specific values should be used.

The energy value is multiplied by the Energy Demand factor to give the primary energy value.

Embedded energy and emissions for process chemicals:

	Energy Demand (MJ/kg)	Emissions Factor (g CO ₂ eq/MJ)
Lime (CaO)	0.11	951
Biocide	3.02	951
Nitrogen	56.33	951
Caustic	75	951
Sulfuric acid	2.4	951
Anti-foam	10	951
Miscellaneous	50	95

¹ Macedo et al. (2008); ² Mortimer et al. (2004); ³ EBAMM

Emissions factor for electricity, in kg CO₂/MJ:

Country/Region	Grid average
Argentina	0.0763
Australia	0.241
Brazil	0.022
Canada	0.062
China	0.214
Finland	0.0826
France	0.0228
Germany	0.139
India	0.253
Indonesia	0.216
Ireland	0.165
Malaysia	0.137
Mozambique	0.0009
Netherlands	0.13
Pakistan	0.103
Philippines	0.128
Poland	0.184
Portugal	0.115
South Africa	0.237
Spain	0.106
Sweden	0.016
Russia	0.091
Ukraine	0.095
United Kingdom	0.131
United States	0.16

Source: RFA, UK



APPENDIX 4: Environmental Management Plan

Main issue	Y/N*	Measures/ practices	Target	Progress
Biodiversity				
Ecosystem services				
Soil				
Water				
Air				
Crop Protection Chemicals				
Fertilizer				
Pests and Diseases				
Burning plan				
Soil erosion plan				

* Issue addressed in EMP Yes/No

1 Annualised emissions from carbon stock changes caused by land-use change after 1 January 2008, e_l , shall be calculated by dividing total emissions equally over 20 years. Change from one crop to another is not regarded as land use change. For the calculation of those emissions the following rule shall be applied:

$$e_l = (CSR - CSA) \times 3,664 \times 1/20 \times 1/P - eB^{(1)}$$

where

e_l = annualised greenhouse gas emissions from carbon stock change due to land-use change (measured as mass of CO₂-equivalent per unit biofuel energy);

CSR = the carbon stock per unit area associated with the reference land use (measured as mass of carbon per unit area, including both soil and vegetation). The reference land use shall be the land use in January 2008 or 20 years before the raw material was obtained, whichever was the later;

CSA = the carbon stock per unit area associated with the actual land use (measured as mass of carbon per unit area, including both soil and vegetation). In cases where the carbon stock accumulates over more than one year, the value attributed to CSA shall be the estimated stock per unit area after 20 years or when the crop reaches maturity, whichever the earlier;

P = the productivity of the crop (measured as biofuel or bioliquid energy per unit area per year); and

eB = bonus of 29 g CO₂eq/MJ biofuel or bioliquid if biomass is obtained from restored degraded land under the conditions provided for in point 4.

2 The bonus of 29 g CO₂eq/MJ shall be attributed if evidence is provided that the land:

(a) was not in use for agriculture or any other activity in January 2008; and

(b) falls into one of the following categories:

(i) severely degraded land, including such land that was formerly in agricultural use;

(ii) heavily contaminated land.

The bonus of 29 g CO₂eq/MJ shall apply for a period of up to 10 years from the date of conversion of the land to agricultural use, provided that a steady increase in carbon stocks as well as a sizable reduction in erosion phenomena for land falling under (i) are ensured and that soil contamination for land falling under (ii) is reduced.

The categories referred to in point (i) and (ii) are defined as follows:

(a) 'severely degraded land' means land that, for a significant period of time, has either been significantly salinated or presented significantly low organic matter content and has been severely eroded;

(b) 'heavily contaminated land' means land that is unfit for the cultivation of food and feed due to soil contamination.

3 Land carbon stocks are calculated according to the guidelines published by the European Commission, for land converted after 1 January 2008. These are outlined in the Commission Decision of 10 June 2010 on guidelines for the calculation of land carbon stocks for the purpose of Annex V of Directive 2009/28/EC, published in the EU Official Journal L151 of 17 June 2010, p. 19.

4 Additional mandatory requirement for biofuels under the EU Renewable Energy Directive (2009/28/EC), included in section 6 and this Appendix, shall be modified according to the publication by the European Union of new communications and decisions, including on the definition of highly biodiverse grasslands, degraded lands, and new default values for greenhouse gases emissions, as well as any modification related to the EU Directive 2009/28/EC. Article 17.3 c) of the EU Directive 2009/28/EC, states that the Commission shall establish the criteria and geographic ranges to determine which grassland shall be covered by this article. In the absence of decision by the Commission on this topic, no legal interpretation can be given or claimed regarding this concept. This Standard will be modified to encompass the criteria and geographic ranges defined by the Commission as soon as an official communication or decision has been issued.

⁽¹⁾ The quotient obtained by dividing the molecular weight of CO₂ (44,010 g/mol) by the molecular weight of carbon (12,011 g/mol) is equal to 3,664.