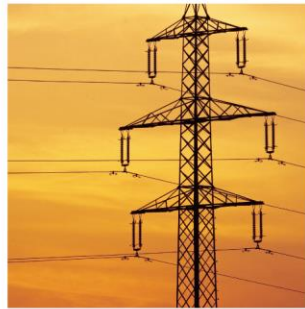


BIOGRACE II

Harmonised Greenhouse Gas Calculations
for Electricity, Heating and Cooling from Biomass



May 2015

BioGrace-II

Publishable final report

www.biograce.net



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BioGrace

Publishable final report

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Executive summary

1.1 Objectives of the BioGrace-II project

The overall objective of the action is European harmonisation of GHG emission calculations for bio-energy (electricity, heat, cooling and biofuels). The three specific objectives of the action are:

- A. Develop & disseminate a GHG Excel calculation tool for electricity and heat from biomass
- B. Convince policy makers from 6 EU member states to decide to harmonise GHG calculations
- C. Cause that companies (including verifiers and owners of voluntary sustainability schemes) give feedback on the Excel tool and use it.

1.2 Main activities and results

Main activities and results achieved in the BioGrace-II project are:

- Policy makers were involved through bilateral meetings and in two policy maker workshops, with as a concrete result that (a) harmonisation of GHG emissions was discussed with policy makers from 13 member states and (b) Denmark and The Netherlands have decided to harmonise GHG calculations by both using the BioGrace-II GHG calculation tool when demonstrating that national sustainability criteria are to be met.
- The project partners built and published three versions of a tool to calculate GHG emissions for electricity, heat and cooling from biomass, which consists of an Excel tool, a list of additional standard values, a methodological background document, calculation rules and a user manual. These outputs have been disseminated, until April 2015 more than 1000 stakeholders downloaded the tool from www.biograce.net;
- Companies and other stakeholders have given feedback in 9 feedback sessions and 3 public workshops and verifiers and verifier trainers have been trained in verifier training sessions. More than 100 companies have commented on the key outputs of the BioGrace-II products. Also 57 verifier trainers from voluntary schemes and verifiers operating under those schemes have been trained in GHG calculations and have passed the information on to other verifiers. Overall, 435 stakeholders participated in workshops, trainings and feedback sessions.
- The BioGrace-II activities and results were disseminated through a website www.biograce.net, a leaflet and a brochure, 8 newsletters and presentations at international conferences.

The project consortium's conclusion is that the action succeeded in reaching its objectives A and C. Objective B was partly reached.

1.3 Success stories

The main results of the BioGrace-II project, which can be seen as "success stories", are:

1.3.1. BioGrace caused harmonisation of solid biomass GHG calculations

As a result of the BioGrace-II project, companies in Denmark and in The Netherlands will use the BioGrace-II GHG calculation tool for making GHG calculations to demonstrate that their bio-energy (electricity and/or heat from solid biomass) meets national sustainability criteria. Hence the GHG emission calculations in these two EU member states are harmonised.

As a number of European countries still has to make first (Italy, Norway) or further (Belgium, UK) implementation decisions, the success of the BioGrace-II project is likely to grow further in the year or years to come. Also other European countries might decide to implement sustainability criteria for solid biomass and join the harmonised approach.

1.3.2. BioGrace contributes to quality and transparency of JRC biofuel & biomass GHG calculations

Since 2010 the BioGrace consortium works together with the Joint Research Centre (JRC) of the European Commission. BioGrace consortium partners gave and give – on a confidential basis – feedback on calculations that JRC makes in the context of the European Commission work on bioenergy sustainability and – doing so – contribute to improve the quality of these calculations. Moreover, the BioGrace-I and BioGrace-II GHG calculation tools make transparent how the RED and SQD(2014)259 typical and default values for GHG emissions have been determined. For instance, the BioGrace-II Excel tool demonstrates how the EC default values on solid and gaseous biomass are calculated. Both JRC and the BioGrace consortium are in favour of such transparency, and welcome stakeholders to comment upon elements that might not be fully transparent and to provide input aimed at improving the quality of calculating typical/default values and the user-friendliness of making actual GHG calculations.

Also the European Commission appreciates the work of the BioGrace consortium: in the July 2014 Staff Working Document "*State of play on the sustainability of solid and gaseous biomass used for electricity, heating and cooling in the EU*" it explicitly refers to the standardised GHG calculation tool developed by the EU-funded BioGrace II project to facilitate calculating actual values for GHG savings.

1.3.3. Online video instructions are of great help to users exploring the functionality of the BioGrace-II GHG calculation tool

The BioGrace-II consortium has developed a series of 25 online video instructions which explain the BioGrace-II Excel tool, calculation rules and methodology and which gives some background to the development of the tool. The consortium has answered many direct stakeholder questions and has given many explanations on the tool during public workshops, feedback sessions and verifier trainings. In the future the consortium will not be able to organise further dissemination and training events and therefore it has created the online video instructions which are available to everyone and which are self-explaining. Feedback on these instructions has been unanimously positive.

1.4 Involvement of target groups and key actors in the action

In the BioGrace-II project many stakeholders such as policy makers, companies plus advisors, and verifiers were involved. The project consortium succeeded very well to get the interest and feedback from stakeholders, although the interest of all three groups of stakeholders diminished to some extent after the EC report was published which did not contain binding sustainability criteria for solid biomass. To the opinion of the project consortium, stakeholders were interested in the project as (a) the outcome of the project was clear (a transparent tool, and a call upon policy makers to harmonise) and (b) as it was clear that the project is close to the European Commission and JRC.

2 Overview of the project

2.1 Key project data

Key data of the BioGrace-II project are the following:

Name

Full project name: *Biofuel Greenhouse gas emissions: Align Calculations in Europe*

Project acronym: BioGrace-II

IEE subsidy

Contract number: IEE/11/733/SI2.616371

Project duration: April 1, 2012 – March 31, 2015

Project coordinator

Organisation: Netherlands Enterprise Agency (RVO)

Coordinator name: John Neeft

Project partners

European Biomass Association (AEBIOM), Belgium

Bioenergy 2020+ GmbH (BE2020), Austria

BIO by Deloitte (BIO IS), France

Institute for Energy and Environmental Research (IFEU), Germany

Swedish Energy Agency (STEM), Sweden

Flemish Regulator of the Electricity and Gas Market (VREG), Belgium

Flemish Energy Agency (VEA), Belgium

Contact details of the coordinator and the project partners are listed in Annex I

Website

www.BioGrace.net



Photograph:

The BioGrace-II project consortium.

From left to right: Nikolaus Ludwiczek (BE2020), Susanne Köppen and Horst Fehrenbach (both IFEU), José Muisers and John Neeft (both RVO), Alesia Israilava and Maria Forsberg (both STEM), Fabio Menten (BIO IS), Cristina Calderón (AEBIOM), Gregoire Thonier (BIO IS) and Caroline Vermeulen (VREG/VEA)

2.2 Background and objectives

The overall motivation to start this project was the observation that sustainability criteria for electricity and heat from solid and gaseous biomass are not yet harmonised. In January 2010, the European Commission published report COM(2010)11¹, followed by SWD(2014)259² in July 2014 (which was accompanied by a JRC report on GHG calculations³). Neither in COM(2010)11 nor in SWD(2014)259 the European Commission proposed binding sustainability criteria at EU level. Instead, the Commission made recommendations to Member States that are planning to introduce sustainability criteria for solid and gaseous biomass used in electricity, heating and cooling. These recommendations must ensure that sustainability criteria are harmonized between member states and are in line with the methodology as laid down in the Renewable Energy Directive⁴ (RED). This would ensure greater consistency and avoid unwarranted discrimination in the use of raw materials.

Sustainability criteria for biofuels and bioliquids have been made obligatory by the RED and the amendment of the Fuel Quality Directive⁵ (FQD). As a result, for biofuels and bioliquids the same set of sustainability criteria applies in EU-27. Concerning the calculation of GHG emissions for biofuels, in 2009 at a policy maker workshop it was noted that more detailed guidance would be needed in order to make sure that calculations are performed in the same way throughout Europe. This became the objective of the previous project BioGrace (IEE contract number IEE/09/736, April 2010 - March 2012) in which a GHG calculation tool for biofuels was developed which received EC recognition as a voluntary scheme. In this BioGrace-II report these previous BioGrace projects and calculation tool will be referred to as "BioGrace-I project" and "BioGrace-I GHG calculation tool".

For electricity and heat from biomass, before the start of the BioGrace-II project some national calculation tools for GHG calculations had been developed in Belgium, The Netherlands and UK, but a discussion on harmonisation of these tools did not start before the start of the BioGrace-II project.

The overall objective of the BioGrace-II project is European harmonisation of GHG emission calculations for bio-energy (electricity, heat, cooling and biofuels). With harmonisation is meant that regulators in EU Member States have agreed on uniform GHG calculation and have implemented this agreement in their national legislation as part of sustainability criteria for electricity, heat, cooling and transportation fuels from biomass.

¹: Report from the Commission on sustainability requirements for the use of solid and gaseous biomass sources in electricity, heating and cooling", also known as report SEC(2010) 65, available at <http://ec.europa.eu/energy/en/topics/renewable-energy/biomass>

²: Commission staff working document "State of play on the sustainability of solid and gaseous biomass used for electricity, heating and cooling in the EU", also known as SWD(2014)259, available at <http://ec.europa.eu/energy/en/topics/renewable-energy/biomass>

³: Joint Research Centre scientific report on the default and input values for GHG emissions of biomass, Report EUR 27215 EN, available at <http://ec.europa.eu/energy/en/topics/renewable-energy/biomass>. Please note that this report is an update – made after the end of the BioGrace-II project (and partly as a result of feedback provided to JRC by the BioGrace consortium) – of the original report EUR 26696 EN published in July 2014.

⁴: Directive 2009/28/EC of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC

⁵: Directive 2009/30/EC of 23 April 2009 amending Directive 98/70/EC as regards the specification of petrol, diesel and gas-oil and introducing a mechanism to monitor and reduce greenhouse gas emissions and amending Council Directive 1999/32/EC as regards the specification of fuel used by inland waterway vessels and repealing Directive 93/12/EEC

The three specific objectives that the project aimed to achieve in its 3-year duration are:

- A. Develop & disseminate a GHG Excel calculation tool for electricity and heat from biomass
- B. Convince policy makers from 6 EU member states to decide to harmonise GHG calculations
- C. Cause that companies (including verifiers and owners of voluntary sustainability schemes) give feedback on the Excel tool and use it.

2.3 Overview of results

The following results have been achieved during the BioGrace-II project (between brackets the paragraph or chapter in which these results are described in more detail):

- A **methodological background document** has been made and published (paragraph 3.3).
- GHG calculations that led to the SWD(2014)259 and EUR 26696 EN / EUR 27215 EN default values have been made transparent, and stakeholders have been facilitated making GHG calculations, by publishing the **BioGrace-II excel-based GHG calculations** on our website. All solid and gaseous biomass pathways of JRC report EUR 26696 EN (which are the same as in the updated report EUR 27215 EN) are reproduced, as well as a number of bioliquid production pathways. The excel sheets allows stakeholders to make actual calculations (paragraph 3.1).

The Excel tool contains a set of standard values, and also a list of additional standard values has been prepared (paragraph 3.2).

- **Calculation rules** and a **user manual** to the BioGrace-II excel-based GHG calculations were made and published on the website (paragraphs 3.4 and 3.5).
- **Outreach to stakeholders** through **seven workshops** and **nine small feedback sessions**.

One workshop was organised on detailed GHG calculation methodological issues and on the first version of the BioGrace-II Excel tool. The first workshop was held for GHG experts (November 30, 2012, Heidelberg).

Two policy maker workshops were organised in order to discuss the topic of harmonisation with those policy makers of European countries that are working on, or thinking about, implementing sustainability criteria for solid biomass. Both workshops were organised in Brussels and were held on March 19, 2014 and on March 6, 2015.

Three public workshops were organised for all stakeholders interested, audiences ranged from 37 to 56 participants. These workshops were held in Brussels (October 30, 2013), Vienna (June 10, 2014), and Brussels (March 4, 2015) (chapter **Error! Reference source not found.**).

A workshop was organised for 15 Danish companies and policy makers on February 16, 2015, as Denmark was considering to make use of the BioGrace-II GHG calculation tool.

Nine small feedback sessions were organised as to receive input on the draft BioGrace-II products. These sessions were organised in Amsterdam, Brussels, Utrecht and Vienna and attracted 125 participants in total, so 14 participants per session on average.

- The BioGrace **website** www.BioGrace.net was extended to also include BioGrace-II, a **leaflet** and a **brochure** were made, and **presentations** were held at European conferences (chapter **Error! Reference source not found.**).

2.4 Communication with other organisations

The BioGrace project maintained contacts with:

- The UK Department for Energy and Climate Change (DECC) plus their advisor E4Tech which developed a UK national GHG calculation tool (the "UK carbon calculator") for solid biomass.
- CWAPE, responsible for solid biomass GHG calculations in Wallonia.
- The European Joint Research Centre (JRC), contacts to both Ispra and Petten.
- CONCAWE.
- Policy makers at DG Energy and DG AGRI of the European Commission.
- The IEE projects BioGasHeat, PellCert and SustainGas.
- The voluntary certification schemes 2BSvs, Bonsucro, Greenergy, ISCC, NTA8080/8081, RBSA (Abengoa), REDcert, and RSB, RSPO and national schemes from Austria, Germany, Slovakia and UK.

Close contacts with DECC, CWAPE, JRC and DG ENER proved to be essential for good progress in this project, in particular as the decision on a report on sustainability criteria for solid and gaseous biomass was postponed which caused delays in the project, and as JRC made last minute changes in their calculations which had to be followed by the consortium.

Moreover, the BioGrace-II project received approximately 100 questions from external stakeholders which were answered by consortium members.

3 BioGrace-II GHG calculation tool

This chapter gives the details on all the elements of the BioGrace-II GHG calculation tool, which are the Excel-based calculation tool, the list of standard values plus the list of additional standard values, the methodological background document, the calculation rules and the user manual. The latest versions of the tool and the individual products can be found on [the BioGrace-II part of the BioGrace website](#), please note that all the elements listed above are included in the downloadable zip file named "BioGrace-II GHG calculation tool version ... – public". Also older versions of the tool can be downloaded from the website. Until April 2015 more than 1000 stakeholders downloaded the tool from www.biograce.net;

3.1 Excel based calculation tool

One of the main products of the BioGrace-II project is the Excel based BioGrace-II GHG calculation tool. Version 3 of this tool was published at the end of the BioGrace-II project. The actual calculation tool, called BioGrace-II Excel tool, is included in the zip file also containing the BioGrace-II GHG methodological background document (see paragraph 3.3), the calculation rules (see paragraph 3.4) and the user manual (see paragraph 3.5).

3.1.1. Three versions of the tool

In the course of the BioGrace-II project, three versions of the GHG calculation tool were developed. This gradual development allowed the project partners to present the tool to stakeholders during the policy maker, GHG expert and public workshops in the project (see Chapter 5) and to receive feedback on the tool. As a result of the late publication of SWD(2014)259, the BioGrace-II consortium could not publish the BioGrace-II GHG calculation tool before the third quarter of 2014. Version 1 of the tool was put on the website in September 2014, version 2 was published in January 2015 and version 3 was published in May 2015.

3.1.2. BioGrace GHG calculation tool serves two functions

The BioGrace GHG calculation tool was made to serve two separate functions:

1. Make transparent the GHG calculations that led to the EC/JRC default values

JRC has made the GHG calculations as input for the Commission, which led to the GHG default values in JRC report EUR 27215 EN and in SWD(2014)259 (see footnotes 2 and 3). Although JRC report EUR 27215 EN gives many details on the numbers used in the calculations, several GHG calculation experts have found that still it is not straightforward to make the calculations and replicate the exact default values. This is one of the functions that the BioGrace-II Excel tool serves, it shows how – using the JRC input values – the default values (or in fact the not yet rounded numbers as calculated by JRC) can be reproduced with an accuracy of about 0,05 g CO_{2,eq}/MJ_{biomass}. The figure below shows for the pathway "wood pellets from forestry residues" in the BioGrace-II Excel tool how the results of the BioGrace calculation (left red circle) can be compared with the outcome of the JRC calculations (right red circle).

Production of electricity and/or heat, or cooling from wood pellets/briquettes from forestry residues

Version 3 - for Compliance

Overview Results

Energy carrier (including emissions from the fuel in use)

All results in g CO _{2,eq} / MJ Wood pellets	Non- allocated results	Total (allocated results)	Actual/ Default
Cultivation e_{ec}			
Feedstock is a residue	0,00	0,00	A
Processing e_p			
Forest residues collection	1,42	1,42	
Chipping	0,39	0,39	
Wood pellet/briquette production	30,73	30,73	
Transport e_{td}			
Transport of forestry residues	0,00	0,00	
Transport of wood chips	1,02	1,02	
Transport of wood pellets	8,34	8,34	
Emissions from the fuel in use e_{fu}			
CH ₄ and N ₂ O emissions at final conversic	0,30	0,30	A
Land use change e_l			
Bonus or e _{sca}	not applicable	not applicable	
e _{ccr} + e _{ccs}	0,0	0,0	
Totals	42,2	42,2	

Default values JRC report

0
0,00
32,5
1,80
30,72
9,4
0,00
1,02
8,35
0,3
0,30
42

Final energy

Electricity		Heat	
All results in g CO _{2,eq} per MJ as indicated			
Allocation factor	Allocated results	Allocation factor	Allocated results
0,0%	0,0	0,0%	0,0
	per MJ pellets		per MJ pellets
	0,0		0,0
	per MJ electr.		per MJ heat

Allocation factors & references

Allocation factors	
Production chain	
100,0% to energy carrier	
0,0% to co-product(s)	
CHP	
0,0% to electricity	
0,0% to heat	
Fossil fuel references	
186	g CO _{2,eq} /MJ _{electricity}
80	g CO _{2,eq} /MJ _{heat}
47	g CO _{2,eq} /MJ _{cooling}

GHG emission reduction

Electricity	Heat	Cooling
100%	100%	100%

General settings

Main output

Electricity
 Heat
 Cooling (including heat and / or electricity)
 Electricity and heat

Conversion efficiencies

Pathway configuration

Heat provision in pellet production:
 Natural gas boiler

Transport distance (pellets):
 above 10 000 km

! When using this GHG calculation tool, the BioGrace calculation rules must be respected. The rules are included in the zip file (containing the complete tool) and also at www.BioGrace.net

Track changes: ON

Calculation per phase

Values calculated from complete pathway

Overall yield per MJ input	0,9660	MJ _{Wood pellets} / MJ _{Forestry residues, input}	This value is used in the calculations below to convert MJ _{feedstock} into MJ _{wood pellets} . The purpose of this box is to facilitate copying rows or steps from one pathway to another, because this value is included in all pathways in cell C38.
----------------------------	--------	---	---

Feedstock is a residue	Quantity of product	Calculated emissions				
Yield		Emissions per MJ wood pellets				
Forestry residues (FR)	1,0 MJ	1,00 MJ _{FR} / MJ _{FR}	g CO ₂	g CH ₄	g N ₂ O	g CO _{2,eq}
		Result	g CO_{2,eq} / MJ_{Wood pellets}			
			0,00			

Forest residues collection	Quantity of product	Calculated emissions				
Yield		Emissions per MJ wood pellets				
Forestry residues	1,0 MJ _{FR} / MJ _{FR, input}	1,00 MJ _{FR} / MJ _{FR, input}	g CO ₂	g CH ₄	g N ₂ O	g CO _{2,eq}

Info per kg residues
g CO_{2,eq}

In the versions 2 and 3 of the BioGrace Excel tool, all 20 solid and gaseous biomass pathways of JRC report EUR 27215 EN are reproduced (versions 1 contained less pathways). Version 2 and 3 also contain bioliquid pathways, in a slightly modified configuration as these pathways must follow the methodology from the RED and not from COM(2010)11 plus some updates from SWD(2014)259.

2. Allow stakeholders to make actual calculations

The BioGrace GHG excel tool allows stakeholders to make actual calculations. This can be done by replacing the input values by actual input values (yields, amounts of fertiliser inputs, amounts of process energy (natural gas, electricity), and/or transport distances as measured from actual biofuel production plants/pathways). The actual inputs can be inputted in the white fields of the tool. In the figure below, only a small part of the calculations are shown, the Excel sheet is larger than shown in the figure. The tool also allows users to add extra

inputs (add a row) and to change the name of the input, in which case also a corresponding emission factor has to be given in the sheet "user defined standard values". Inexperienced users can use the user manual or the online video instructions to get familiar with the tool.

When making actual calculations, the tool allows fixing "disaggregated default values" for the steps cultivation, processing or transport (change the "A" in the upper red ellipse in the figure below into a "D"). This will allow keeping the disaggregated default values listed in JRC report EUR 27215 EN even when making changes to the values in the calculations that would normally change the outcome. The tool also allows keeping track of changes, facilitating auditors with checking actual calculations. The "track changes" mode can be switched off when clicking on the orange button in the lower red ellipse in the figure below.



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Production of electricity and/or heat, or cooling from wood chips from stemwood

Version 3 - for Compliance

Overview Results

Energy carrier (including emissions from the fuel in use)				Default values JRC report
All results in g CO _{2,eq} / MJ Wood chips	Non- allocated results	Total (allocated results)	Actual/ default	
Cultivation e_{ec}		1,1	A	1,1
Cultivation and harvesting	1,09	1,09		1,10
Stemwood seasoning	0,00	0,00		
Processing e_p		0,4	A	0,4
Chipping	0,38	0,38		0,38
Transport e_{td}		22,8	A	22,8
Transport of stemwood	0,00	0,00		0,00
Transport of wood chips	22,77	22,77		22,78
Emissions from the fuel in use e_u		0,5	A	0,5
CH ₄ and N ₂ O emissions at final conversio	0,50	0,50		0,50
Land use change e _l	0,0	0,0		
Bonus or e _{sca}	0,0	0,0		
e _{ccr} + e _{ccs}	0,0	0,0		
Totals	24,7	24,7		25

Final energy			
All results in g CO _{2,eq} per MJ as indicated			
Electricity	Heat	Electricity	Heat
Allocation factor	Allocated results	Allocation factor	Allocated results
0,0%	0,0	0,0%	0,0
	per MJ chips		per MJ chips
	0,0		0,0
	per MJ electr.		per MJ heat

Allocation factors & references	
Allocation factors	
Production chain	
100,0%	to energy carrier
0,0%	to co-product(s)
CHP	
0,0%	to electricity
0,0%	to heat
Fossil fuel references	
186	g CO _{2,eq} /MJ _{electricity}
80	g CO _{2,eq} /MJ _{heat}
47	g CO _{2,eq} /MJ _{cooling}

GHG emission reduction	
Electricity	Heat
100%	100%
Cooling	
100%	100%

General settings

Main output

 Electricity
 Heat
 Cooling (including heat and / or electricity)
 Electricity and heat

Conversion efficiencies

Pathway configuration

Transport distance (chips): above 10 000 km

! When using this GHG calculation tool, the **BioGrace calculation rules must be respected**. The rules are included in the zip file (containing the complete tool) available at www.BioGrace.net

Track changes: ON

Calculation per phase

Values calculated from complete pathway			
Overall yield per (hectare cropland, year)	0	MJ _{Wood chips} ha ⁻¹ year ⁻¹	These values are used in the calculations below to convert MJ _{feedstock} into MJ _{wood chips} . The purpose of this box is to facilitate copying rows or steps from one pathway to another, because these values are included in all pathways in cells C37 and C38.
Overall yield per MJ input	0,9268	MJ _{Wood chips} / MJ _{Stemwood, input}	

Cultivation and harvesting	Quantity of product	Calculated emissions	Info
Yield		Emissions per MJ wood chips	per kg _{wet} stemwood
Stemwood (Pine)	<input type="text" value="Give value"/> kg ha ⁻¹ year ⁻¹	g CO ₂ g CH ₄ g N ₂ O g CO _{2,eq}	g CO _{2,eq}
	0,0E+00 MJ _{Stemwood} ha ⁻¹ year ⁻¹		

3.2 Standard values and additional standard values

The BioGrace-II Excel tool contains a list of standard values. Standard values are lower heating values (LHV) and conversion factors. Conversion factors are for instance the direct and indirect emissions (CO₂, CH₄ and N₂O) of the use of 1 MJ of natural gas, or the emissions of the use of 1 kg of N-, P- or K-fertiliser, or the fuel intensity of transport of 1 ton of goods over 1 km distance by a truck or train. These factors cannot directly be changed by stakeholders in the biofuel production chain and, therefore, are also called "standard values".

Version 4d		www.biograce.net							Intelligent Energy Europe		
BIOGRACE Harmonised Calculations of Biofuel Greenhouse Gas Emissions in Europe											
ADDITIONAL STANDARD VALUES											
parameter:	unit:	gCO ₂ /kg	gCH ₄ /kg	gN ₂ O/kg	gCO ₂ -eq/kg	gCO ₂ /MJ	gCH ₄ /MJ	gN ₂ O/MJ	gCO ₂ -eq/MJ	Fossil energy input	
										MJ _{fossil} /kg	MJ _{fossil} /MJ
Global Warming Potentials (GWPs)											
CO ₂	1										
CH ₄	23										
N ₂ O	296										
Agro inputs											
N-fertiliser (kg N)											
Ammonium nitrate (AN)		2671	6,9	2,1	3451						
Ammonium sulphate (AS)		2560	6,5	0,0	2711						
Ammonium nitrate sulphate (ANS)		2561	8,9	1,3	3141						
Anhydrous ammonia		2662	6,8	0,0	2818						
Calcium ammonium nitrate (CAN)		2863	7,3	2,1	3652						
Calcium nitrate (CN)		2653	7,0	5,1	4324						
Urea		1703	9,3	0,0	1916						
Urea ammonium nitrate (UAN)		2162	7,5	1,1	2676						
P₂O₅-fertiliser (kg P₂O₅)											
Triple superphosphate (TSP)		517	0,9	0,0	542						
Rock phosphate 21%P ₂ O ₅ 23%SO ₃		95	0,0	0,0	95						
Mono ammonium phosphate (MAP) 11%N 52%P ₂ O ₅		967	2,5	0,0	1024						
Di-Ammonium-Phosphate (DAP) 18%N 46%P ₂ O ₅		1459	3,73	0,00	1545						
K₂O-fertiliser (kg K₂O)											
Muriate of Potash (MOP) 60%K ₂ O		409	0,17	0,0	413						
Other fertilisers											
NPK 15-15-15		4261	10,0	1,7	4990						
MgO (kg MgO)		769	0,0	0,0	769						
Sodium (Na) fertiliser (kg Na)		1620	0,0	0,0	1620						
Seeds											
maize/corn (non GMO)		350	0,0	0,0	350						
soybean (non GMO)		400	0,0	0,0	400						
Conversion inputs											
Acetic acid		1570	0,0	0,0	1570						
Citric acid		963	0,0	0,0	963						
Potassium hydroxide (KOH)		1824	3,8	0,05	1926						
Sodium methylate		4885	0,0	0,0	4885						
Sodium silicate (37% in water)		1145	0,0	0,0	1145						
Zeolith		4000	0,0	0,0	4000						
Antioxidant BHT (butylated hydroxytoluene)		10000	0,0	0,0	10000						
Isobutene		1501	0,0	0,0	1501						
Nitrogen		434	0,0	0,0	434						
Electric emission coefficients											
Europe (EU - 28)											
Austria						48,0	0,13	0,004	52,1		
Belgium						56,7	0,08	0,003	59,4		
Bulgaria						187,0	0,12	0,006	191,5		
Croatia						109,0	0,09	0,004	112,2		

The list of standard values contains the values that were determined by JRC when calculating the default values. The zip file "BioGrace GHG calculation tool" also contains a list of additional standard values (screenshot of first part below) which contains the same kind of values but which were not used by JRC. However, these values are needed by some users making actual GHG calculations. Examples of additional standard values are emission coefficients of different N-, P- and K-fertilisers and the average emissions of electricity taken from the national grid in a large number of countries.

3.3 Methodological background document

Some of the methodological choices made by the European Commission are not clear at first sight, and therefore the BioGrace-II consortium decided to prepare a methodological background document in which some of the choices are explained, such as the exergy-based allocation of emissions between heat and electricity or between heat at different temperatures, credits for biogas calculations, the two different approaches to calculate N₂O field emissions, etc. Version 3 of the methodological background document contains, as an annex, the GHG accounting methodology used for calculating the default values and to be used for making actual calculations.

The methodological background document is part of the zip file "BioGrace-II GHG calculation tool – version ...".

3.4 Calculation rules

When making GHG calculations many detailed questions arise. The choices made in answer to these questions all influence the final result of the calculations. The GHG methodology in COM(2010)11 plus SWD(2014)259 prescribes which choices to make for some of the questions. Other questions are not covered by these two documents, and therefore BioGrace has made a list of calculation rules which in part rephrases the methodology and in part adds new and more detailed rules that have to be followed when using the BioGrace-II GHG calculation tool.

The BioGrace-II GHG calculation rules are fully in line with the methodology as given in COM(2010)11 plus SWD(2014)259. When using the BioGrace Excel tool, the calculation rules must be followed (see the light blue text box in the two screenshots of the tool a few pages back). One of the calculation rules is that a verifier may not approve an actual calculation made with the BioGrace-II GHG calculation tool when the rules are not followed, in other words: the rules are binding.

Other rules deal with the use of the standard values (emission factors, LHV's, transport efficiencies), the cut-off criterion (how small should an emission be before it can be neglected), how to use the disaggregated default values, use of average, aggregated or measured input numbers, etc.

Also the calculation rules are part of the zip file "BioGrace-II GHG calculation tool – version ...".

3.5 User manual

The user manual is a document describing how the BioGrace-II Excel tool works and how actual calculations can be made (replacing input numbers, inserting new input materials or creating a modified or new pathway). It explains the functions of the tool and how the Excel spreadsheet is structured.

For those who do not like reading through a manual: part of the contents of the user manual has been reworked into on-line video instruction which can be accessed following [this link](#).

The user manual also describes the "special" sheets in the Excel BioGrace GHG calculation tool, which are the sheets to perform calculations on land use change, improved agricultural management and N₂O field emissions following the IPCC Tier 1 method.

Last but not least the user manual gives some background on the history of BioGrace.

Also the user manual is part of the zip file "BioGrace-II GHG calculation tool – version ...".

4 Stakeholder interaction

4.1 Objectives

An important objective of the BioGrace-II project was to interact with stakeholders, in order to (a) reach harmonisation of European GHG calculations, (b) receive feedback on the draft BioGrace-II products and (c) train verifiers that will verify actual GHG emission calculations.

4.2 Interaction with policy makers

During the BioGrace-II project, policy makers have been actively involved through bilateral meetings and two policy maker workshops. Project partners contacted policy makers in their own countries and policy makers known in other countries. These policy makers have been invited to a policy maker workshop that was held in March 2014 in Brussels. As a result, harmonisation of GHG emissions was discussed with policy makers from 13 member states. One of the important discussion points at this workshop was the expected content of the document that the European Commission was preparing on sustainability of electricity, heat and cooling from solid and gaseous biomass.

Finally, this document appeared (as SWD(2014) 259) in July 2014, which caused that some countries started with (preparing) the implementation of sustainability criteria for solid biomass. These member states were invited to the second policy maker workshop, together with some voluntary schemes and stakeholders that were part of the implementation discussions in the several countries. This second policy maker workshop was held in March 2015, again in Brussels.

One month before this second workshop, two BioGrace-II consortium members explained the BioGrace-II tool to Danish companies and policy makers. As a result of this meeting and of the second policy maker workshop, Denmark and The Netherlands decided to harmonise GHG calculations by both using the BioGrace-II GHG calculation tool when demonstrating that national sustainability criteria are to be met.

4.3 Interaction with companies

As companies will be the users of the BioGrace-II GHG calculation tool, the input and feedback of companies was important for the BioGrace-II consortium while building and improving the tool. Three public workshops and nine smaller feedback sessions were organised in order to enable stakeholders to give feedback. More than 100 companies have commented on the key outputs of the BioGrace-II products. Overall, 435 stakeholders participated in workshops, trainings and feedback sessions.

Comments and feedback of companies have been used to make improvements to the Excel tool, the user manual, the calculation rules and the methodological background document.

4.4 Interaction with verifiers

Also verifiers are important stakeholders for fulfilling bioenergy sustainability criteria, as these verifiers will have to check and approve information submitted. As GHG calculations are not the daily routine of verifiers, the BioGrace-II consortium has offered trainings to verifiers and the trainers of verifiers. These trainings contained several topics, such as the basics of GHG calculations, different existing GHG calculation tools, and the BioGrace GHG calculation tool which contains some elements

that facilitate the work of the verifier. The trainings contained practical exercises, and all training material was distributed after the trainings were completed.

Two rounds of three trainings each were given. The first round was on biofuel GHG calculations and was held late 2012 and early 2013 for 33 verifiers and verifier trainers in total. The second round was on GHG calculations for electricity, heat and cooling from biomass and was held late 2014 and early 2015 for 24 verifiers and verifier trainers. Many of the verifiers and verifier trainers that participated are from voluntary schemes or operate under those schemes.

5 Dissemination of results

Dissemination activities in the BioGrace project were aimed as a broad dissemination of the project results amongst the stakeholders. Stakeholders to the BioGrace project are policy makers, companies and auditors/verifiers that are working with biofuel sustainability criteria under the RED and FQD.

Dissemination of results was achieved via our website, a leaflet, newsletters, workshops and targeted presentations at conferences and meetings, as is explained in the following paragraphs.

5.1 Website

The website www.BioGrace.net was created in the previous project. Early in the current project, the website was enlarged to also contain BioGrace-II. This addition was launched in August 2012. The website contains all results of the project, including all the products as presented in this chapter and in this report. The website is self-explaining.

During the lifetime of the BioGrace-II project the website had 24.511 unique visitors from 163 countries, so BioGrace (BioGrace-I and BioGrace-II) received worldwide attention as is illustrated in **Figure 1** below.

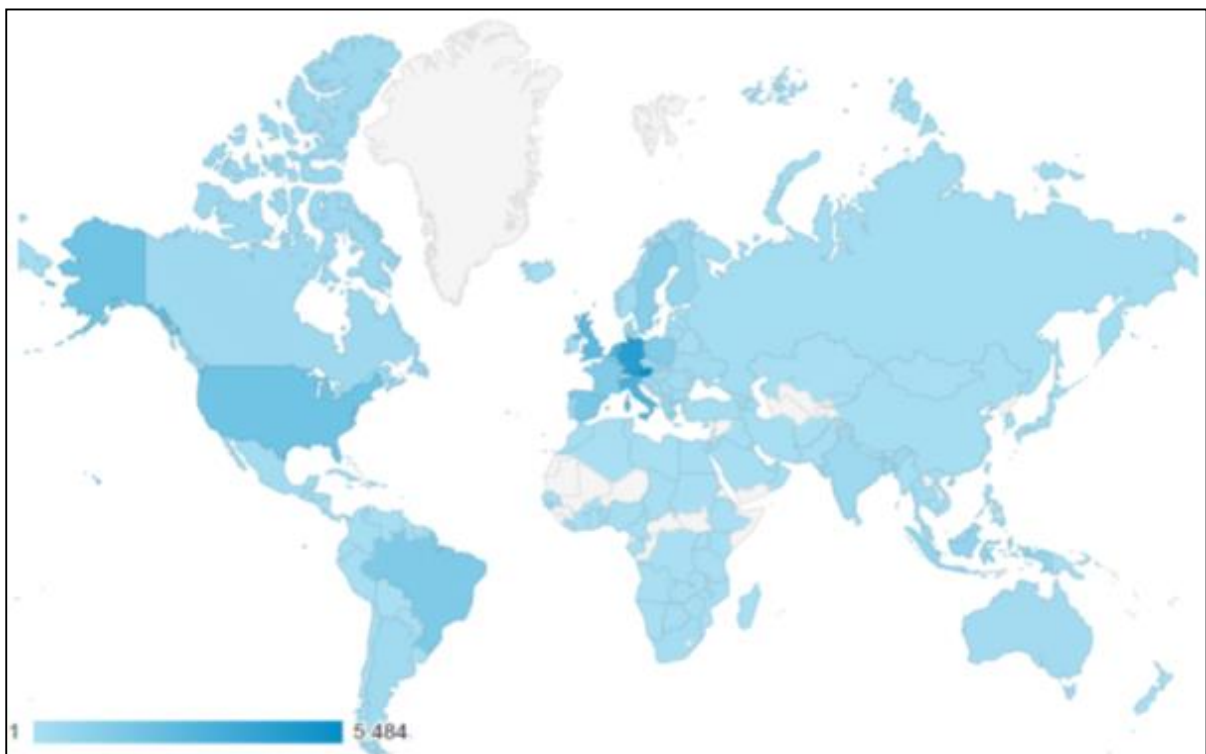


Figure 1: Visits to BioGrace website per country.

Through the website the consortium could monitor the number of downloads from the BioGrace-II GHG calculation tool. Until the end of the project version 1 was downloaded 1023 times and version 2 352 times. As a result it can be concluded that the tool was used at least 1000 times. Version 3 of the

tool was put on the website shortly after the end of the project, so when writing this report no statistics on number of downloads of version 3 are available.

5.2 Video instructions

After several requests from stakeholders (verifiers and companies) the BioGrace-II consortium decided to produce a series of 25 short (2 to 18 min. each) video instructions, which were put on-line and which can be watched through YouTube. Reactions from users on these video instructions are positive. The videos are made in such a way that they will not become outdated if updates to the tool will have to be made in the future. The BioGrace-II video instructions can be accessed through [an overview file on the website](#) with direct links to the YouTube video instructions. Clicking on the links in this overview file gives direct access to the online video instructions. Also for biofuels a similar set of [BioGrace-I video instructions](#) has been prepared, some of the video instructions overlap, some are different for BioGrace-I as compared to BioGrace-II.

5.3 Leaflet and brochure

The project leaflet was created early in the project and explains the project and its deliverables in short. The leaflet has been printed and was distributed at workshops and conferences, and is also accessible on-line via [this link](#).

The BioGrace-II project brochure was created in the last half year of the project as it needed reference to the SWD(2014)259 which was published in July 2014. The brochure has been used during the last round of workshops and feedback sessions and has also been translated. The English version, which can be found [here](#), was printed. Two translated versions of the brochure are available on-line, in [French](#) and in [German](#).

5.4 Newsletters

In the course of the BioGrace-II project 7 issues of the project newsletter were disseminated; and the 8th issue was already been prepared to be sent as soon as version 3 of the tool is put online (this 8th issue was send out late May 2015). The number of subscribers to the newsletter increased by 170 persons from 565 to 725 during the BioGrace-II project. All newsletter versions can also be found back on the website via [this link](#).

5.5 Workshops and trainings

During the project lifetime workshops and trainings were organised for different groups of stakeholders as presented in the previous chapter 4. The table below gives an overview of all workshops organised during the three years of the BioGrace-II project.

Title of the event	Date and place	Type and number of participants	Responsible partner(s)
GHG expert workshop	Heidelberg, 30-11-2012	GHG calculation experts, 24	IFEU
1 st policy workshop	Brussels, 19-3-2014	Policy makers, 29	VREG
2 nd policy workshop	Brussels, 6-3-2015	Policy makers and companies, 27	BE2020
1 st feedback sessions	Several, in total 9 small meetings	Companies and consultants, 66	AEBIOM, BE2020,
2 nd feedback sessions		Companies and consultants, 59	RVO, VEA, VREG
1 st public workshop	Brussels, 30-10-2013	Companies plus everyone interested, 56	AEBIOM
2 nd public workshop	Vienna, 10-6-2014	Companies plus everyone interested, 37	BE2020
3 rd public workshop	Brussels, 4-3-2015	Companies plus everyone interested, 45	AEBIOM
1 st verifier training	Utrecht, 10+11-9-2012	Verifiers and verifier trainers, 11	RVO
2 nd verifier training	Paris, 30+31-1-2013	Verifiers and verifier trainers, 7	BIO IS
3 rd verifier training	Heidelberg, 10+11-4-2013	Verifiers and verifier trainers, 15	IFEU
4 rd verifier training	Heidelberg, 21-11-2014	Verifiers and verifier trainers, 10	IFEU
5 th verifier training	Heidelberg, 13-1-2015	Verifiers and verifier trainers, 7	IFEU
6 th verifier training	Paris, 13-2-2015	Verifiers and verifier trainers, 7	BIO IS
Meeting voluntary schemes	Bonn, 15-12-2014	Voluntary schemes owners + DG ENER + BLE, 20 (+ 6 organisers BLE)	RVO
Danish workshop	Copenhagen, 16-02-2015	Danish companies + policy makers, 15	RVO

5.6 Presentations at conferences and meetings

The BioGrace-II project and the BioGrace-II calculation tool was presented at a number of European conferences, as listed below.

Date	Place	Conference	Type of presentation
2013, Dec.	St. Pölten/ Austria	Biogas13	Oral presentation
2014, Jan.	Graz	Central European Biomass Conference	Poster
2014, May	Rome	CA-RES 2nd plenary meeting	Oral presentation
2014, June	Vienna	European Energy Community	Oral presentation
2014, June	Hamburg	22th European Biomass Conference EU BC&E 2014	Oral presentation
2015, Feb.	Wels/ Austria	World Sustainable Energy Days 2015	Poster*

5.7 Conclusion from dissemination

The conclusion of the project partners was that dissemination of the BioGrace-II products was successful given the circumstances. The dissemination results were compared with the results of the dissemination from the previous BioGrace-I project, and it is concluded that the BioGrace-I project was more successful in dissemination as (for instance) website statistics showed an higher interest in BioGrace-I (at the time this project finished) as compared to the interest in BioGrace-II early 2015. Of course this can be explained by the fact that BioGrace-I was and is used by all EU member states (as the RED sustainability criteria apply in all EU member states) whereas the BioGrace-II GHG calculation tool is mainly used in the member states that have introduced or that prepare introducing sustainability criteria for solid biomass.

This conclusion that dissemination was successful given the circumstances, was based on the following information:

- The website and download statistics show that the tool has been widely used.
- BioGrace project partners have received and answered many questions on details of the BioGrace-II GHG calculation tool, showing that these stakeholders have looked deeply into details of the tool.
- BioGrace-II is mentioned in official documents such as in SWD(2014) 259 from the European Commission and presentations by Dutch, Danish and UK policy makers. Also voluntary schemes like NTA8080 and SBP refer to the BioGrace-II GHG calculation tool.

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