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1. Introduction
2. Why harmonisation of biofuel GHG calculations?
3. Project BioGrace
4. One list of standard values
5. Concluding summary

Introduction

GHG calculations under Renewable Energy Directive (RED)
and Fuel Quality Directive (FQD)

- RED and FQD: same sustainability criteria including GHG

- RED article 19:

- o Economic operators may use

- default values (19.1.a)

- actual values calculated according to Annex V.C (19.1.b)

- sum of actual value and disaggregated default value (19.1.c)

- o In Europe default values only when feedstock is produced in
area on list (19.2) or from waste/residue

- RED article 18:

- o Independent auditors must check information (18.3)

- o Can be part of voluntary certification schemes (18.4)

Introduction

- o Input data
- o Standard values ("conversion factors")

Cultivation of rapeseed		Calculated emissions			
Yield		Emissions per MJ FAME			
Rapeseed	3.113 kg ha ⁻¹ year ⁻¹	g CO ₂	g CH ₄	g N ₂ O	g CO _{2,eq}
Moisture content	10,0%				
By-product Straw	n/a kg ha ⁻¹ year ⁻¹				
Energy consumption					
Diesel	2.963 MJ ha ⁻¹ year ⁻¹	6,07	0,00	0,00	6,07
Agro chemicals					
N-fertiliser	137,4 kg N ha ⁻¹ year ⁻¹	9,08	0,03	0,03	18,89
CaO-fertiliser	19,0 kg CaO ha ⁻¹ year ⁻¹	0,05	0,00	0,00	0,06
K ₂ O-fertiliser					
P ₂ O ₅ -fertiliser					
Pesticides					
STANDARD VALUES		GHG emission coefficient			
	parameter:	gCO ₂ /kg	gCH ₄ /kg	gN ₂ O/kg	gCO _{2-eq} /kg
	unit:				
	N-fertiliser	2827,0	8,68	9,6418	5880,6
Seeding material					
Seeds- rapeseed	6 kg ha ⁻¹ year ⁻¹	0,06	0,00	0,00	0,10

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Why harmonisation of biofuel GHG calculations?

1. Significant variation possible in actual GHG values (RED 19.1.b) following RED Annex V.C
 - Using same input values
 - Caused by variation in standard values (or “conversion factors” / “background processes”) to convert kg, MJ or m³ into CO_{2,eq}
2. This causes a problem using actual GHG values
 - Auditors can not check if standard values are correct
 - Economic operations can enhance the GHG performance of their biofuel without decreasing actual GHG emissions
3. Three possible solutions were discussed
4. Several GHG experts and MS policy makers...
 - ...agree that harmonisation of standard values is best solution
 - ...intend to implement this solution

Why harmonisation of biofuel GHG calculations?

EXAMPLE 1: Different results from same biofuel
(same input values but different standard values)

Production of FAME from Rapeseed

Overview Results

Parameter

Nitrogen Fertilizer
P fertilizer
K fertilizer
CaO fertilizer (85%CaCO₃+15%CaO,Ca(O
Pesticides
Diesel (direct plus indirect emissions)
Natural gas (direct plus indirect emissions)
Methanol (direct plus indirect emissions)

Production of FAME from Rapeseed

Overview Results

All results in g CO _{2,eq} / MJ _{FAME}	Total	Default values RED Annex V.D
Cultivation e_{ec}	27,7	29
Cultivation of rapeseed	27,29	28,51
Rapeseed drying	0,42	0,42
Processing e_p	16,5	22
Extraction of oil	3,29	3,82
Refining of vegetable oil	0,85	17,88
Esterification	12,39	
Transport e_{td}	1,3	1
Transport of rapeseed	0,15	0,17
Transport of FAME	0,73	0,82
Filling station	0,44	0,44
Land use change e_l	0,0	0
e _{sca} + e _{ccr} + e _{ccs}	0,0	0
Totals	45,6	52

Emission reduction
Fossil fuel reference (diesel)
83,8 g CO _{2,eq} /MJ
GHG emission reduction
46%

Why harmonisation of biofuel GHG calculations?

1. Significant variation possible in actual GHG values (RED 19.1.b) following RED Annex V.C
 - Using same input values
 - Caused by variation in standard values (or “conversion factors” / “background processes”) to convert kg, MJ or m³ into CO_{2,eq}
2. This causes a problem using actual GHG values
 - Auditors can not check if standard values are correct
 - Economic operators can enhance the GHG performance of their biofuel without decreasing actual GHG emissions
3. Three possible solutions were discussed, of which two theoretical
4. Several GHG experts and MS policy makers...
 - ...agree that harmonisation of standard values is best solution
 - ...intend to implement this solution

Formulation of project BioGrace

1. Dresden workshop (June 2, 2009) led to project
 - based on finding that harmonisation is needed
 - initiated by advisors to governments with expertise on GHG calculations (IFEU, RFA, SenterNovem = NL Agency)
2. Project received letters of support from governments
 - France, Germany, Netherlands, Spain, UK
3. Proposal for subsidy from “Intelligent Energy Europe”
 - Advantage: funding from EC
 - Disadvantage: long lead time
(submission end of June 2009, start project in April 2010)
4. Work was already started 2nd half of 2009
 - Because of tight timeline implementation RED
5. Final preparation of project
 - Contract negotiation Dec. 2009 – March 2010

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Project BioGrace

Biofuel Greenhouse Gas emissions:
alignment of calculations in Europe

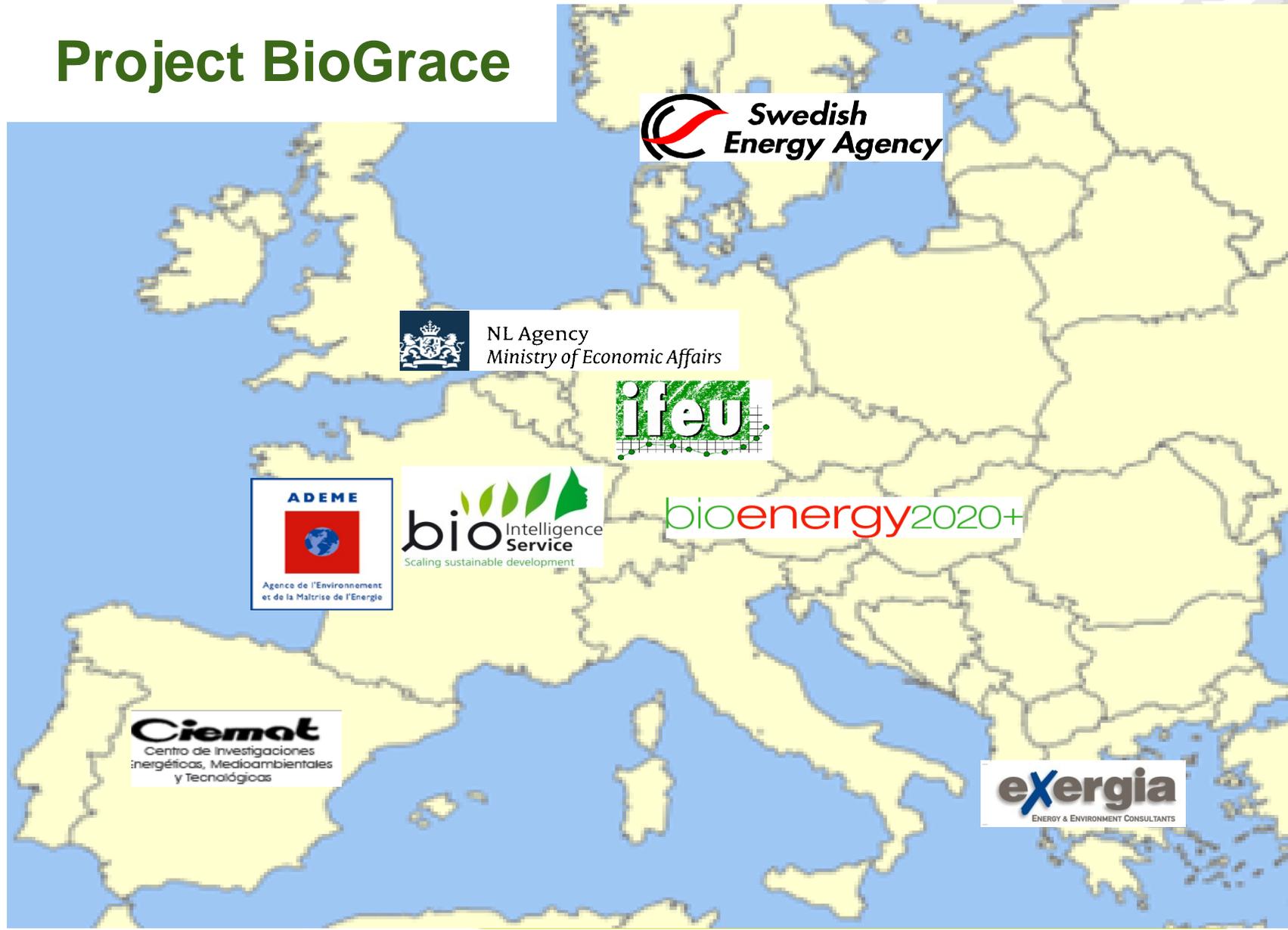
Aim of project:

- o Harmonise calculations of biofuel greenhouse gas (GHG) emissions performed in EU-27 under legislation implementing the Renewable Energy and Fuel Quality directives

Consortium

- o Agencies/organisations close to national governments and experts in GHG calculations
 - Coordinator: Agentschap NL (formerly SenterNovem)
 - Partners: ADEME, BE2020, BIO-IS, CIEMAT, IFEU, EXERGIA, STEM

Project BioGrace



 Swedish Energy Agency

 NL Agency
Ministry of Economic Affairs

 ifeu

 ADEME
Agence de l'Environnement
et de la Maîtrise de l'Énergie

 bioIntelligence Service
Scaling sustainable development

 bioenergy2020+

 Ciemat
Centro de Investigaciones
Energéticas, Medioambientales
y Tecnológicas

 exergias
ENERGY & ENVIRONMENT CONSULTANTS

Project BioGrace

Key objectives are:

1. Cause transparency
2. Cause harmonisation
3. Facilitate stakeholders
4. Disseminate results

Project BioGrace

Key objectives are:

- 1. Cause transparency**
Reproduce biofuel default GHG values (Annex V RED)
 - Has not been done by the Commission or JEC
 - Is a recurrent exercise
- 2. Cause harmonisation**
Cause that GHG calculation tools give the same results
- 3. Facilitate stakeholders**
Allow relevant stakeholders to calculate actual values
- 4. Disseminate results**
Make our results public to all relevant stakeholders

Project BioGrace

Key objectives are:

1. **Cause transparency**
Reproduce biofuel default GHG values (Annex V RED)
2. **Cause harmonisation**
Cause that GHG calculation tools give the same results
 - All tools that are linked to our project
 - Note: this is a policy effort, not a scientific effort
3. **Facilitate stakeholders**
Allow relevant stakeholders to calculate actual values
4. **Disseminate results**
Make our results public to all relevant stakeholders

Project BioGrace

Key objectives are:

1. **Cause transparency**
Reproduce biofuel default GHG values (Annex V RED)
2. **Cause harmonisation**
Cause that GHG calculation tools give the same results
3. **Facilitate stakeholders**
Allow relevant stakeholders to calculate actual values
 - By providing them calculation tools
 - By improving tools following stakeholder input
4. **Disseminate results**
Make our results public to all relevant stakeholders

Project BioGrace

Key objectives are:

1. **Cause transparency**
Reproduce biofuel default GHG values (Annex V RED)
2. **Cause harmonisation**
Cause that GHG calculation tools give the same results
3. **Facilitate stakeholders**
Allow relevant stakeholders to calculate actual values
4. **Disseminate results**
Make our results public to all relevant stakeholders
 - All information is available through www.BioGrace.net
 - All information is for free !
 - Public stakeholder workshops
 - 31 May: Madrid
 - 1 June: Stockholm

Project BioGrace

- o BioGrace will also:
 - make a list of additional standard values
 - list rules for making actual calculations
 - add ‘sophisticated’ support sheets for calculation of
 - ✓ direct land use change (based on Commission Decision)
 - ✓ N₂O emissions (based on IPCC Tier 1)
- o BioGrace will not:
 - add pathways to the Excel file with GHG calculations that are not listed in RED Annex V
 - help stakeholders make actual calculations
 - check actual calculations at the request of stakeholders
- o Feedback by stakeholders is warmly welcomed

Project BioGrace

- Project coordinator: Agentschap NL (NL Agency)
Dr. John P.A. Neeft
e-mail: john.neeft@agentschapnl.nl
- Project partners:
 - ADEME, France (Bruno Gagnepain)
 - BE2020, Austria (Dina Bacovsky)
 - BIO IS, France (Remy Lauranson)
 - CIEMAT, Spain (Yolanda Lechon)
 - EXERGIA, Greece (Konstantinos Georgakopoulos)
 - IFEU, Germany (Horst Fehrenbach)
 - STEM, Sweden (Matti Parikka)
- Project duration: 2 years (April 2010 – March 2012)
- Project website: www.BioGrace.net

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One list of standard values

- o Input data
- o Standard values (“conversion factors”)

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STANDARD VALUES		GHG emission coefficient			
	parameter:	gCO ₂ /kg	gCH ₄ /kg	gN ₂ O/kg	gCO _{2-eq} /kg
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	N-fertiliser	2827,0	8,68	9,6418	5880,6
Seeding material					
Seeds- rapeseed	6 kg ha ⁻¹ year ⁻¹	0,06	0,00	0,00	0,10

Slide

One list of standard values

List of standard values

- o is publicly available
- o to be used by everyone that makes GHG calculations under RED/FQD based legislation

We are achieving this by:

- Including values in all software tools
- Causing that list is known by all GHG calculation experts
- Showing that these (and only these) standard values lead to RED defaults
- Requesting policy makers to make reference from national legislation (implementing RED / FQD)

One list of

Version 3 - Public

STANDARD VALUES	parameter:	unit:	gCO ₂ e
Global Warming Potentials (GWP's)			
CO ₂			1
CH ₄			23
N ₂ O			296
Agro inputs			
N-fertiliser			282
P ₂ O ₅ -fertiliser			964
K ₂ O-fertiliser			530
CaO-fertiliser			119
Pesticides			988
Seeds- corn			412
Seeds- rapeseed			412
Seeds- soy bean			412
Seeds- sugarbeet			218
Seeds- sugarcane			151
Seeds- sunflower			412
Seeds- wheat			151
EFB compost (palm oil)			0
Fuels- gasses			
Natural gas (4000 km, Russian NG quality)			87,64
Natural gas (4000 km, EU Mix quality)			84,98
Fuels- liquids			
Diesel			87,64
Gasoline			84,98
HFO			84,98
Ethanol			92,80
Methanol	0,2900	0,0003	99,57
FAME			890
Syn diesel (BtL)			780
HVO			780
Fuels / feedstock / byproducts - solids			
Hard coal			26,5
Lignite			9,2
Corn			18,5
FFB			24,0
Rapeseed			26,4
Soybeans			23,5
Sugar beet			16,3
Sugar cane			19,6
Sunflowerseed			26,4
Wheat			17,0
Animal fat			37,1
BioOil (byproduct FAME from waste oil)			21,8
Crude vegetable oil			36,0
DDGS			16,0
Glycerol			16,0
Palm kernel meal			17,0

Condensed list of standard values, version 3 - Public

This file gives the standard values as published on www.biograce.net in Word format.

Two Word versions of this list exist:

1. A complete list of standard values, containing all the values as listed in the Excel version
2. A condensed list showing the most important standard values

This file contains the condensed list.

Abbreviations and definitions used can be found in the Excel file on the web page

<http://www.biograce.net/content/ghgcalculationtools/standardvalues>.

1 Global Warming potentials

CO ₂	1	g CO _{2,eq} / g CO ₂
CH ₄	23	g CO _{2,eq} / g CH ₄
N ₂ O	296	g CO _{2,eq} / g N ₂ O

2 GHG emission coefficients

N-fertiliser	5880,6	g CO _{2,eq} /kg N
P ₂ O ₅ -fertiliser	1010,7	g CO _{2,eq} /kg P ₂ O ₅
K ₂ O-fertiliser	576,1	g CO _{2,eq} /kg K ₂ O
CaO-fertiliser	129,5	g CO _{2,eq} /kg CaO

Both Excel and Word versions available at www.BioGrace.net

One list of standard values

List of standard values

- o European Commission makes reference to list

European Commission
Energy
 Transparency & harmonisation
 European Commission > Energy > Renewable Energy > Biofuels



Renewable Energy

- Bioenergy
- Biofuels
 - ▶ Members states reports
 - ▶ Standards
 - ▶ Sustainability Criteria
 - ▶ Projects
- Wind Energy
- Solar Electricity
- Solar Heating and Cooling
- Geothermal Energy
- Ocean Energy
- Grid
- Hydrogen for Transport
- CONCERTO
- Thematic Promotion Dissemination
- Electricity
- European Technology Platforms (ETPs)
- Transparency Platform
- Target of 20% by 2020

Renewable Energy

Biofuels: Sustainability Criteria

Commission sets up system for certifying sustainable biofuels

The Commission decided on 10 June 2010 to encourage industry, governments and NGOs to set up certification schemes for all types of biofuels, including those imported into the EU. It laid down what the schemes must do to be recognised by the Commission. This will help implement the EU's requirements that biofuels must deliver substantial reductions in greenhouse gas emissions and should not come from forests, wetlands and nature protection areas. The rules for certification schemes are part of a set of guidelines explaining how the Renewable Energy Directive, coming into effect in December 2010, should be implemented.



- [Press release \[IP/10/711, 10/06/2010\]](#)
- [Memo \[MEMO/10/247, 10/06/2010\]](#)

Related documents

- ▶ **Communications and Decision**
 - ▶ [Communication on the practical implementation of the EU biofuels and bioliquids sustainability scheme and on counting rules for biofuels \[Q1 C160, page 8\]](#)
 - ▶ [Standard values, derived from the datasets used to establish the default values](#)
 - ▶ [Annotated example for the calculation of an actual greenhouse gas value](#) [90 KB]
 - ▶ [Annotated example for the calculation of emissions from carbon stock changes due to land use change](#) [3 MB]

Search

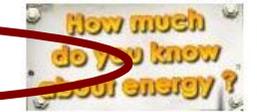
Günther Oettinger
Commissioner for Energy

Philip Lowe
Director-General for Energy

Multimedia
• [Video portal](#)

Publications
• [figures](#)

- Agencies**
- ACER
 - EACI
 - ESA



One list of standard values

List of standard values

- o European Commission makes reference to list
- o Member States include list in Technical Guidance:
 - Austria, Sweden, UK are preparing to do
 - Germany, Ireland, Netherlands are about to decide to do so
- o Example (from UK consultation on C&S Technical Guidance)
 - *The RFA therefore proposes the following approach to which standard values should be used:*
 1. *For the reporting period 2011/2012, the RFA proposes to **align its current standard emission factors with the ones proposed by the BioGrace project.***

One list of standard values

List of standard values

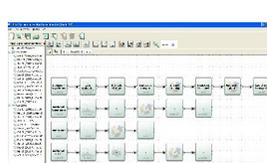
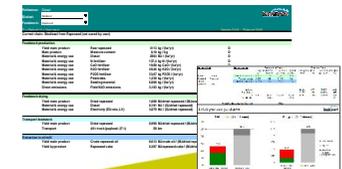
- o When motivated, other standard values can be used
- o BioGrace will publish a calculation rule for this, stating that
 - For standard values not yet on the list
 - a reliable source (literature, database) should be given
 - auditors can verify this information conform RED Article 18.3
 - For standard values that are already listed:
 - reliable information is submitted showing how these values were determined
 - auditors can verify this information conform RED Article 18.3.
 - it is shown that this input was used in the production of the biofuel
 - the use of this alternative standard value does not contradict any other calculation rule

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Concluding summary

- One biofuel, different GHG calculations => different results
- IEE funded project BioGrace will:
 1. Cause transparency in how RED default values were calculated
 2. Cause harmonisation
 - Excel tool and GHG calculators give same result
 - All GHG calculations based on one set of standard values
 3. Facilitate stakeholders
 - Tools that allow own input and/or modifications to pathways
 4. Broadly disseminate results

Thank you for your attention

Intelligent Energy  **Europe**

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The European Commission is not responsible for any use that may be made of the information contained therein.



BIOGRACE

Harmonised Calculations of
Biofuel Greenhouse Gas Emissions in Europe



• **National GHG calculators –
• harmonized in co-operation with
• BioGrace**



• Eva Kallivoka
• EXERGIA S.A.
• Public workshop Athens
• May 26, 2011

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3. German GHG calculator
4. Spanish GHG calculator
5. UK GHG calculator
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Introduction

Rules and methodology for GHG calculations

- RED article 19: Economic operators may use
 - default values (19.1.a)
 - actual values calculated according to Annex V.C (19.1.b)
 - sum of actual value and disaggregated default value (19.1.c)
- RED Annex V.C + June communications: Methodology

Making actual calculations not straightforward

- Some kind of tool or software is needed
 - Some companies will develop own tools
 - Many others will use publicly available tools

Several GHG calculators available

Project BioGrace will ensure that all calculators will give the same result

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Dutch tool - General information

Background

- o Dutch government prepared a reporting obligation on sustainability for biofuels to start per 1-1-2009
- o This was abandoned after the publication of the draft Renewable Energy Directive (RED).

The Dutch GHG calculator

- o was developed in 2007/2008 by consultants EcoFys and CE
- o has been available for (Dutch) stakeholders to make GHG calculation on biofuels
- o has not been used extensively due to lack of legal framework in 2008 – 2010
- o was recently updated and made “RED”- proof by Agency NL

Dutch GHG tool

Reference: Diesel

Biofuel: Biodiesel

Feedstock: Rapeseed

Load Default Values

Chain management

Calculate Results

Disclaimer

Adapt Chain

D = Default; U = User input

Version 3.1 - aug

Current chain: Biodiesel from Rapeseed (not saved by user)

Feedstock production

Yield main product	Raw rapeseed	3113 kg / (ha*yr)	D
Main product	Moisture content	0,10 kg / kg	D
Material & energy use	Diesel	2963 MJ / (ha*yr)	D
Material & energy use	N fertilizer	137,4 kg N / (ha*yr)	D
Material & energy use	CaO fertilizer	19,00 kg CaO / (ha*yr)	D
Material & energy use	K2O fertilizer	49,46 kg K2O / (ha*yr)	D
Material & energy use	P2O5 fertilizer	33,67 kg P2O5 / (ha*yr)	D
Material & energy use	Pesticides	1,230 kg / (ha*yr)	D
Material & energy use	Seeding material - rapeseed	6,000 kg / (ha*yr)	D
Field emissions	Field N2O emissions	3,103 kg / (ha*yr)	D
Field emissions	Direct Land Use Change	No g CO2/MJbiofuel	D

Feedstock drying

Yield main product	Dried rapeseed	1,000 MJdried rapeseed / (MJraw rapeseed)	D
Main product	Moisture content	0,10 kg / kg	D
Material & energy use	Diesel	0,181 MJ / (GJdried rapeseed)	D
Material & energy use	Electricity (EU-mix, LV)	3,079 MJ / (GJdried rapeseed)	D

Transport feedstock

Yield main product	Dried rapeseed	0,990 MJdried rapeseed / (MJdried rapeseed)	D
Main product	Moisture content	0,10 kg / kg	D
Transport	Truck for dry product (Diesel)	50 km	D

Extraction in oil mill

Yield main product	Crude vegetable oil	0,613 MJcrude oil / (MJdried rapeseed)	D
Yield by-product	Rapeseed cake	0,387 MJrapeseed cake / (MJdried rapeseed)	D

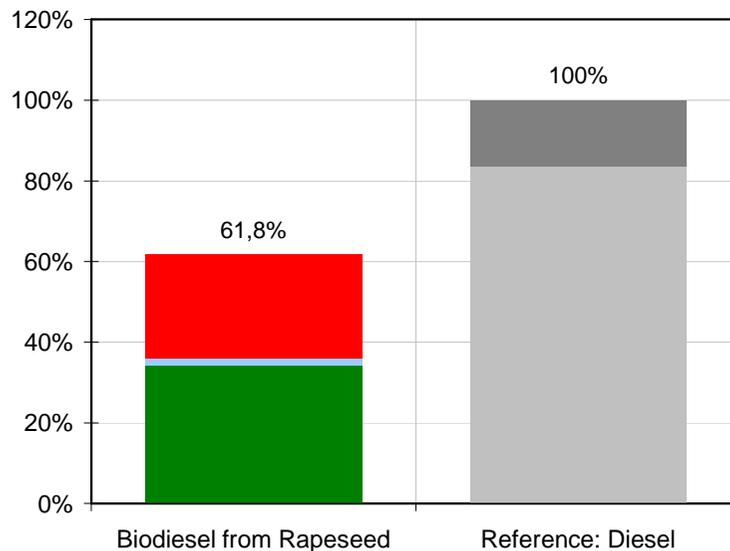
Dutch GHG tool

Summary Input		Summary output	Biodiesel from Rapeseed				Reference: Diesel			
			Energy use (per MJ)		GHG emissions (kg/MJ)		Energy use (per MJ)		GHG emissions (kg/MJ)	
			(MJ)	(% of ref.)	(g CO ₂ -eq.)	(% of ref.)	(MJ)	(%)	(g CO ₂ -eq.)	(%)
Biofuel	Biodiesel	Feedstock production	0,1672	14%	28,7496	34%				
Feedstock	Rapeseed	Transport actions	0,0233	2%	1,4345	2%				
Process	-	Conversion operations	0,3677	32%	21,5636	26%				
Reference	Diesel	End use					1,0000	87%	70,1047	84%
		Fossil indirect					0,1550	13%	13,6953	16%
		Total	0,5582	48,3%	51,7477	61,8%	1,1550	100%	83,8000	100%
		% Reduction		51,7%		38,2%				0%
		Print summary results								
		Show detailed results								
		Return to input								
Avoided emission (tonne CO ₂ /ha/yr)			1371,5							

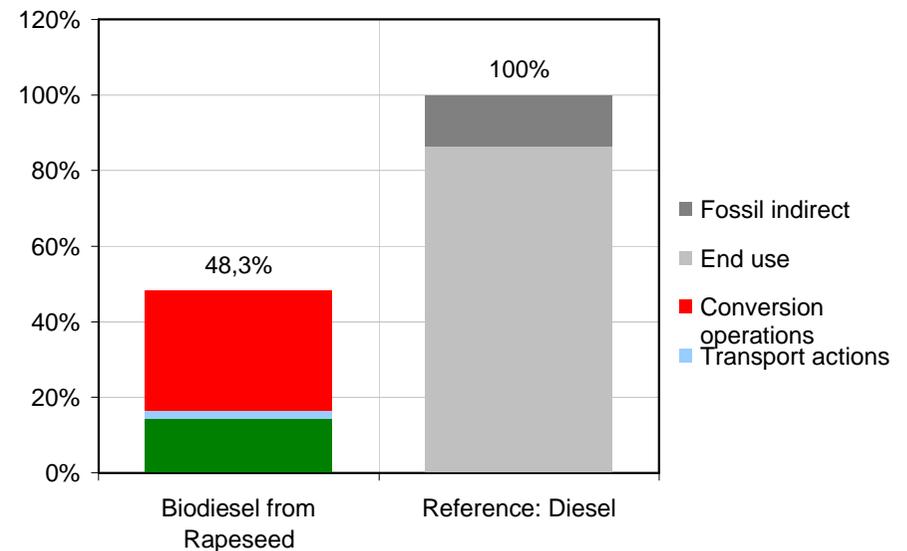
Biofuels greenhouse gas calculator



GHG emissions [% of reference]



Energy use [% of reference]



Dutch GHG tool

Biofuel
Feedstock
Process
Reference

Biodiesel
Rapeseed
-
Diesel

[Return to overview results](#)

[Return to input](#)

	Absolute Numbers (including allocation)					Relative contribution (including allocation)			
	Energy use [MJ fossil fuel/ MJ biofuel]	Emission CO2 [kg CO2/ MJ biofuel]	Emission N2O [kg CO2-eq/ MJ biofuel]	Emission CH4 [kg CO2-eq/ MJ biofuel]	Emission GHG [kg CO2-eq/ MJ biofuel]	Energy use [%]	Emission CO2 [%]	Emission N2O [%]	Emission CH4 [%]
Feedstock production									
Diesel	0,047	3,555	0,00E+00	0,00E+00	3,555	8,4%	6,9%	0,0%	0,0%
N fertilizer	0,092	5,319	5,370	0,376	11,065	16,5%	10,3%	10,4%	0,7%
CaO fertilizer	5,13E-04	0,031	1,41E-03	1,29E-03	0,034	0,1%	0,1%	0,0%	0,0%
K2O fertilizer	6,55E-03	0,363	2,47E-03	0,024	0,390	1,2%	0,7%	0,0%	0,0%
P2O5 fertilizer	7,02E-03	0,445	7,03E-03	0,014	0,466	1,3%	0,9%	0,0%	0,0%
Pesticides	4,52E-03	0,166	8,38E-03	9,89E-03	0,185	0,8%	0,3%	0,0%	0,0%
Seeding material - rapeseed	6,46E-04	0,034	0,024	1,72E-03	0,060	0,1%	0,1%	0,0%	0,0%
Field N2O emissions	0,00E+00	0,00E+00	12,575	0,00E+00	12,575	0,0%	0,0%	24,3%	0,0%
Direct Land Use Change	-	0,00E+00	-	-	0,00E+00	-	0,0%	-	-
Total Feedstock production	0,159	9,914	17,989	0,427	28,331	28,4%	19,2%	34,8%	0,8%

Allocation burden of this and previous steps to main product Raw rapeseed

100,0%

Allocation burden of this and previous steps to by-product Raw rapeseed

0,0%

Allocation burden of this step to Biodiesel at end-of-chain

58,6%

Feedstock drying

Diesel	2,13E-04	0,016	0,00E+00	0,00E+00	0,016	0,0%	0,0%	0,0%	0,0%
Electricity (EU-mix, LV)	8,51E-03	0,377	5,05E-03	0,021	0,403	1,5%	0,7%	0,0%	0,0%
Total Feedstock drying	8,72E-03	0,393	5,05E-03	0,021	0,419	1,6%	0,8%	0,0%	0,0%

Allocation burden of this and previous steps to main product Dried rapeseed

100,0%

Allocation burden of this and previous steps to by-product Dried rapeseed

0,0%

Allocation burden of this step to Biodiesel at end-of-chain

58,6%

Transport feedstock

Truck for dry product (Diesel)	2,29E-03	0,173	0,00E+00	2,43E-04	0,173	0,4%	0,3%	0,0%	0,0%
Total Transport feedstock	2,29E-03	0,173	0,00E+00	2,43E-04	0,173	0,4%	0,3%	0,0%	0,0%

Dutch GHG tool

DIRECT LAND USE CHANGE CALCULATION

[Return to input](#)

1. Standard Soil Carbon stock in mineral soil (SOC_{ST})

Climate region: See figure 1
 Soil type: See figure 3 & 2
 The blue fields are drop down boxes.

Result SOC_{ST} ton C / ha

2. Factors reflecting the difference in Soil Organic Carbon (SOC) compared to the Standard Soil Organic Carbon (SOC_{ST})

Actual land use Default=Calculate with standard values
 User = Own calculation incl. measured value

Type of land: See tables 3, 6 and 8
 Climate region:
 Land use F_{LU}:
 Management F_{MG}:
 Input F_I:
Result SOC_A ton C / ha

Reference land use Default=Calculate with standard values
 User = Own calculation incl. measured value

Type of land: See tables 3, 6 and 8
 Climate region:
 Land use F_{LU}:
 Management F_{MG}:
 Input F_I:
Result SOC_{ref} g C / ha

3. Above and below ground vegetation (C_{veg})

Actual land use Default=Calculate with standard values
 User = Own calculation incl. measured value

Type of land:
 Domain:
 Climate region:
 Ecological zone:
 Continent:
 Crop type:
Result C_{VEG,A} ton C / ha

Reference land use Default=Calculate with standard values
 User = Own calculation incl. measured value

Type of land:
 Domain:
 Climate region:
 Ecological zone:
 Continent:
 Crop type:
Result C_{VEG,ref} ton C / ha

4. Bonus (eb) for cultivation on restored degraded land under the conditions provided for in point 8 of Annex V of directive.

Bonus: No = 0 g CO₂/MJ
 Yes = -29 g CO₂/MJ

Total results

Result: CO₂ emission caused by direct land use change g CO₂/MJ biofuel

[Calculate Results](#) Re-calculate the results if you changed the values here or at the input page.

Dutch tool - Summary

Contents

- o Excel-based tool
- o Tool is rather similar to BioGrace Excel sheets, but
 - It is more user-friendly:
no calculations details, results in graphs
 - DLUC calculations are user-friendly
- o The software programming makes it less flexible
 - More difficult to modify pathways or build new ones

Status

- o Tool is available on-line via
www.senternovem.nl/gave_english/ghg_tool
- o All 22 chains (BioGrace) are included
- o Updates follow updates of BioGrace Excel sheet

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German tool - general information

Background

- o No public tool has been available so far in Germany
- o Aim: to facilitate stakeholders calculating actual values (combination of actual values and disaggregated default values)

The German GHG calculator

- o is made by IFEU, contracted by BMU
- o should be finalised mid 2011
- o should be in line with BLE Guidance
- o is strongly linked to economic operators: 1 sheet dedicated for cultivators, mill operators, refinery operators, etc.

BIOGRACE

Harmonised Calculations of
Biofuel Greenhouse Gas Emissions in Europe

Intelligent Energy  Europe

German GHG tool

Palm oil greenhouse gas calculator

About

Background data

Start

according to the EU Directive 2009/28/EC

-  Plantation operator / first buyer of crops 
-  Oil mill operator 
-  Refinery operator 
-  Last interface 

supported by



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Environment, Nature Conservation
and Nuclear Safety



BIOGRACE

Harmonised Calculations of
Biofuel Greenhouse Gas Emissions in Europe

Intelligent Energy  Europe

German GHG tool

Palm oil greenhouse gas calculator

About

Background data

Start

according to the EU Directive 2009/28/EC

 Plantation operator / first buyer of crops 

 Oil mill operator 

 Refinery operator 

 Last interface 

supported by



Federal Ministry for the
Environment, Nature Conservation
and Nuclear Safety



German GHG tool

Palm oil greenhouse gas calculator

About

Background data

Start

according to the EU Directive 2009/28/EC

I. Market actor: Plantation operator, first purchaser

Step-by-step manual for calculating GHG emissions of oil palm cultivation

Final Result

Please provide this info together with your batch to oil miller.

Please note: When combining FFB batches and averaging GHG emissions, GHG value for each batch may not exceed **280g CO₂eq/kg FFB**



The CO₂ emissions from oil palm cultivation amount to

123,7 g CO₂eq/kg FFB



Size of the FFB batch

0 kg

Enter your operating data in step 1-4 to calculate CO₂ emissions of your FFB batch

STEP 1 - GHG emissions from land use changes

Do FFB 's originate from plantation areas that were plantation areas before January 1st 2008?



Emissions from land use change are zero.



Click here to calculate emissions in sheet "land use changes"

Which emissions arose from land use changes?

0 kg CO₂eq per ha per year

STEP 2 - GHG emissions from cultivation

German GHG tool

Palm oil greenhouse gas calculator

About

Background data

Start

according to the EU Directive 2009/28/EC

I. Market actor: Plantation operator, first purchaser

Step-by-step manual for calculating CO₂ emissions from land use change

The European Commission has published guidelines for the calculation of land carbon stocks (notified under document C (2010) 3751). These consist of tables with values for carbon stock in soils, above and below ground biomass for different soil types, climate regions, vegetation types etc.

Result

value will be added in sheet
»actor cultivator« step 1



#WAARDE!



confirm value and back

kg CO₂eq per ha per year

Specify the parameters in step 1-4 to calculate CO₂ emissions from land use changes

STEP 1 - Carbon stock in above and below ground biomass on 01.01.2008 (CS_R)

Please select:

Vegetation type	Forest (10-30% canopy cover)	
Domain		
Climate region		
Ecological zone		
Continent		
Above and below ground carbon on 01.01.08	Please make a valid selection	t C/ha

STEP 2 - Soil carbon on 01.01.2008 (CS_R)

Climate region	Tropical, moist	
Please select:		
Soil type	Low activity clay soils	
Standard soil carbon t C/ha		47

German GHG tool

Palm oil greenhouse gas calculator

About

Background data

Start

according to the EU Directive 2009/28/EC

I. Market actor: Plantation operator, first purchaser

Step-by-step manual for calculating GHG emissions of oil palm cultivation

Final Result

Please provide this info together with your batch to oil miller.

Please note: When combining FFB batches and averaging GHG emissions, GHG value for each batch may not exceed **280g CO₂eq/kg FFB**



The CO₂ emissions from oil palm cultivation amount to

123,7 g CO₂eq/kg FFB



Size of the FFB batch

0 kg

Enter your operating data in step 1-4 to calculate CO₂ emissions of your FFB batch

STEP 2 - GHG emissions from cultivation

What is your FFB yield per ha per year?

19.000 kg FFBs per ha per year



What is the size of your cultivation area?

28 ha

How much fertilizer did you apply per ha per year? Please enter the amount for each of the following fertilizers.

N-fertiliser 128,0 kg N per ha per year



P₂O₅-fertiliser 144,0 kg P₂O₅ per ha per year



K₂O-fertiliser 200,0 kg K₂O per ha per year



German GHG tool

STEP 2 - GHG emissions from cultivation	
What is your FFB yield per ha per year?	19,000 kg FFBs per ha per year
What is the size of your cultivation area?	28 ha
How much fertilizer did you apply per ha per year? Please enter the amount for each of the following fertilizers.	
N-fertiliser	128.0 kg N per ha per year
P ₂ O ₅ -fertiliser	144.0 kg P ₂ O ₅ per ha per year
K ₂ O-fertiliser	200.0 kg K ₂ O per ha per year
CaO-fertiliser	0.0 kg CaO per ha per year
How much pesticides did you apply per ha per year?	
Pesticides	8.4 kg active ingredient per ha per year
How much diesel did you use per ha per year? Please include	
Diesel	57.4 l per ha per year
What is the size of your batch (consignment)?	0 kg
Emissions fertilizer	2,077 kg CO₂eq per ha per year
N-fertilizer production	757 kg CO ₂ eq per ha per year
N ₂ O field emissions	1,058 kg CO ₂ eq per ha per year
P ₂ O ₅ -fertilizer production	146 kg CO ₂ eq per ha per year
K ₂ O-fertilizer production	116 kg CO ₂ eq per ha per year
Ca-fertilizer production	0 kg CO ₂ eq per ha per year
Emissions pesticide production	93 kg CO₂eq per ha per year
Emissions diesel	180 kg CO₂eq per ha per year
Emissions (cultivation)	2,350 kg CO₂eq per ha per year
Emissions (land use changes)	0 kg CO₂eq per ha per year
Total emissions	2,350 kg CO₂eq per ha per year

BIOGRACE

Harmonised Calculations of
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Intelligent Energy  Europe

German GHG tool

Palm oil greenhouse gas calculator

About

Background data

Start

according to the EU Directive 2009/28/EC

 Plantation operator / first buyer of crops 

 Oil mill operator 

 Refinery operator 

 Last interface 

supported by



Federal Ministry for the
Environment, Nature Conservation
and Nuclear Safety



German GHG tool

Palm oil greenhouse gas calculator

About

Background data

Start

according to the EU Directive 2009/28/EC

II. Market actor: Oil mill operator

Step-by-step manual for calculating CO₂ emissions of CPO production

Final Result

Please provide this info together with your batch to refinery.

Please note: When combining CPO batches and averaging GHG emissions, GHG value for each batch may not exceed **1190g CO₂eq/kg CPO**



The CO₂ emissions from palm oil mill amount to

1517 g CO₂eq/kg CPO



Size of the CPO batch

30000 kg

Enter your operating data in step 1-4 to calculate CO₂ emissions of your CPO batch

STEP 1 - GHG emissions of pre-products

What GHG emissions arose from the production of the FFBs? Indicate whether you want to use the default value or a calculated value.

default value



Click here to use default value "126" g CO₂eq/kg FFB in the field below

calculate value



Click here to calculate your emissions in g CO₂eq/kg FFB.

126 g CO₂eq/kg FFB

STEP 2 - GHG emissions from oil mill operation

How many tons of FFB 's did you process per year?

10.000 t FFB/year



German GHG tool

Palm oil greenhouse gas calculator

About

Background data

Start

according to the EU Directive 2009/28/EC

Mixing CPO batches from several suppliers and averaging GHG emissions

Overall quantity metric tonnes	Overall GHG value g CO ₂ eq/kg FFB
0	0

 confirm value and back

Supplier#	Plantation name	FFB quantity metric tonnes	GHG value g CO ₂ eq/kg FFB
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			



fill in the information delivered by your suppliers

German GHG tool

Palm oil greenhouse gas calculator About Background data Start

according to the EU Directive 2009/28/EC

IV. Market actor: Last Interface

Step-by-step manual for calculating greenhouse gas savings:

Final Result
Greenhouse gas savings  **44%** compared to fossil comparator 

STEP 1

What are the GHG emissions of the final product? 

1747 g CO ₂ eq/kg refined palm oil	
Calculation of heat content	47 g CO ₂ eq/MJ
Is the biofuel used for electricity production or for cogeneration?	
Electricity from Cogeneration	85 g CO ₂ eq/MJ

German tool - Summary

Contents

- o Excel-based tool
- o Tool differs from BioGrace Excel sheets:
 - Pathways are split in partial calculations
 - DLUC calculations are user-friendly
- o The software programming makes it inflexible
 - Not possible to modify pathways or build new ones

Status

- o Tool is available on-line via www.ifeu.de/english
- o Currently one chain available: palm oil
- o Cereals-to-ethanol and oil_seeds-to-biodiesel chains are ready but not available on line

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Spanish tool - general information

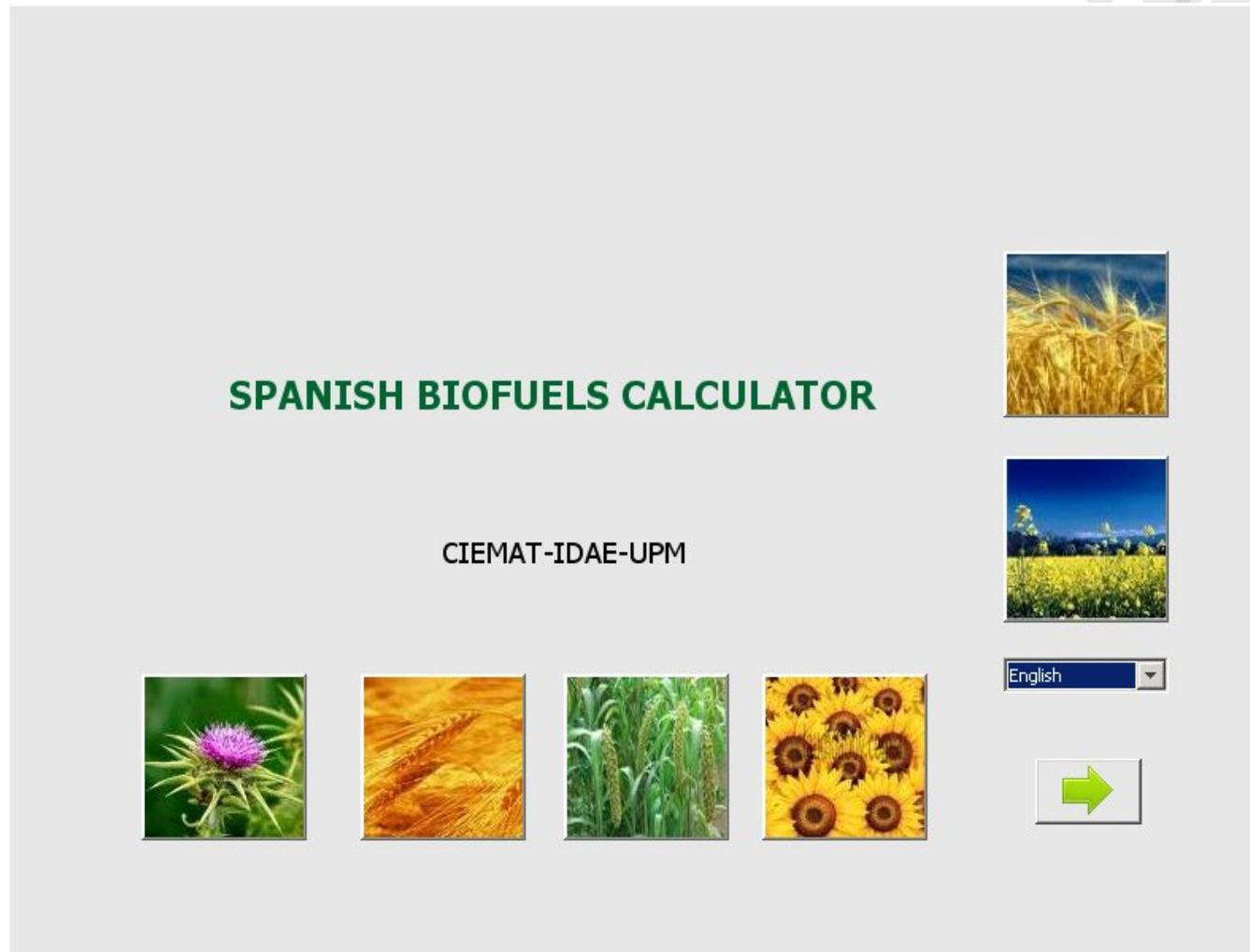
Background

- o No public tool has been available so far in Spain
- o Aim: to provide stakeholders (especially farmers and small biofuel companies) with a tool to calculate the GHG emissions required by the RED

The Spanish GHG calculator

- o being developed by CIEMAT, contracted by IDAE
- o focuses on agricultural stages
- o uses data from NUTS study (actual values or averages calculated for smaller geographical areas)

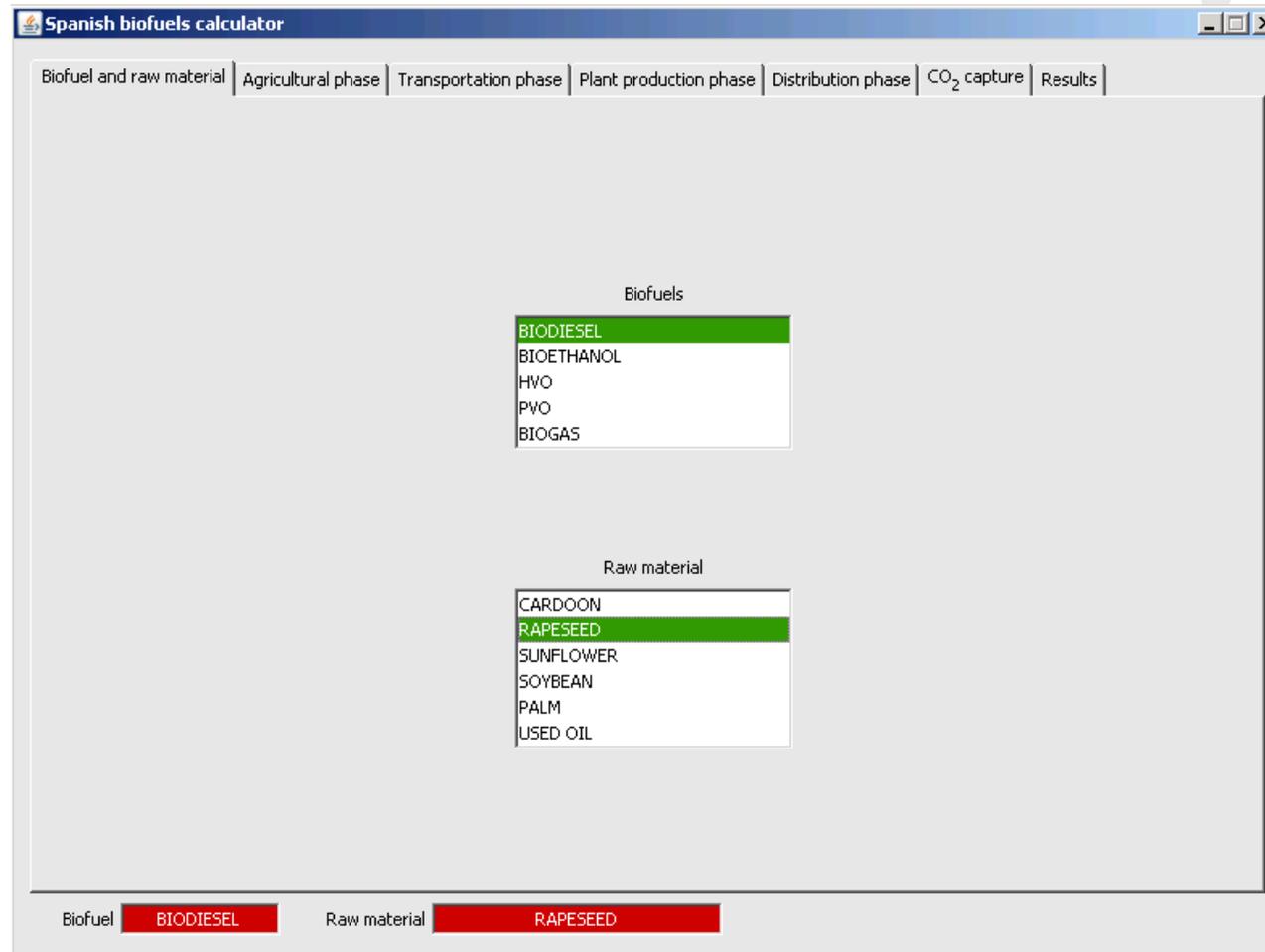
Spanish GHG tool



The screenshot shows the main interface of the Spanish Biofuels Calculator. At the top center, the text "SPANISH BIOFUELS CALCULATOR" is displayed in green. Below this, the text "CIEMAT-IDAIE-UPM" is centered. On the right side, there are two small images: the top one shows a field of golden wheat, and the bottom one shows a field of yellow rapeseed. Below these images is a dropdown menu with "English" selected. At the bottom right, there is a green arrow button pointing to the right. At the bottom left, there are four small images representing different biofuel feedstocks: a purple thistle, a stalk of wheat, a stalk of corn, and a field of sunflowers.

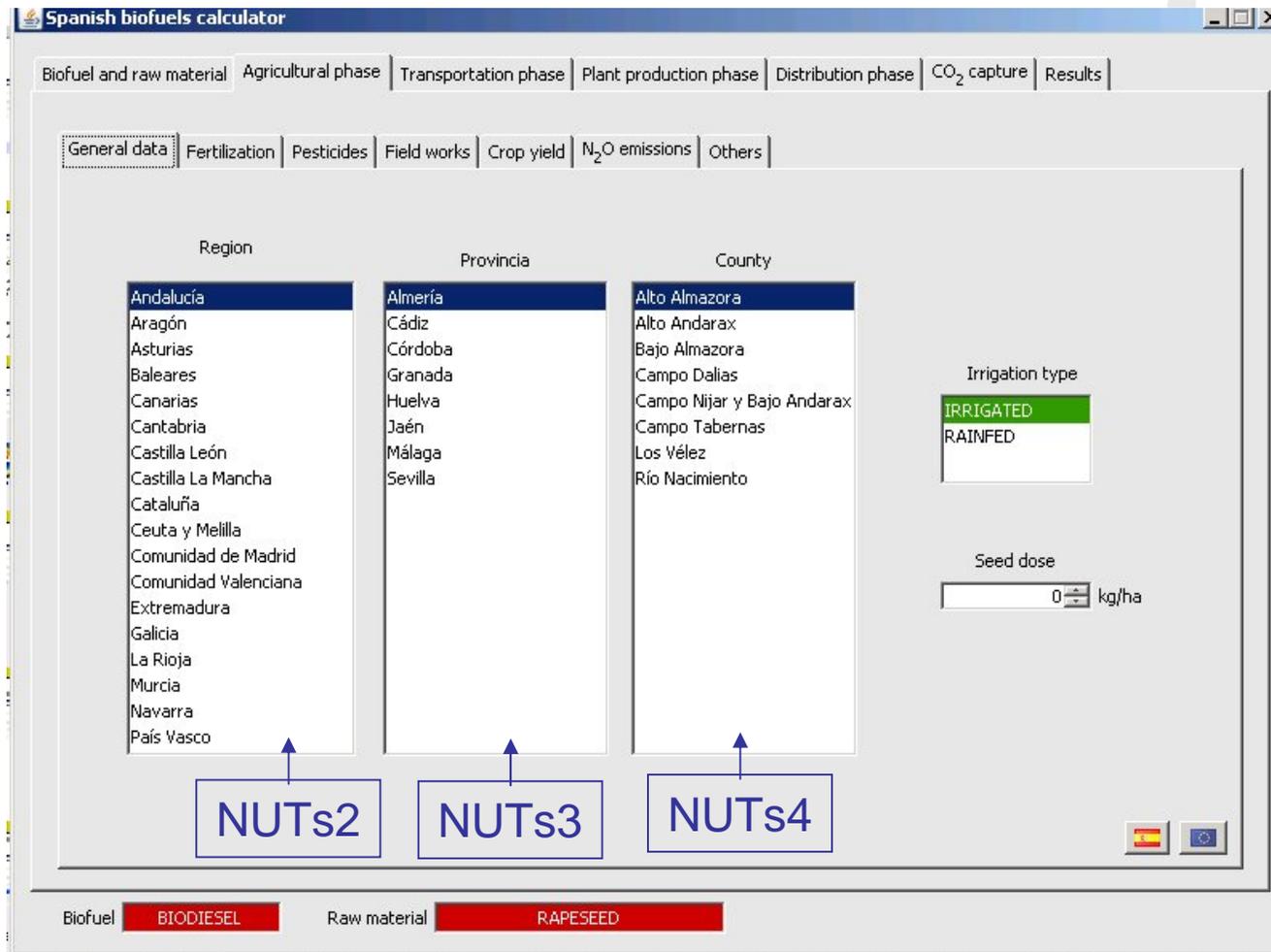
Spanish GHG tool

Biofuel and raw material selection screen



Spanish GHG tool

Agricultural county selection screen



Spanish biofuels calculator

Biofuel and raw material | Agricultural phase | Transportation phase | Plant production phase | Distribution phase | CO₂ capture | Results

General data | Fertilization | Pesticides | Field works | Crop yield | N₂O emissions | Others

Region	Provincia	County
Andalucía	Almería	Alto Almazora
Aragón	Cádiz	Alto Andarax
Asturias	Córdoba	Bajo Almazora
Baleares	Granada	Campo Dalías
Canarias	Huelva	Campo Nijar y Bajo Andarax
Cantabria	Jaén	Campo Tabernas
Castilla León	Málaga	Los Vélez
Castilla La Mancha	Sevilla	Río Nacimiento
Cataluña		
Ceuta y Melilla		
Comunidad de Madrid		
Comunidad Valenciana		
Extremadura		
Galicia		
La Rioja		
Murcia		
Navarra		
País Vasco		

Irrigation type
 IRRIGATED
 RAINFED

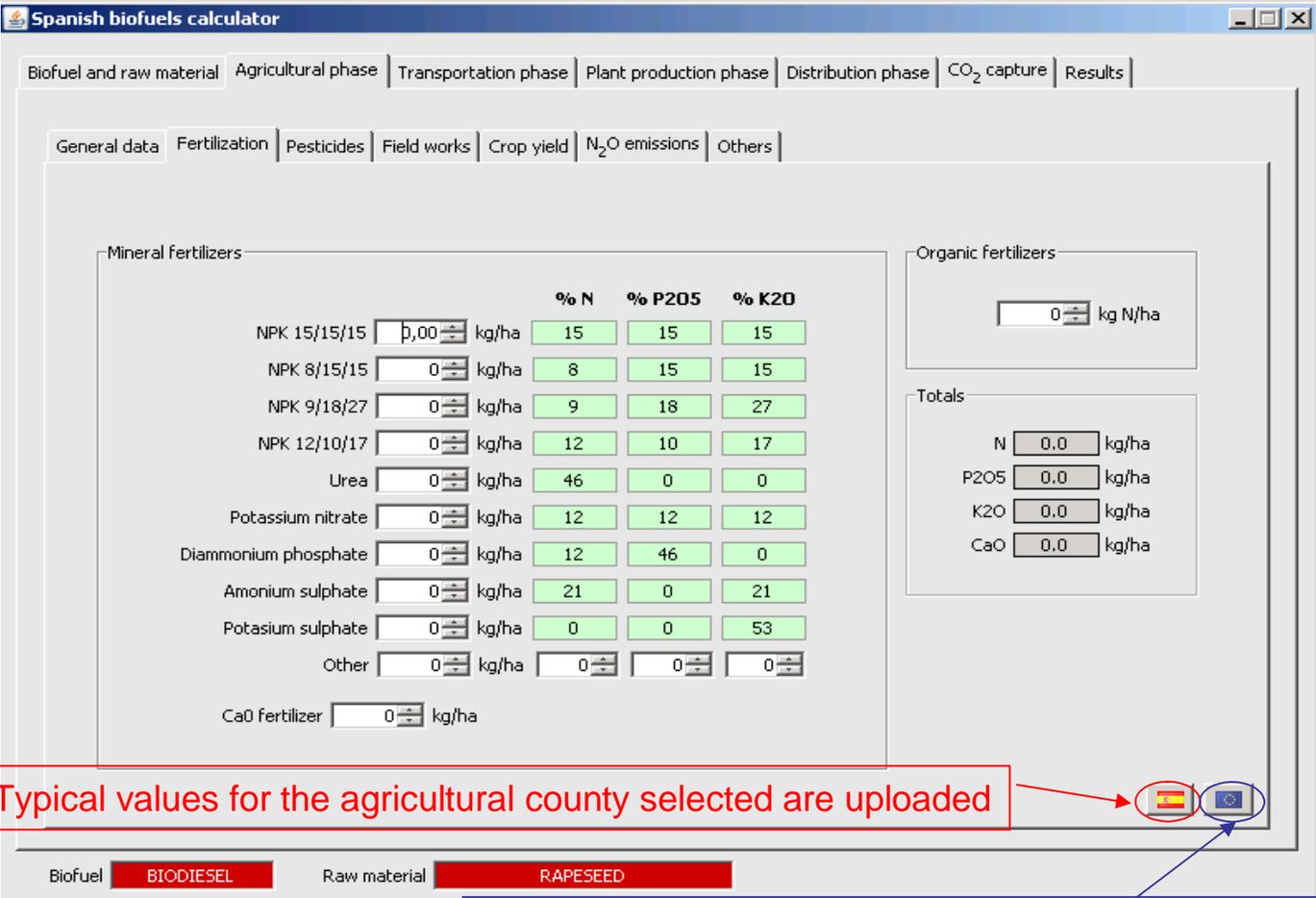
Seed dose
 kg/ha

NUTs2 **NUTs3** **NUTs4**

Biofuel **BIODIESEL** Raw material **RAPESEED**

Spanish GHG tool

Fertilization data input screen



Spanish biofuels calculator

Biofuel and raw material | Agricultural phase | Transportation phase | Plant production phase | Distribution phase | CO₂ capture | Results

General data | Fertilization | Pesticides | Field works | Crop yield | N₂O emissions | Others

Mineral fertilizers

	kg/ha	% N	% P2O5	% K2O
NPK 15/15/15	0,00	15	15	15
NPK 8/15/15	0	8	15	15
NPK 9/18/27	0	9	18	27
NPK 12/10/17	0	12	10	17
Urea	0	46	0	0
Potassium nitrate	0	12	12	12
Diammonium phosphate	0	12	46	0
Amonium sulphate	0	21	0	21
Potassium sulphate	0	0	0	53
Other	0	0	0	0
CaO fertilizer	0			

Organic fertilizers

kg N/ha

Totals

N 0.0 kg/ha
P2O5 0.0 kg/ha
K2O 0.0 kg/ha
CaO 0.0 kg/ha

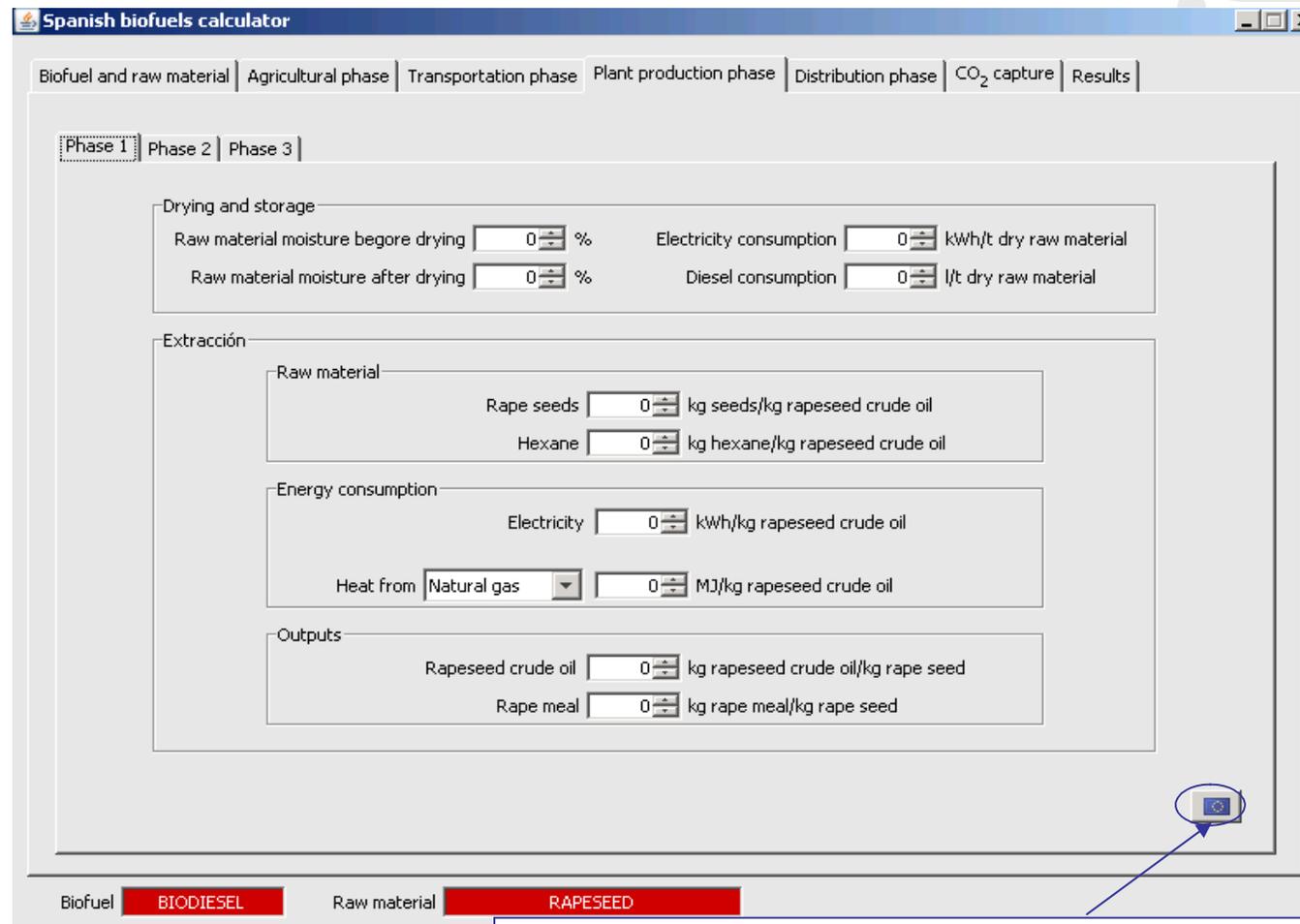
Biofuel **BIODIESEL** Raw material **RAPESEED**

Typical values for the agricultural county selected are uploaded

Values to reproduce the default values of the RED are uploaded

Spanish GHG tool

Transformation data input screen



Values to reproduce the default values of the RED are uploaded

www.biograce.net

Spanish GHG tool

Results screen

Spanish biofuels calculator

Biofuel and raw material | Agricultural phase | Transportation phase | Plant production phase | Distribution phase | CO₂ capture | **Results**

Cultivation of raw materials e_{ec} | Transport and distribution phases e_{td} | Transformation phase $e_p - e_{ee}$ | Totals

All results in CO ₂ eq g/MJ biodiesel	Non-allocated results	Allocation factor (%)	Allocated results	Emission reduction (%)	Default values RED Annex V.D
Cultivation e_c	49,33	58,59	28,9		29
Transport e_{td}	1,64		1,53		1
Processing e_p	25,5		22,08		22
Land use change e_l	0	58,59	0		0
$e_{sca} + e_{ccr} + e_{ccs}$	0	100	0		0
TOTALS	76,47		52,51	37,34	52

g CO₂ eq/MJ biodiesel

Allocated results: 28,901 (Cultivation), 22,075 (Processing)

Default values RED: 29 (Cultivation), 22 (Processing)

Legend:

- Cultivation (e_c)
- Transport (e_{td})
- Processing (e_p)
- Land use change (e_l)
- $e_{sca} + e_{ccr} + e_{ccs}$

Biofuel: **BIODIESEL** | Raw material: **RAPSEED**

Spanish tool - Summary

Contents

- o Tool build in Java
- o Focus on Spain:
 - Contains data on agricultural inputs and yields for 6 crops used to produce biofuels in Spain at the level of agrarian county (NUTs4)
 - Any farmer in the country can select his/her county and crop and the corresponding values regarding agricultural inputs and yields will appear in the tool.
- o For processing and transport: RED default values
- o Standard values from BioGrace

Status

- o Biodiesel from rapeseed, rapeseed HVO and ethanol from wheat CHP chains ready
- o Final version expected mid-2011

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UK tool - general information

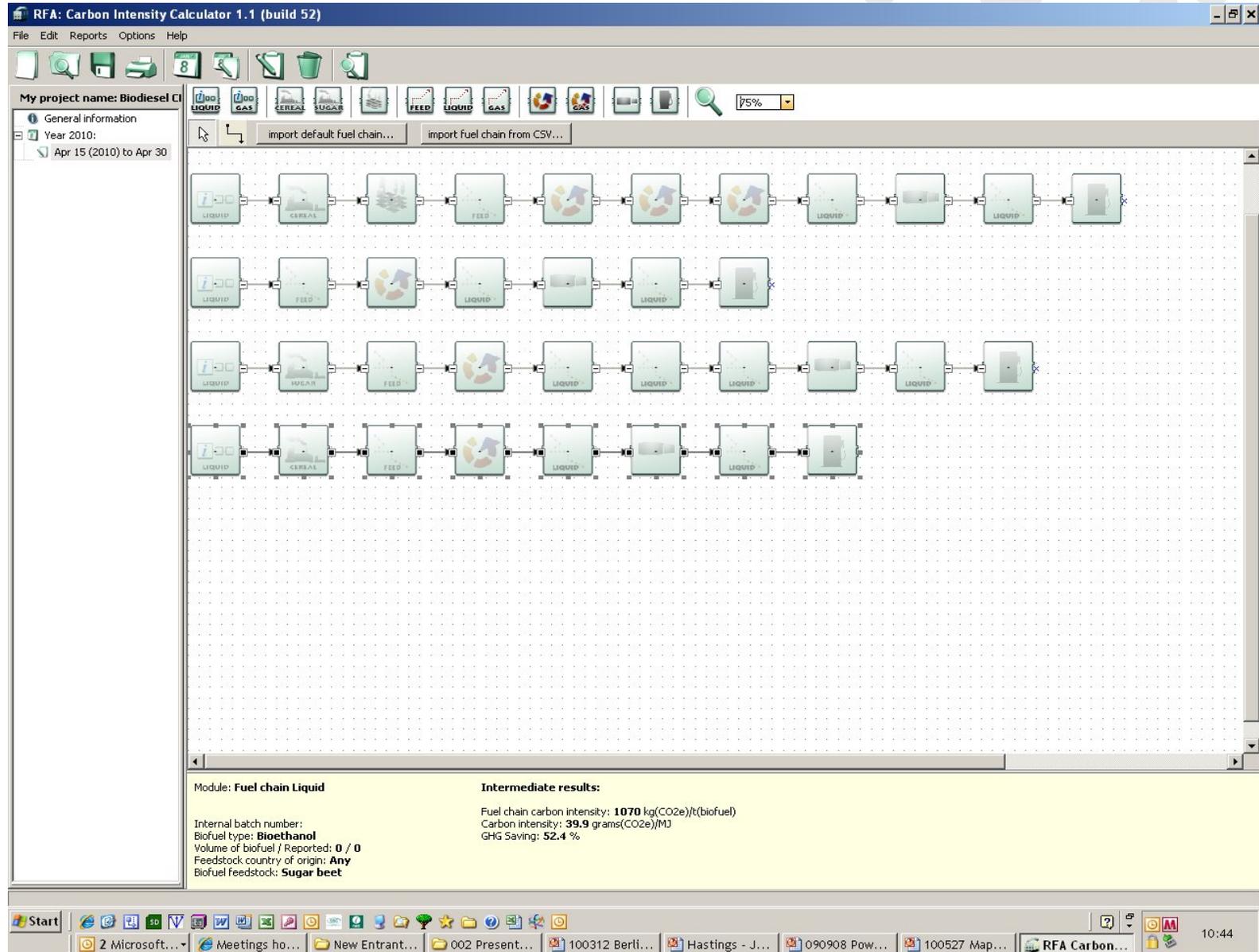
Background

- o UK GHG calculator was developed under RTFO reporting scheme
- o Calculator existing since 2008, regularly updated
- o Aim is to facilitate stakeholders calculating actual values under RTFO reporting

The UK GHG calculator

- o was made and is regularly updated by consultant E4Tech, contracted by RFA
- o has recently been made “RED-proof”
- o strongly linked to RTFO reporting scheme
- o provides more “standard values” as compared to BioGrace

UK GHG tool



My project name: Biodiesel C

General information

- Year 2010:
- Apr 15 (2010) to Apr 30

Module: Fuel chain Liquid

Intermediate results:

- Fuel chain carbon intensity: 1070 kg(CO₂e)/t(biofuel)
- Carbon Intensity: 39.9 grams(CO₂e)/MJ
- GHG Saving: 52.4 %

Internal batch number:

- Biofuel type: Bioethanol
- Volume of biofuel / Reported: 0 / 0
- Feedstock country of origin: Any
- Biofuel feedstock: Sugar beet

UK GHG tool

7.2 Fuel chain – Liquid



Basic data	
Module description	A brief description of the module. This field is optional.
Details and links to verification evidence	Any further details can be added here, including, for example links to any evidence which supports the actual data used within this module. This field is optional.
Internal batch number	A batch number for your own reference can be entered here. This field is optional.
Fuel type produced	The biofuel type of this batch / fuel chain. This field is compulsory. This field can only be changed if no modules follow the 'Fuel chain – Liquid' module.
Country	The country in which the feedstock was produced (NOT necessarily the country in which the biofuel was produced). This field is compulsory ('Unknown' can be selected if relevant). This field can only be changed if no modules follow the 'Fuel chain – Liquid' module.
Biofuel feedstock	The type of feedstock from which the biofuel was produced. This field is compulsory ('Unknown' can be selected if relevant). This field can only be changed if no modules follow the 'Fuel chain – Liquid' module.

UK GHG tool

7.2 Fuel chain – Liquid



Quantity of fuel	The quantity of biofuel in this batch (measured in litres) – this is the quantity of fuel the software enters into the monthly CSV report which can be uploaded to the RFA Operating System.
Quantity of fuel recorded in the RFA Operating System	If you make any adjustments to fuel quantities recorded on the RFA Operating System after uploading a monthly CSV report, the new quantities can be recorded in this field (measured in litres). Annual reports can only be prepared if fuel quantities are recorded in this field.
Fuel chain default value	This field shows the appropriate fuel chain default value, based on the data you supplied on fuel type, feedstock and country of origin.
Social and Environmental	
Land use on 01 Jan 2008	The land use, on 1 st January 2008, for the land on which the biofuel feedstock was grown. Definitions of the land use are given in the Technical Guidance for RTFO year 3 Part 1 Annex H.
Standard	The sustainability standard to which the reported feedstock was produced – see Section 3.3 of the Technical Guidance for RTFO year 3 Part 1 for further details.
Social level	The ‘Social level’ achieved by the sustainability standard selected. This field will generally not need to be changed.

UK tool - Summary

Contents

- o Tool build in LCA-software package
- o Tool can produce supplier monthly and annual C&S reports
- o Tool differs from BioGrace Excel sheets:
 - More than 250 biofuel production pathways included
 - DLUC calculations not included
- o The software programming makes it flexible
 - Rather easy to modify pathways or build new ones

Status

- o Tool on-line via www.renewablefuelsagency.gov.uk including a user manual
- o All chains available (and more) but not all chains give same result (yet) as compared to RED defaults

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Comparison of results

Check list Version 3.0 February 2011	Default greenhouse gas emissions						
	Table A RED Annex V/FQD Annex IV	BIOGRACE W3		BIOGRACE WP4 National GHG Calculators			
	Default value	1/25/298	1/23/296	The Netherlands ANL	Germany IFEU	Spain CIEMAT	UK
Biofuel production pathways							
Ethanol wheat lignite	70	69.9	69.8	69.9	67.9		70
Ethanol wheat (proces fuel not specified)	70	69.9	69.8	69.8	67.9		70
Ethanol wheat (natural gas - steam boiler)	55	54.9	54.6	54.6	52.8	55.61	55
Ethanol wheat (natural gas - CHP)	44	44.3	44.1	44.1	42.2		44
Ethanol wheat (straw)	26	26.1	26.0	26.0	24.0		26
Ethanol corn	43	43.6	43.4	43.4	42.6		43
Ethanol sugarbeet	40	40.3	40.1	40.1			40
Ethanol from sugarcane	24	24.3	24.0	24.0			24
Biodiesel rape seed	52	52.0	51.7	51.8		52.51	52
Biodiesel palm oil	68	68.7	66.0	66.0	68.9		68
Biodiesel palm oil (methane capture)	37	37.1	36.9	37.0	36.3		37
Biodiesel soy	58	57.2	56.9	57.0			58
Biodiesel sunflower	41	40.8	40.6	40.6			41
Biodiesel UCO	14	21.4	21.3	21.3			14
PVO rape seed	36	36.1	35.9	31.2			36
HVO rape seed	44	44.5	44.2	44.2		44.57	44
HVO palm oil	62	61.6	58.9	58.9			62
HVO palm oil (methane capture)	29	29.1	29.0	29.0			29
HVO sunflower	32	32.9	32.7	32.7			32
Biogas - dry manure	15	14.3	13.0	12.9			15
Biogas - wet manure	16	15.8	14.5	14.4			16
Biogas - MSW.	23	22.7	21.4	21.4			23
	1/25/298	1/25/298	1/23/296	1/23/296	1/25/298	1/23/296	

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Conclusions

Several GHG calculators available

- o Two exist since 2008, three (including BioGrace Excel sheets) are newly developed
- o Project BioGrace will ensure that all calculators will give the same result
- o Some allow to modify or build new pathways, others don't

National GHG calculators have different aims

- o Some are more focussed on national data or national reporting, others are more international oriented
- o Focus on different aspects
 - Agricultural stages (Spain)
 - Supply of data through the chain of custody (Germany)

Thank you for your attention

Intelligent Energy  **Europe**

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BIOGRACE

Harmonised Calculations of
Biofuel Greenhouse Gas Emissions in Europe

The BioGrace Excel GHG calculation tool - Basics

Yolanda Lechón
CIEMAT
Public workshop Athens
May 26, 2011

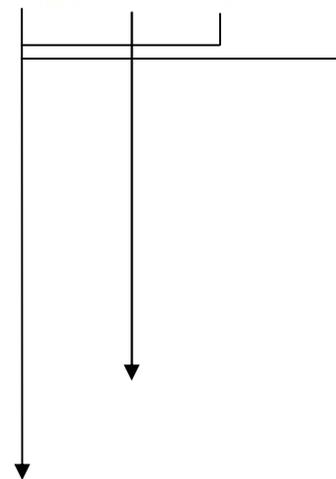
Contents

1. Steps from cultivation to filling station
2. Use individual input numbers
3. Navigate through tool
4. Standard values
5. Define own standard values
6. Inconsistent use of global warming potentials

**Demonstrated
in Excel
Spreadsheet vs.4**

Steps from cultivation to filling station

$$E = e_{ec} + e_l + e_p + e_{td} + e_u - e_{sca} - e_{ccs} - e_{ccr} - e_{ee}$$



e_{ee} : combined with e_p

$ee_{ccs/ccr}$: technology not in place

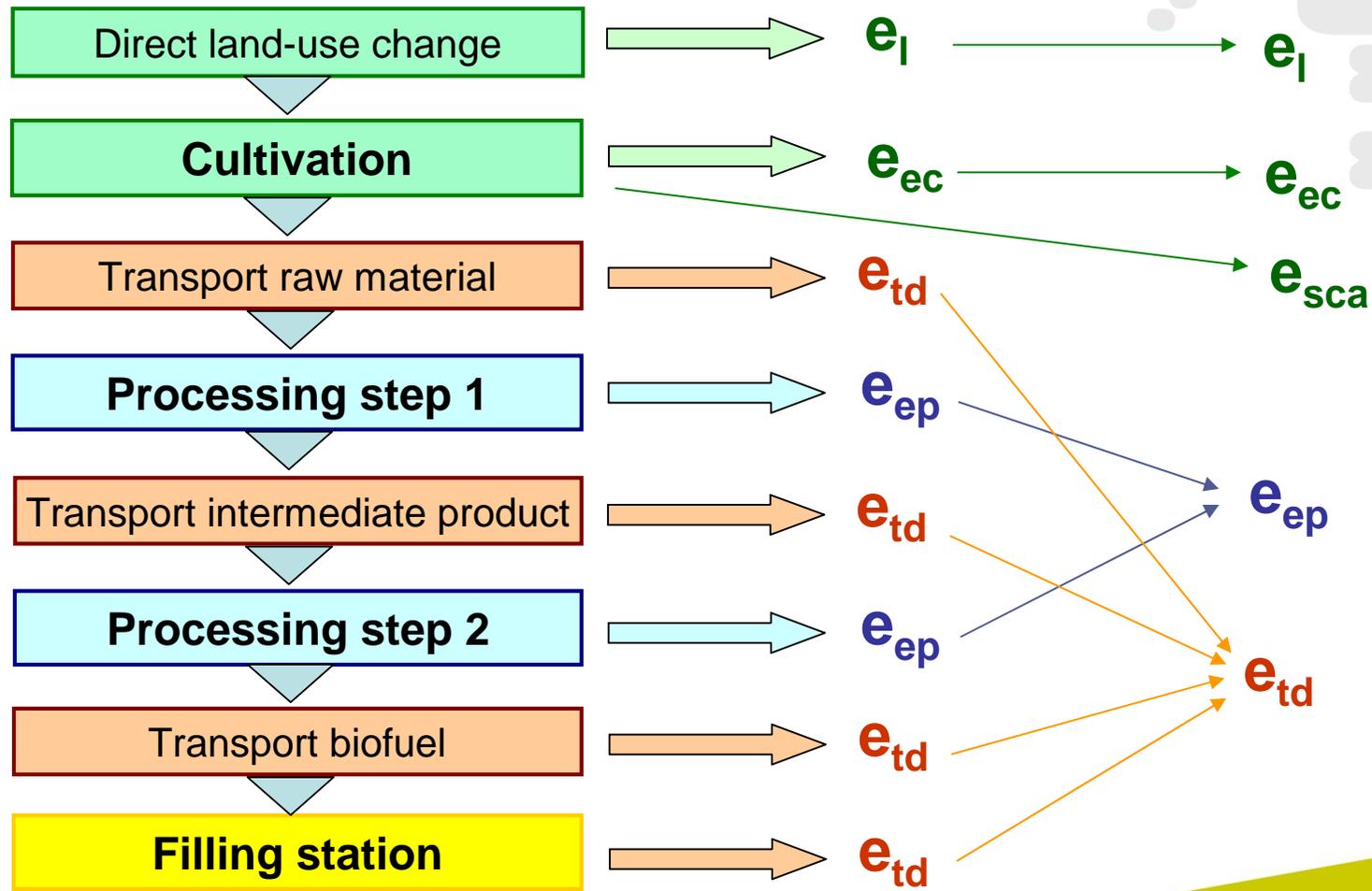
e_{sca} : methodology still under discussion

e_u : maybe relevant for biogas pathways

e_l : following the decision 2010/335/EU

e_{ec} , e_p , e_{td} = basic „disaggregated default values“

Steps from cultivation to filling station



Steps from cultivation to filling station The aggregation on top

Production of FAME from Rapeseed (steam from natural gas boiler)

Overview Results

All results in $g\ CO_{2,eq} / MJ_{FAME}$	Non-allocated results	Allocation factor	Allocated results	Total	Actual/ Default	Default values RED Annex V.D
Cultivation e_{ec}				28.7	A	29
Cultivation of rapeseed	48.35	58.6%	28.33			28.51
Rapeseed drying	0.72	58.6%	0.42			0.42
Processing e_p				21.6	A	22
Extraction of oil	6.50	58.6%	3.81			3.82
Refining of vegetable oil	1.06	95.7%	1.01			17.88
Esterification	17.51	95.7%	16.75			
Transport e_{td}				1.4	A	1
Transport of rapeseed	0.30	58.6%	0.17			0.17
Transport of FAME	0.82	100%	0.82			0.82
Filling station	0.44	100%	0.44			0.44
Land use change e_l	0.0	58.6%	0.0	0.0		0
$e_{soa} + e_{ocf} + e_{ocs}$	0.0	100%	0.0	0.0		0
Totals	75.7			51.7		52

Allocation factors

Extraction of oil
61.3% to Rapeseed oil
38.7% to Rapeseed cake
Esterification
95.7% to FAME
4.3% to Refined glycerol

Calculations in this Excel sheet

- strictly follow the methodology Directives 2009/28/EC and 2003/90/EC
 - follow JRC calculations by using values 25 for CHA and 298 for t
- As explained in "About" under "Inconsis

Cultivation e_{ec}

Cultivation of rapeseed		Quantity of product	Calculated emissions			
Yield		Yield	Emissions per MJ FAME			
Rapeseed	3.113 kg ha ⁻¹ year ⁻¹	73.975 MJ _{Rapeseed} ha ⁻¹ year ⁻¹	g CO ₂	g CH ₄	g N ₂ O	g CO _{2, eq}
Moisture content	10,0%	1,000 MJ / MJ _{Rapeseed, input}				
By-product Straw	n/a kg ha ⁻¹ year ⁻¹	0,073 kg _{Rapeseed} /MJ _{FAME}				
Energy consumption						
Diesel	2.963 MJ ha ⁻¹ year ⁻¹		6,07	0,00	0,00	6,07
Agro chemicals						
N-fertiliser (kg N)	137,4 kg N ha ⁻¹ year ⁻¹		9,08	0,03	0,03	19,00
CaO-fertiliser (kg CaO)	19,0 kg CaO ha ⁻¹ year ⁻¹		0,05	0,00	0,00	0,06
K ₂ O-fertiliser (kg K ₂ O)	49,5 kg K ₂ O ha ⁻¹ year ⁻¹		0,62	0,00	0,00	0,67
P ₂ O ₅ -fertiliser (kg P ₂ O ₅)	33,7 kg P ₂ O ₅ ha ⁻¹ year ⁻¹		0,76	0,00	0,00	0,80
Pesticides	1,2 kg ha ⁻¹ year ⁻¹		0,28	0,00	0,00	0,32
Seeding material						
Seeds- rapeseed	6 kg ha ⁻¹ year ⁻¹		0,06	0,00	0,00	0,10
Field N₂O emissions						
	3,10 kg ha ⁻¹ year ⁻¹					
		Total	16,92	0,03	0,10	21,61
		Result	g CO_{2,eq} / MJ_{FAME}			48,63

fill in actual data

fill in actual data

Yield	
Rapeseed	3.113 kg ha ⁻¹ year ⁻¹
Moisture content	10,0%
By-product Straw	n/a kg ha ⁻¹ year ⁻¹
Energy consumption	
Diesel	2.963 MJ ha ⁻¹ year ⁻¹
Agro chemicals	
N-fertiliser (kg N)	137,4 kg N ha ⁻¹ year ⁻¹
CaO-fertiliser (kg CaO)	19,0 kg CaO ha ⁻¹ year ⁻¹
K ₂ O-fertiliser (kg K ₂ O)	49,5 kg K ₂ O ha ⁻¹ year ⁻¹
P ₂ O ₅ -fertiliser (kg P ₂ O ₅)	33,7 kg P ₂ O ₅ ha ⁻¹ year ⁻¹
Pesticides	1,2 kg ha ⁻¹ year ⁻¹
Seeding material	
Seeds- rapeseed	6 kg ha ⁻¹ year ⁻¹
Field N₂O emissions	3,10 kg ha ⁻¹ year ⁻¹

A fixed value.
But calculation
Sheet provided

Cultivation e_{ec}

Cultivation of rapeseed		Quantity of product	Calculated emissions			
Yield		Yield	Emissions per MJ FAME			
Rapeseed	3.113 kg ha ⁻¹ year ⁻¹	73.975 MJ _{Rapeseed} ha ⁻¹ year ⁻¹	g CO ₂	g CH ₄	g N ₂ O	g CO _{2, eq}
Moisture content	10,0%	1,000 MJ / MJ _{Rapeseed, input}				
By-product Straw	n/a kg ha ⁻¹ year ⁻¹	0,073 kg _{Rapeseed} /MJ _{FAME}				
Energy consumption		 <p>conversion factors yield related</p>	6,07	0,00	0,00	6,07
Diesel	2.963 MJ ha ⁻¹ year ⁻¹		9,08	0,03	0,03	19,00
Agro chemicals			0,05	0,00	0,00	0,06
N-fertiliser (kg N)	137,4 kg N ha ⁻¹ year ⁻¹		0,62	0,00	0,00	0,67
CaO-fertiliser (kg CaO)	19,0 kg CaO ha ⁻¹ year ⁻¹		0,76	0,00	0,00	0,80
K ₂ O-fertiliser (kg K ₂ O)	49,5 kg K ₂ O ha ⁻¹ year ⁻¹		0,28	0,00	0,00	0,32
P ₂ O ₅ -fertiliser (kg P ₂ O ₅)	33,7 kg P ₂ O ₅ ha ⁻¹ year ⁻¹					
Pesticides	1,2 kg ha ⁻¹ year ⁻¹					
Seeding material			0,06	0,00	0,00	0,10
Seeds- rapeseed	6 kg ha ⁻¹ year ⁻¹					
Field N₂O emissions	3,10 kg ha ⁻¹ year ⁻¹					
		Total	0,00	0,00	0,07	21,61
		Result	g CO_{2,eq} / MJ_{FAME}			48,63

fill in actual data

Quantity of product

Yield

73.975 MJ_{Rapeseed} ha⁻¹ year⁻¹

1,000 MJ / MJ_{Rapeseed, input}

0,073 kg_{Rapeseed}/MJ_{FAME}

**yield related conversion factors
raw material per final biofuel**

**values as a function of input values
and/or of the chain**

Cultivation e_{ec}

multiplying input values with “standard values”

Cultivation of rapeseed		Quantity of product	Calculated emissions				
Yield		Yield	Emissions per MJ FAME				
Rapeseed	3.113 kg ha ⁻¹ year ⁻¹	73.975 MJ _{Rapeseed} ha ⁻¹ year ⁻¹	g CO ₂	g CH ₄	g N ₂ O	g CO _{2, eq}	
Moisture content	10,0%	1,000 MJ / MJ _{Rapeseed, input}					
By-product Straw	n/a kg ha ⁻¹ year ⁻¹	0,073 kg _{Rapeseed} /MJ _{FAME}					
Energy consumption		conversion factors yield related					
Diesel	2.963 MJ ha ⁻¹ year ⁻¹		6,07	0,00	0,00	6,07	
Agro chemicals							
N-fertiliser (kg N)	137,4 kg N ha ⁻¹ year ⁻¹		9,08	0,03	0,03	19,00	
CaO-fertiliser (kg CaO)	19,0 kg CaO ha ⁻¹ year ⁻¹		0,05	0,00	0,00	0,06	
K ₂ O-fertiliser (kg K ₂ O)	49,5 kg K ₂ O ha ⁻¹ year ⁻¹		0,62	0,00	0,00	0,67	
P ₂ O ₅ -fertiliser (kg P ₂ O ₅)	33,7 kg P ₂ O ₅ ha ⁻¹ year ⁻¹		0,76	0,00	0,00	0,80	
Pesticides	1,2 kg ha ⁻¹ year ⁻¹		0,28	0,00	0,00	0,32	
Seeding material							
Seeds- rapeseed	6 kg ha ⁻¹ year ⁻¹		0,06	0,00	0,00	0,10	
Field N₂O emissions							
	3,10 kg ha ⁻¹ year ⁻¹		0,00	0,00	0,07	21,61	
			Total	16,92	0,03	0,10	48,63
			Result	g CO_{2,eq} / MJ_{FAME}		48,63	

fill in actual data

Results related to raw material or acreage

Cultivation e_{ec}

Cultivation of rapeseed		Info	
		per kg rapeseed	per ha, year
	g CO _{2, eq}	g CO _{2, eq}	kg CO _{2, eq}
Yield			
Rapeseed			
Moisture content			
By-product Straw			
Energy consumption			
Diesel	6,07	83,40	259,7
Agro chemicals			
N-fertiliser (kg N)	19,00	261,19	813,2
CaO-fertiliser (kg CaO)	0,06	0,79	2,5
K ₂ O-fertiliser (kg K ₂ O)	0,67	9,20	28,6
P ₂ O ₅ -fertiliser (kg P ₂ O ₅)	0,80	10,96	34,1
Pesticides	0,32	4,36	13,6
Seeding material			
Seeds- rapeseed	0,10	1,41	4,4
Field N₂O emissions			
	21,61	296,99	924,7
	48,63	668,31	2080,7
	48,63		

Processing e_p Step 1, oil extraction

Extraction of oil		Quantity of product		Calculated emissions			
Yield				Emissions per MJ FAME			
Crude vegetable oil	0,6125 MJ _{Oil} / MJ _{Rapeseed}	44.861 MJ _{Oil} ha ⁻¹ year ⁻¹		g CO ₂	g CH ₄	g N ₂ O	g CO _{2,eq}
By-product Rapeseed cake	0,3875 MJ _{Rapeseed cake} / MJ _{Rapeseed}	0,606 MJ / MJ _{Rapeseed, input}					
Energy consumption			0,029 kg _{Oil} / MJ _{FAME}				
Electricity EU mix MV	0,0118 MJ / MJ _{Oil}			1,47	0,00	0,00	1,58
Steam (from NG boiler)	0,0557 MJ / MJ _{Oil}						
NG Boiler				Emissions from NG boiler			
CH ₄ and N ₂ O emissions from NG boiler				0,00	0,00	0,00	0,02
Natural gas input / MJ steam	1,111 MJ / MJ _{Steam}			4,08	0,01	0,00	4,41
Natural gas (4000 km, EU mix)	0,062 MJ / MJ _{Oil}						
Electricity input / MJ steam	0,020 MJ / MJ _{Steam}			0,14	0,00	0,00	0,15
Electricity EU mix MV	0,001 MJ / MJ _{Oil}						
Chemicals							
n-Hexane	0,0043 MJ / MJ _{Oil}			0,36	0,00	0,00	0,37
Total				6,06	0,02	0,00	6,53
Result				g CO_{2,eq} / MJ_{FAME}			6,53

conversion factors yield related

fill in actual data

Allocation over main- and byproduct		Total emission before allocation:		g CO _{2,eq} / MJ _{FAME}		55.86
		Emissions up to and including this process step:		55.86 g CO _{2,eq} / MJ _{FAME}		
Main product:	Rapeseed oil	Energy content (based on 1MJ)	1.0000 MJ	34.21 g CO _{2,eq} / MJ _{FAME}		
Co-product:	Rapeseed cake	Energy content co-product	0.6326 MJ	21.65 g CO _{2,eq} / MJ _{FAME}		
		Total:	1.6326 MJ			
		Total emission after allocation:		g CO_{2,eq} / MJ_{FAME}		34.21

Transport e_{td} of FAME

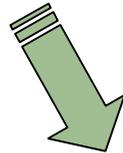
Transport of FAME to and from depot		Quantity of product	Calculated emissions			
FAME	1,000 MJ _{FAME} / MJ _{FAME}	42790,9 MJ _{FAME} ha ⁻¹ year ⁻¹	Emissions per MJ FAME			
Transport per Truck for liquids (Diesel)	300 km	0,578 MJ / MJ _{Rapeseed, input}	g CO ₂	g CH ₄	g N ₂ O	g CO _{2, eq}
Fuel Diesel		0,0047 ton km / MJ _{Rapeseed, input}	0,71	0,00	0,00	0,71
Energy cons. depot Electricity EU mix LV	0,00084 MJ / MJ _{FAME}		0,10	0,00	0,00	0,11
Result			g CO_{2,eq} / MJ_{FAME}			0,8225

fill in actual data

conversion factors yield related

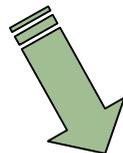
Filling station		Quantity of product	Emissions per MJ FAME			
Yield	1,000 MJ _{FAME} / MJ _{FAME}	42790,9 MJ _{FAME} ha ⁻¹ year ⁻¹	g CO ₂	g CH ₄	g N ₂ O	g CO _{2, eq}
Energy consumption Electricity EU mix LV	0,0034 MJ / MJ _{FAME}	0,578 MJ / MJ _{Rapeseed, input}	0,41	0,00	0,00	0,44
Result			g CO_{2,eq} / MJ_{FAME}			0,44

- **Include new process steps**
- **Set up completely new biofuel production chains**



Afternoon session “Practical calculation”

- **Navigate through tool**
- **Standard values**
- **Define own standard values**
- **Inconsistent use of global warming potentials**



BioGrace GHG calculations – version 3 - Public.xls

BIOGRACE

Harmonised Calculations of
Biofuel Greenhouse Gas Emissions in Europe

**The BioGrace Excel GHG
calculation tool – Other parts**

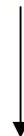


Contents

1. Introduction
2. Land use change
3. Improved agricultural management
4. CO₂ storage or replacement
5. New items in Public version 4
 - User manual
 - Calculation rules
 - Track changes
6. New item for Public version 5:
 - Calculation of N₂O field emissions
7. BioGrace as a voluntary scheme

Introduction

$$E = e_{ec} + e_l + e_p + e_{td} + e_u - e_{sca} - [e_{ccs} - e_{ccr}] - e_{ee}$$

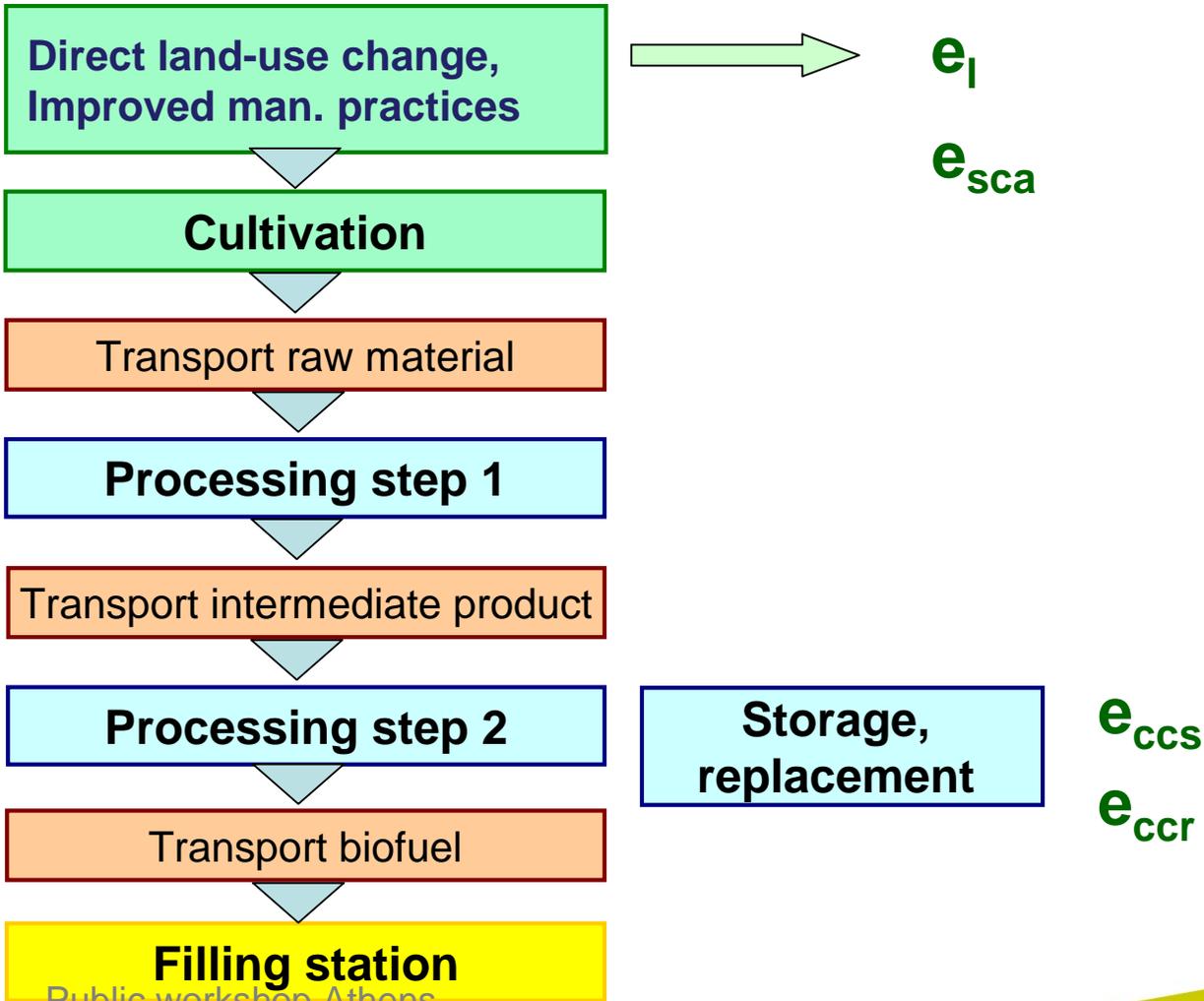


$ee_{ccs/ccr}$: CO₂ capture, storage or replacement

e_{sca} : Carbon storage from improved agricultural management

e_l : Land use change,
following the decision 2010/335/EU

Introduction



Contents

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Land Use Change

General principles :

1. Annex V of the RED gives the general calculation guidelines (part C, point 7):

$$e_l = (CS_R - CS_A) \times 3,664 \times 1/20 \times 1/P - e_B \text{ (1)}$$

2. Calculation rules are explained in the following the decision 2010/335/EU: *Commission Decision of 10 June 2010 on guidelines for the calculation of land use carbon stocks for the purpose of Annex V of Directive 2009/28/EC.*

This communication gives:

- Consistent representation of land carbon stocks
- Calculation rules
- Default data for applying this formula (tables)

Land Use Change

General principles :

Two types of calculation are possible :

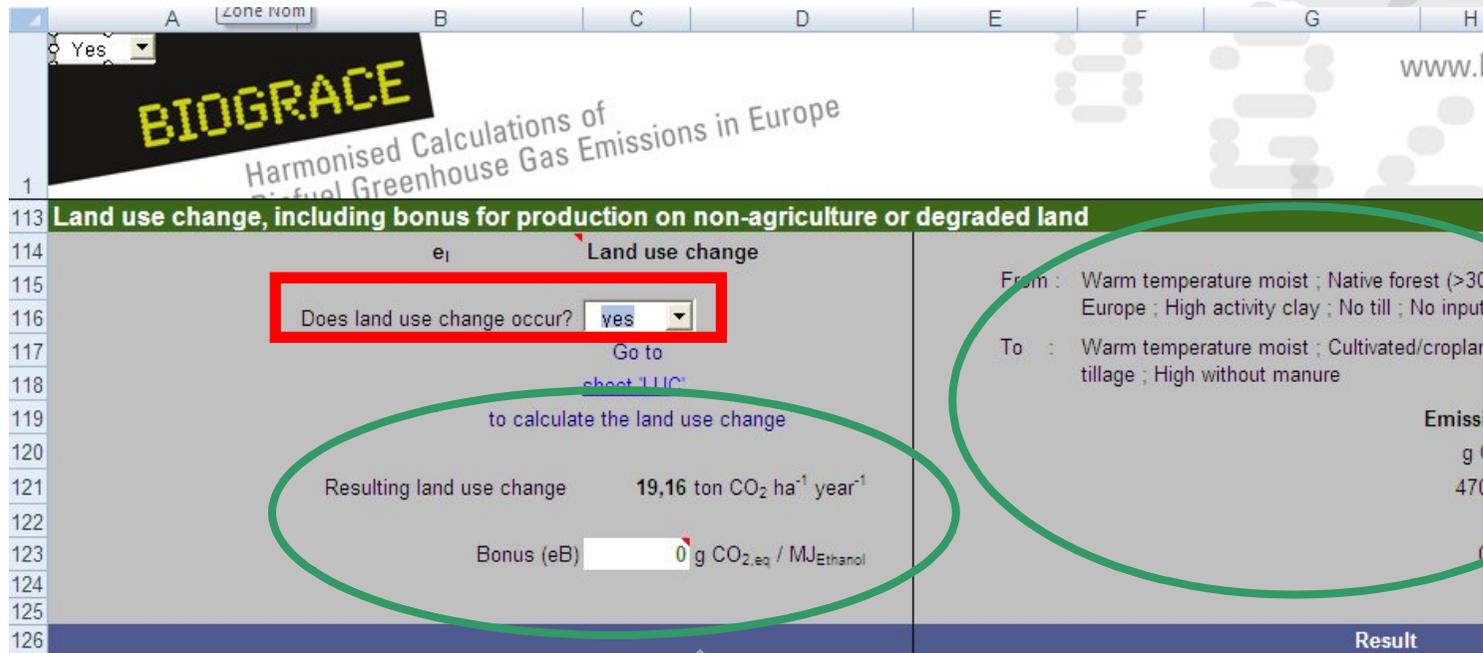
- 1. Calculation using default value*

$$CS_i = C_{VEG} + SOC_{ST} * F_{LU} * F_{MG} * F_I$$

- 2. Calculation using actual value for C_{VEG} and Soil Organic Carbon (SOC).*

$$CS_i = C_{VEG} + SOC_i$$

Step 1 : declare LUC in your pathway

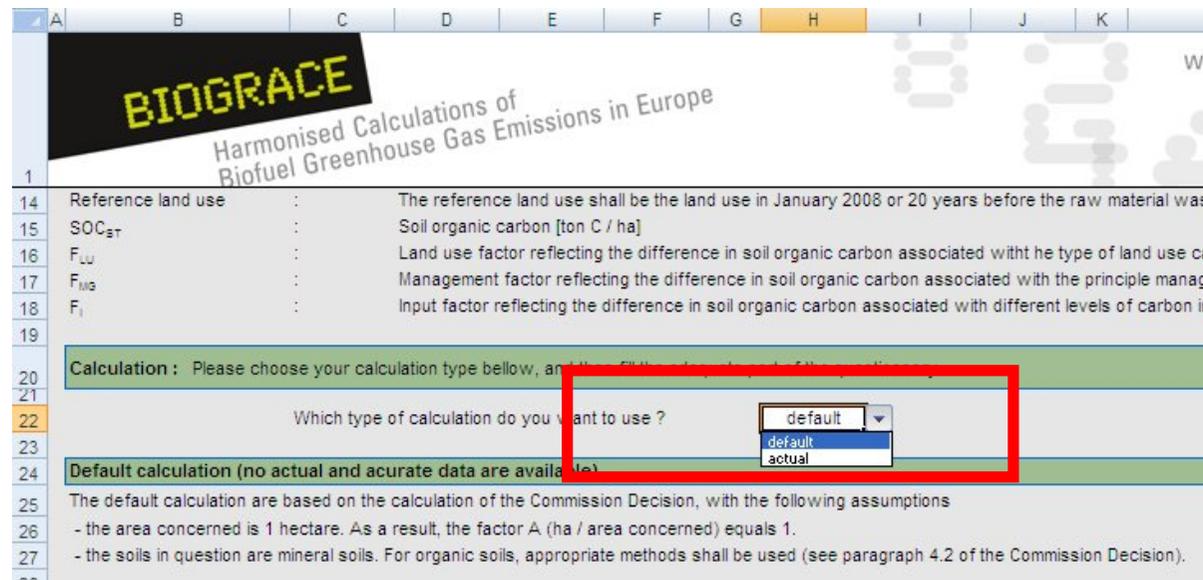


Land use change, including bonus for production on non-agriculture or degraded land	
e _l Land use change	
Does land use change occur? <input type="button" value="yes"/>	
Go to sheet 'LUC' to calculate the land use change	
Resulting land use change	19,16 ton CO ₂ ha ⁻¹ year ⁻¹
Bonus (eB)	<input type="text" value="0"/> g CO _{2,eq} / MJ _{ethanol}
From :	Warm temperature moist ; Native forest (>30 Europe ; High activity clay ; No till ; No input
To :	Warm temperature moist ; Cultivated/cropland tillage ; High without manure
Emission factor	g CO ₂ / MJ _{ethanol}
	470
	0
Result	

Text appear

Step 2 : Go to the LUC excel sheet and read through this sheet. Get the Commission Decision 2010/335/EU with you.

Step 3 : Choose the type of calculation : default or actual and fill the appropriate white cells.



The screenshot shows an Excel spreadsheet with the following content:

	A	B	C	D	E	F	G	H	I	J	K	
1		BIOGRACE										
		Harmonised Calculations of Biofuel Greenhouse Gas Emissions in Europe										
14	Reference land use	:	The reference land use shall be the land use in January 2008 or 20 years before the raw material was									
15	SOC _{BT}	:	Soil organic carbon [ton C / ha]									
16	F _{LU}	:	Land use factor reflecting the difference in soil organic carbon associated with the type of land use ca									
17	F _{MG}	:	Management factor reflecting the difference in soil organic carbon associated with the principle manag									
18	F _I	:	Input factor reflecting the difference in soil organic carbon associated with different levels of carbon in									
19												
20	Calculation : Please choose your calculation type below, and then fill the appropriate cells.											
21												
22		Which type of calculation do you want to use ?										
23		<div style="border: 1px solid red; padding: 2px;"> default ▼ default actual </div>										
24	Default calculation (no actual and accurate data are available)											
25	The default calculation are based on the calculation of the Commission Decision, with the following assumptions											
26	- the area concerned is 1 hectare. As a result, the factor A (ha / area concerned) equals 1.											
27	- the soils in question are mineral soils. For organic soils, appropriate methods shall be used (see paragraph 4.2 of the Commission Decision).											

Step 4 (default calculation) : use EC decision to fill out data

29 CS_A and CS_R are calculated with the following equation: $CS_i = C_{VEG} + SOC_{ST} * F_{LU} * F_{MG} * F_i$

30

31

32

33

34

35

36 Above and below ground vegetation

37 Ecological zone (if relevant) -

38 Continent (if relevant) -

39 C_{VEG} 0 ton C / ha

40

41 Carbon stock in mineral soil

42 Climate region Warm temperature moist

43 Soil type High activity clay

44 Soil management Full-tillage

45 Input High without manure

46

47 SOC_{ST} 88 ton C / ha

48 F_{LU} 0,69

49 F_{MG} 1

50 F_i 1,11

Actual land use

Climate region: Warm temperature moist

Vegetation/crop (land use): Cultivated/cropland

Reference land use

Climate region: Warm temperature moist

Vegetation/crop (land use): Native forest (>30% canopy cover)

Ecological zone (if relevant): Oceanic forest

Continent (if relevant): Europe

C_{VEG} : 84 ton C / ha

Climate region: Warm temperature moist

Soil type: High activity clay

Soil management: No till

Input: No input

SOC_{ST} : 88 ton C / ha

F_{LU} : 1

F_{MG} : n/a

F_i : n/a

17.6.2010 EN Official Journal of the European Union L 151/27

71. Cropland

Table 2
Factors for cropland

Climate region	Land use (F_{LU})	Management (F_{MG})	Input (F_i)	F_{LU}	F_{MG}	F_i
Temperate/boreal, dry	Cultivated	Full-tillage	Low	0,8	1	0,95
			Medium	0,8	1	1
			High with manure	0,8	1	1,37
		High without manure	0,8	1	1,04	
		Reduced tillage	Low	0,8	1,02	0,95
			Medium	0,8	1,02	1

Calculate value according to Chapter 5, or look up value

Determine using paragraph 6.1 of Commission Decision
 Determine using paragraph 6.2 of Commission Decision
 Determine using table 3 of Commission Decision
 Determine using table 3 of Commission Decision

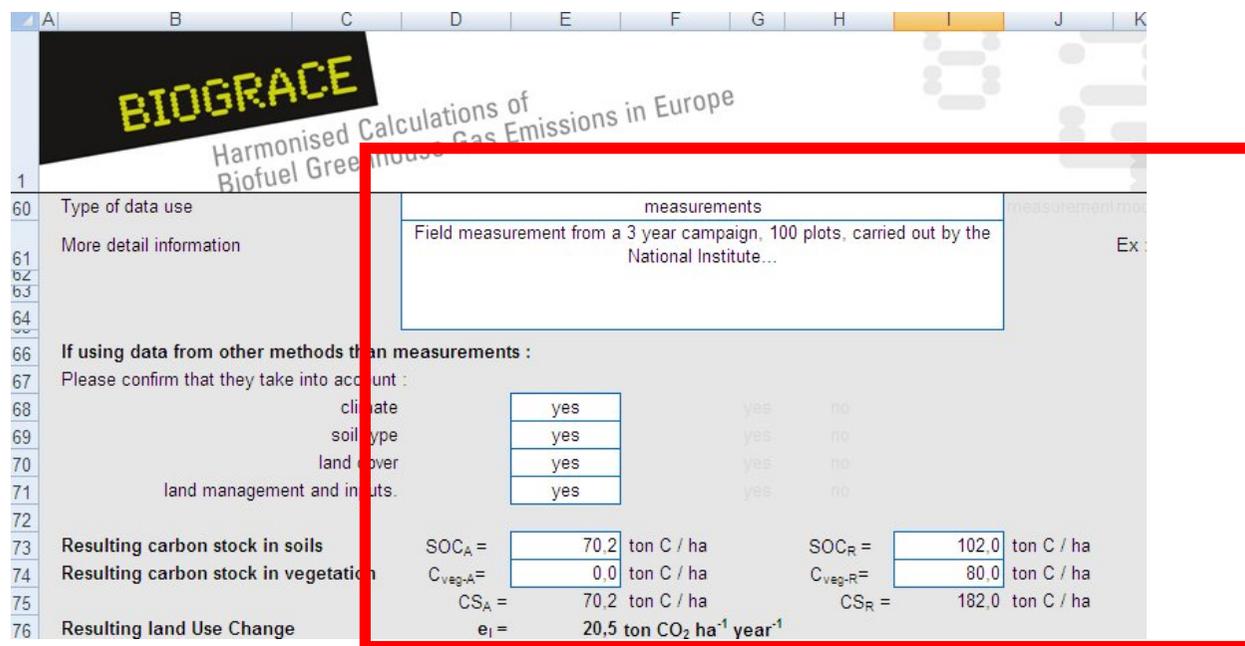
Loop up in Table 1 of Commission Decision, using climate region
 Look up in Tables 2 - 8 of Commission Decision
 Look up in Tables 2 - 8 of Commission Decision
 Look up in Tables 2 - 8 of Commission Decision

52
53 **Resulting carbon stock**
54 **Resulting LUC**

$CS_A = 67,4$ ton C / ha
 $e_i = 19,16$ ton eq. CO₂ / ha / an

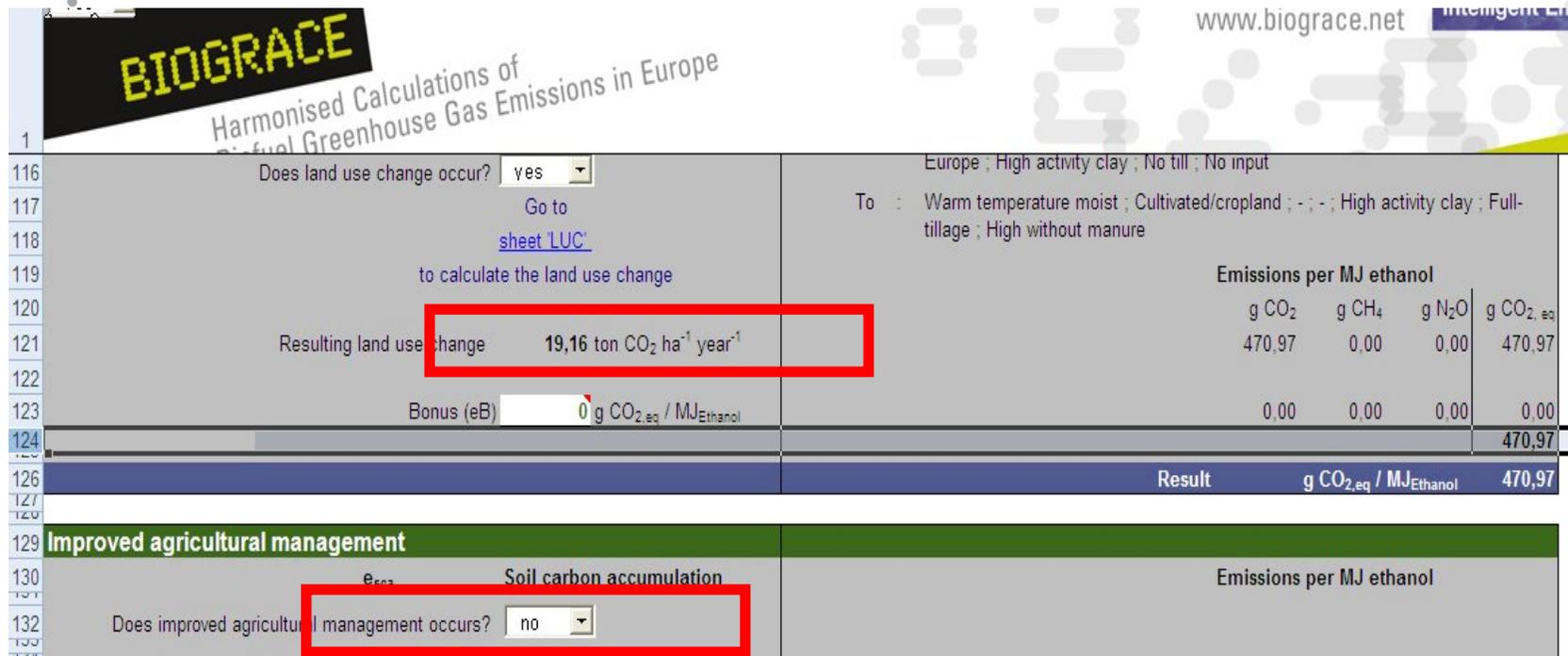
$CS_R = 172,0$ ton C / ha

Step 4 (actual calculation) : mind filling detailed information on the sources of the SOC data used.



BIOGRACE		Harmonised Calculations of Biofuel Greenhouse Gas Emissions in Europe	
60	Type of data use	measurements	
61	More detail information	Field measurement from a 3 year campaign, 100 plots, carried out by the National Institute...	
66	If using data from other methods than measurements :		
67	Please confirm that they take into account :		
68	climate	<input type="text" value="yes"/>	<input type="text" value="no"/>
69	soil type	<input type="text" value="yes"/>	<input type="text" value="no"/>
70	land cover	<input type="text" value="yes"/>	<input type="text" value="no"/>
71	land management and inputs	<input type="text" value="yes"/>	<input type="text" value="no"/>
72			
73	Resulting carbon stock in soils	SOC _A = <input type="text" value="70.2"/> ton C / ha	SOC _R = <input type="text" value="102.0"/> ton C / ha
74	Resulting carbon stock in vegetation	C _{veg-A} = <input type="text" value="0.0"/> ton C / ha	C _{veg-R} = <input type="text" value="80.0"/> ton C / ha
75		CS _A = 70.2 ton C / ha	CS _R = 182.0 ton C / ha
76	Resulting land Use Change	e ₁ = 20,5 ton CO ₂ ha ⁻¹ year ⁻¹	

- **Step 5** : Check in the biofuel pathway that the LUC value is there. Please, also check that no Improved agricultural management is declared.



The screenshot shows the BIOGRACE software interface with the following data:

Does land use change occur?		Emissions per MJ ethanol			
Does land use change occur?	yes	g CO ₂	g CH ₄	g N ₂ O	g CO _{2, eq}
Resulting land use change	19,16 ton CO ₂ ha ⁻¹ year ⁻¹	470,97	0,00	0,00	470,97
Bonus (eB)	0 g CO _{2, eq} / MJ _{Ethanol}	0,00	0,00	0,00	0,00
Result					g CO_{2, eq} / MJ_{Ethanol}
Result					470,97

Improved agricultural management		Emissions per MJ ethanol			
Does improved agricultural management occurs?					
Does improved agricultural management occurs?	no				

e_b bonus for degraded and contaminated lands :

- A specific line exists within the LUC module of each pathway.
- Explanations on how to use are to be taken from the RED

3 Land use change, including bonus for production on non-agriculture or degraded land				
4 e_l Land use change				
5	Does land use change occur?	no		
6				
7				
8				
9			Emissions per MJ ethanol	
10			g CO ₂	g CH ₄
11			g N ₂ O	g CO ₂ eq
12	Resulting land use change	0,00 ton CO ₂ ha ⁻¹ year ⁻¹	0,00	0,00
13	Bonus (eB)	0 g	The bonus of 29 gCO ₂ eq/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 gCO ₂ eq/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.	
14				
15				
16				
17	Improved agricultural management			
18	e_{soil}	Soil carbon		
19				
20				
21				

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Improved Agricultural Management

1. Annex V of the RED has a specific term for carbon stock accumulation thanks to improved practices, but does not give much more explanations on how to calculate it
2. Calculation rules from the Commission Decision can serve as guidelines for making first level calculations
3. As for LUC, actual data can be used to assess them
4. In the BioGrace tool, an e_{sca} sheet exist to carry out the calculation
5. This sheet is build on the same frame than the LUC sheet
6. Don't declare e_{sca} when LUC are already declared (double counting)

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CO₂ storage or replacement

General principles :

1. Annex V of the RED has specific terms for carbon stock accumulation thanks to improved practices, but does not give much more explanations
2. In the BioGrace tool, two modules exist to declare these technological solutions. The value in g CO₂/MJ has to be added
3. Please, keep track of your calculations for verification requirements

43	CO₂ capture and replacement		
44	e_{cor}	<input type="text" value="0"/>	Emissions per MJ ethanol
45		g CO _{2,eq} / MJ _{Ethanol}	0,00
46			Result g CO _{2,eq} / MJ _{Ethanol} 0,00
47			
48			
49	CO₂ capture and geological storage		
50	e_{oss}	<input type="text" value="0"/>	Emissions per MJ ethanol
51		g CO _{2,eq} / MJ _{Ethanol}	0,00
52			Result g CO _{2,eq} / MJ _{Ethanol} 0,00

CO₂ storage or replacement

General principles :

4. Replacement : *“Emission saving from carbon capture and replacement, e_{CCR} , shall be limited to emissions avoided through the capture of CO₂ of which the carbon originates from biomass and which is used to replace fossil-derived CO₂ used in commercial products and services.”*
5. Storage : *“Emission saving from carbon capture and geological storage e_{CCS} , that have not already been accounted for in e_p , shall be limited to emissions avoided through the capture and sequestration of emitted CO₂ directly related to the extraction, transport, processing and distribution of fuel.”*

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New items in Public version 4

User Manual (or tutorial)

- A detailed tutorial is provided with the BioGrace tool
- It aims at helping the economic operators to understand and use the BioGrace GHG calculation tool.

User manual for the BioGrace greenhouse gas (GHG) calculation tool

This support document is designed to help the economic operators to understand and use the BioGrace GHG calculation tool. The main questions that arise concerning the tool are presented below, with a link to the appropriate chapter of this user manual.

Functions of the tool	This chapter details the different way of using this tool. You will find what the tool was developed for and what it can possibly do.
How does the tool work?	This chapter explains how the tool is designed and the general principles of the calculations.
How can I use the tool to understand the default values?	The following chapters allow any user to make use of the tool in function of its personal objective.
How can I use the tool to calculate my own actual value?	
How can I create a new pathway with the tool?	

New items in Public version 4

Calculation rules

- Making actual calculations under the RED/FQD requires rules
 - Which input data and standard values are allowed?
 - Cut-off criterion
 - Combination of actual and disaggregated values
- Many of these rules not yet defined
 - More detailed than methodology in RED Annex V.C
 - Some rules given in communications, several are not covered
- BioGrace has made a document “calculation rules”
 - Published as a separate document
 - Linked to GHG Excel tool
- European Commission will be evaluating rules...
 - ... when assessing a voluntary certification scheme after a request for recognition

New items in Public version 4

Track changes

- One of the calculation rules:
 - “Use ‘track changes’ for verification purposes”

Production of Ethanol from Sugarbeet (steam from NG boiler)

Version 4 - Public

Overview Results

All results in g CO _{2,eq} / MJ Ethanol	Non- allocated results	Allocation factor	Allocated results	Total
Cultivation e_{ec}				11,3
Cultivation of sugarbeet	15,89	71,3%	11,33	
Processing e_p				26,4
Ethanol plant	37,03	71,3%	26,40	
Transport e_{td}				2,3
Transport of sugarbeet	1,11	71,3%	0,79	
Transport of ethanol	1,10	100%	1,10	
Filling station	0,44	100%	0,44	
Land use change e_l	0,0	71,3%	0,0	0,0
e _{sca} + e _{ccr} + e _{ccs}	0,0	100%	0,0	0,0
Totals	55,6			40,1

Default values RED Annex V.D	
12	11,54
26	26,42
2	0,84
	1,10
	0,44
0	0
0	0
40	

Allocation factors
Ethanol plant
71,3% to ethanol
28,7% to Sugar beet pulp

Emission reduction
Fossil fuel reference (petrol)
83,8 g CO _{2,eq} /MJ
GHG emission reduction
52%

Calculations in this Excel sheet.....

strictly follow the methodology as given in Directives 2009/28/EC and 2009/30/EC

follow JEC calculations by using GWP values 25 for CH₄ and 298 for N₂O

AS explained in "About" under "Inconsistent use of GWPs"

Calculation per phase

Track changes: ON

When using this GHG calculation tool, the BioGrace calculation rules must be respected. The rules are included in the zip file in which you downloaded this tool. The rules are also available at www.BioGrace.net

Cultivation of sugarbeet	Quantity of product	Calculated emissions	Info
Yield	Yield	Emissions per MJ ethanol	per kg sugarbeet
Sugar beet	285.250 MJ _{Sugar beet} ha ⁻¹ year ⁻¹	g CO ₂ g CH ₄ g N ₂ O g CO _{2,eq}	per ha, year
Moisture content	1,000 MJ / MJ _{Sugar beet, input}		g CO _{2,eq} kg CO _{2,eq}
	0,451 kg _{Sugar beet} /MJ _{ethanol}		

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New item in Public version 5

Calculation of N₂O field emissions

1. A major contributors to GHG emissions of most of the pathways
2. Default value : N₂O emissions calculated from a model (DNDC, average EU), except some pathways (IPCC Tier 1 for soybeans, palm trees, sugarcane)
3. For new pathways or when modifying the cultivation data from an existing pathways : BioGrace recommends to use IPCC Tier 1 estimation for this emission
4. BioGrace tool aims to provide an Excel sheet for making N₂O calculations

N₂O emissions : fill in few input data

Crop data.

Please enter the data for your crop in the blue cells

General information

Crop name	<input type="text" value="Sugar beet"/>	
Crop yield (fresh matter)	<input type="text" value="68,860"/>	kg _{fm} /ha/year
Humidity(%)	<input type="text" value="75.0%"/>	
Crop yield (dry matter)	<input type="text" value="17215"/>	kg _{dm} /ha/year
Straw yield (removed from the field)	<input type="text"/>	kg dm/ha/year
Is the soil water saturation high ?	<input type="text" value="yes"/>	

Put "yes" when the crop is irrigated OR when rainfall in rainy season (1) minus potential evaporation is higher than soil water holding capacity. If not known, the average nitrate leakage will be applied.
(1) Rainy season: period when rainfall > 0.5 * Pan Evaporation

Specific information in case of Land Use Change or modified management practices

What type of land use change is it ?	<input type="text" value="Not concerned"/>	
Carbon loss due to land use change	<input type="text" value="0"/>	t/ha/year

Use "arable to arable land" in case of modified practices
[Please calculate this value by using the LUC sheet](#)
[or the Ex-s sheet for modified practices](#)

Specific information for some imported crops

Please, fill in the following cells only when a text appears. Default value used by RED

Text appears when the adequate imported crop is selected in the above section (cell C15).

<input type="text"/>
<input type="text"/>
<input type="text"/>
<input type="text"/>

N₂O direct emissions

Direct N₂O emissions from managed soils (Tier1). See Table 2, Table 3, Table 4 and Table 5 for intermediate calculations (right side of the this sheet)

Please enter the N additions in the form of synthetic or organic fertilizer in the blue cells

N₂O emissions from N inputs:

F _{SN}	119.70	kg N/ha/year	N in synthetic fertilizer
F _{ON}	0.00	kg N/ha/year	N in organic fertilizer
F _{CR}	423	kg N/ha/year	N in crop residues
F _{SOM}	0.00	kg N/ha/year	N mineralized

Emission factor for direct emission (IPCC Tier 1)

	average	min	max
EF ₁	1.0%	0.3%	3.0%

Table 2 N in crop residues = F _{CR}	
AG _{DIRT}	19,960 kg/ha/year
FRAC _{RENEW(T)}	1
R _{AG(T)}	1.159
N _{AG(T)}	0.016
FRAC _{REMOVE(T)}	0
R _{RG(T)}	0.43
N _{RG(T)}	0.014
R _{RG-SID(T)}	0.200
F _{CR}	423 kg N/ha/year Eq 11.6
	375 kg N/ha/year Eq 11.7A

source : from IPCC 2006

Table 4	N _{AG}	slope	intercept	AG _{DIRT1}	(AG _{DIRT1} *1000+Crop(T))/Crop(T) R _{AG(T)}	R
Sugar beet	0.0160	1.07	1.54	19.96	2.16	1.16
Wheat	0.0060	1.51	0.52	26.51	2.54	1.54
Corn	0.0060	1.03	0.61	18.34	2.07	1.07
Sugar cane				0.00	1.00	0.00
Rapeseed	0.0060	1.09	0.88	19.64	2.14	1.14
Sunflower	0.0060	1.09	0.88	19.64	2.14	1.14
Soybeans	0.0080	0.93	1.35	17.36	2.01	1.01
Palm	0.0110			0.00	1.00	0.00

Table 3 N mineralised from LUC = F _{SOM}			
	average	min	max
R1	15	10	30
R2	10	8	15
F _{SOM}	0	kg N/ha	Eq 11.8

source : from IPCC 2006

N₂O indirect emissions :

Indirect N₂O emissions from managed soils (Tier 1)

See Table 6, Table 7, Table 8 for inter

Quantity of NH₃ volatilized(IPCC Tier 1):

Quantity of nitrate leaching (IPCC Tier 1):

Emission factor for NH₃ volatilization (IPCC Tier 1):

Emission factor for Nitrate leaching (IPCC Tier 1):

	average	min	max
NH ₃ _N (kg)	12.0	3.6	
NO ₃ _N (kg)	162.9	54.3	
EF₁ (%)	1.0%	0.2%	5.0%
EF₂ (%)	0.75%	0.1%	2.5%

Table 6 Volatilization = N₂O₍₁₊₂₊₃₎-N Eq.11.9

	average	min	max	
F _{SN}	119.70	N in synthetic fertilizer		kg N/ha/year
F _{ON}	0.00	N in organic fertilizer		kg N/ha/year
Frac _{GRSH}	20%	5%	50%	
Frac _{GRSF}	10%	3%	30%	
NH₃	11.97	3.591	35.91	kg NH₃_N/ha/year

Table 7 Leaching = N₂O₍₁₊₁₁₎-N

	average	min	max	
F _{SN}	120	N in synthetic fertilizer		k
F _{ON}	0.000	N in organic fertilizer		k
F _{CR}	423.45094	N in crop residues		k
F _{SOH}	0	N mineralized		k
Frac _{LEACH(N)}	30%	10%	80%	
NO₃	163	54.315094	434.52075	kg N
EF ₂	0.75%	0.05%	2.50%	

source : from IPCC, 2006

Total N₂O emissions :

TOTAL N₂O EMISSIONS (Direct + Indirect N₂O) from managed soils (Tier1)

	kg N ₂ O_N/ha/year			kg N ₂ O/ha/year		
	average	min	max	average	min	max
per ha	6.77	1.66	28.95	10.64	2.61	45.50
per kg dm	0.39	0.10	1.68	0.62	0.15	2.64
per MJ of crop	0.0241	0.0059	0.1032	0.04	0.01	0.16

Value to report in your pathway :

10.64 kg N₂O/ha/year

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BioGrace as a voluntary scheme

Observations:

- Current voluntary cert. schemes do not include GHG tool
 - ISSC, REDcert, NTA8080, RSPO, RTRS, Bonsucro (BSI)
- European Commission only allows use of GHG tool if it is recognised as a voluntary cert. scheme
- To our knowledge no GHG tools have been send to Commission for recognition
 - Some schemes will be send in, eg. National GHG tools
 - Information on actual developments is scarce
- GHG tool can be used as “add-on” to existing schemes

BioGrace has submitted the GHG tool to EC for recognition as a voluntary scheme

BioGrace as a voluntary scheme

- BioGrace voluntary scheme consist of a zip file with
 1. BioGrace Excel GHG tool
 2. BioGrace calculation rules
 3. BioGrace user manual
- BioGrace scheme does not contain requirements on audits and mass balance
 - BioGrace has to be used together with another scheme

Time schedule

- Sent in BioGrace tool to EC for recognition April
- Recognition period lasts ... ?

Thank you for your attention

Intelligent Energy  **Europe**

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