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BIOGRACE

Harmonised Calculations of Biofuel Greenhouse Gas Emissions in Europe

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BIOGRACE

Harmonised Calculations of
Biofuel Greenhouse Gas Emissions in Europe

Enable stakeholders to perform biofuel greenhouse gas calculations according to the Renewable Energy Directive (RED)

In 2009 the European Union set sustainability criteria for biofuels with the legislation of the Renewable Energy Directive (2009/28/EC, RED) and the Fuel Quality Directive (2009/30/EC). The greenhouse gas emission saving achieved by biofuels must be at least 35% compared to fossil fuels; this requirement rises to at least 50% by 2017, and 60% by 2018 for biofuels produced in new installations. The project BioGrace aims to harmonise calculations of biofuel greenhouse gas emissions and thus supports the implementation of these two directives into national laws.

Default values determine greenhouse gas emission savings

RED Annex V defines default values for greenhouse gas emission saving of 22 biofuel production pathways (equal to Annex IV of the Fuel Quality Directive). For economic operators who want to or have to make their own calculations, the calculation methodology is prescribed in Annex V: total greenhouse gas emissions are the sum of emissions from cultivation, processing and transportation of the biofuels. However, the directives specify neither the "standard values" (also called conversion factors) nor the "input numbers" that were used to obtain the default values.

How to calculate greenhouse gas emission savings?

The BioGrace project makes transparent how the default values were calculated and elaborates a list of standard values for greenhouse gas calculations.

Standard values are for example the emissions of nitrous oxide ("laughing gas") or carbon dioxide per kilogramme of nitrogen fertiliser or per megajoule of natural gas. Input numbers are for instance the amount of fertiliser to grow rape or the amount of electricity and natural gas to produce biodiesel from rapeseed. Standard values are required to convert input numbers into greenhouse gas emissions.

Prevent "cherry picking"

As the Renewable Energy Directive and the Fuel Quality Directive do not fix the standard values, and as various different values can be found in literature, economic operators are free to choose the most beneficial values ("cherry-picking") and in that way enhance the greenhouse gas performance of their biofuels without actually improving anything in the production chain. Even when the calculations have been made for the same shipment of biofuel, the difference in results can be as high as 10%, 20% or even more.

Auditors and biofuel policy makers throughout Europe confirm that this is a problem for at least two reasons:

1. This problem negatively affects the level playing field on the European biofuels market;
2. Auditors cannot verify calculations if key parameters are not defined unambiguously. In particular they are unable to check the standard values used.

This problem was discussed at a policy maker workshop in early June 2009. Policy makers from 9 EU Member States and from the European Commission concluded that the most appropriate solution is to produce and publish a complete set of standard values and to refer to this from national legislation implementing the Renewable Energy Directive and the Fuel Quality Directive.

BIOGRACE

... publishes a list of standard values

The list of standard values contains the conversion factors that were used for calculating the default values in the RED Annex V, and is available on the BioGrace website. Policy makers from all EU member states are requested to use or make reference to this list of standard values in their national legislation implementing the Renewable Energy Directive and the Fuel Quality Directive.

The BioGrace consortium has contacted European policy makers to find the best way to include this list into national legislations. There are three different options:
a) Include (a limited number of) standard values in legislation
b) Make reference to the list of standard values from national legislation
c) Request the national regulating authority to implement (use) it.

BIOGRACE

... makes biofuel greenhouse gas calculations transparent

The BioGrace excel greenhouse gas calculation tool reproduces the calculation of the greenhouse gas emission default values of 22 biofuel production pathways listed in the RED Annex V part A. This is made according to the methodology laid out in the same Annex part C. The calculation tool enables economic operators and other users to calculate actual values of biofuel greenhouse gas emissions following the same methodology.

The BioGrace excel calculation tool allows to
- use individual input numbers
- define own standard values
- add process steps to an existing biofuel production chain (e.g. add drying step, or extra transport step)
- set up completely new biofuel production chains.

BIOGRACE

... harmonises biofuel greenhouse gas calculators

Currently user-friendly greenhouse gas calculators are being developed in Germany, the Netherlands, Spain, and the United Kingdom – in close co-operation with the project BioGrace. Once these calculators are finalised, economic operators may insert their individual input values into a template and the greenhouse gas emissions of their biofuel pathway are calculated immediately. The template is adjusted to local production characteristics. However, users cannot add new kinds of input values or influence the calculation formula (as they can do in the BioGrace excel calculation tool). BioGrace aims to harmonise these calculators to use the same standard values and produce the same results.

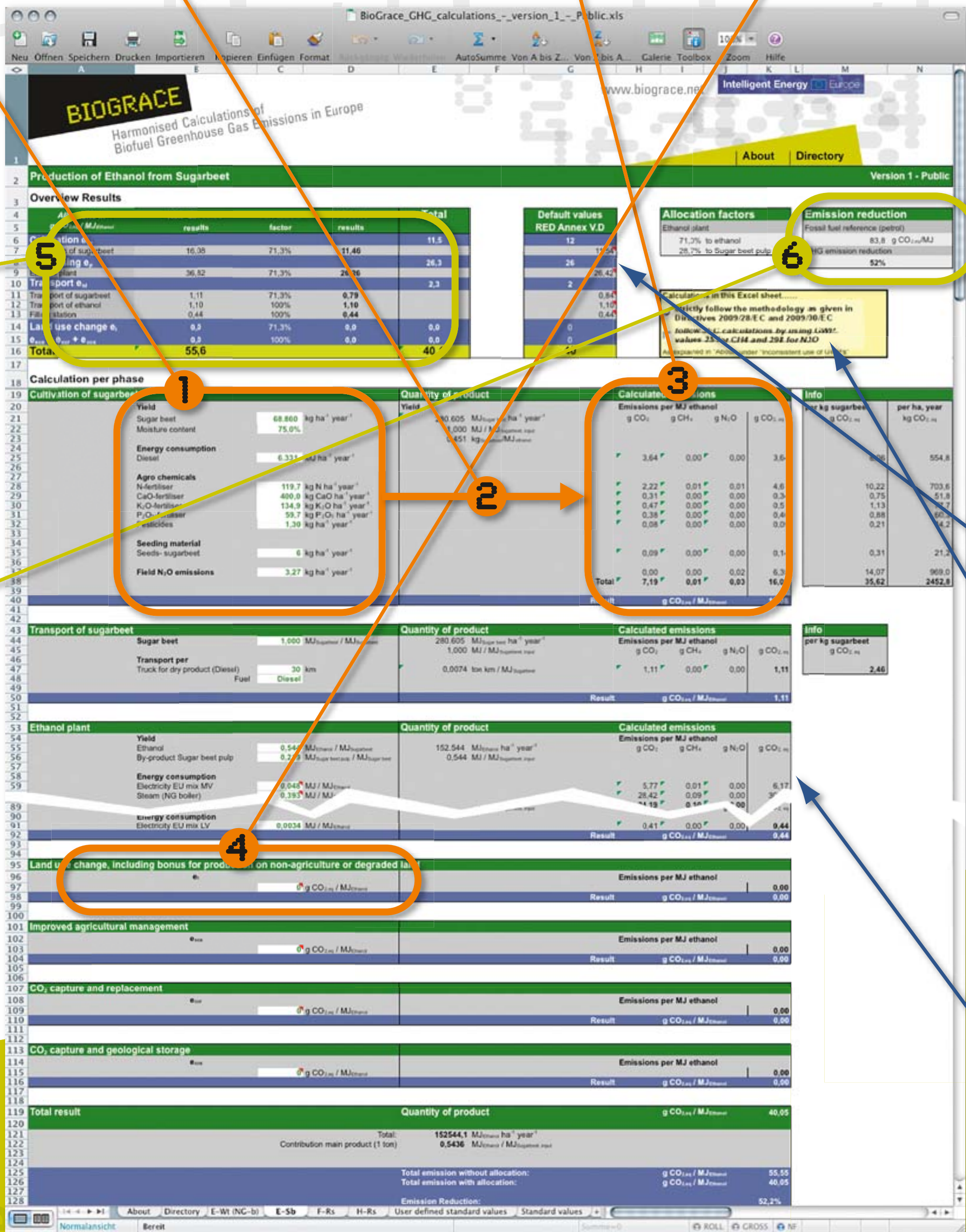
How to use the BioGrace excel greenhouse gas calculation tool

Step 1:
Input numbers are inserted in order to calculate actual greenhouse gas emission savings. The numbers shown in the picture have been used by the European Commission for the calculation of the RED Annex V default values.

Step 2:
Standard values are used to convert input numbers into greenhouse gas emissions (gCO_2, gN_2O, gCH_4, and finally $gCO_{2\text{-eq}}$). This BioGrace calculation tool applies the same standard values as the European commission has used for calculating the RED Annex V default values. Users, however, can define own standard values and use them within the excel file.

Step 3:
Greenhouse gas emissions as calculated from the input numbers are displayed.

Step 4:
Annualised emissions from carbon stock changes caused by land use change have to be added. Emission savings from improved agricultural management and from carbon capture can be added. Default values do not include these items. BioGrace aims to provide further guidance for their calculation.



Step 5:
The overview results box summarises the detailed calculation of emissions which is done for each step of the biofuel pathway in the boxes below.

Step 6:
Emission saving is expressed as a percentage of the fossil fuel reference. Until 2017 the required minimum saving is 35%.

Production pathways

The RED Annex V gives default values for following 22 biofuel production pathways, each pathway representing one sheet in the BioGrace Excel GHG calculation tool.

- Ethanol from sugar beet
- Ethanol from wheat (process fuel not specified)
- Ethanol from wheat (lignite CHP)
- Ethanol from wheat (natural gas steam boiler)
- Ethanol from wheat (natural gas CHP)
- Ethanol from wheat (straw CHP)
- Ethanol from corn
- Ethanol from sugarcane
- FAME from rape seed
- FAME from sunflower
- FAME from soybean
- FAME from palm oil
- FAME from palm oil (methane capture)
- FAME from waste vegetable or animal oil
- HVO from rape seed
- HVO from sunflower
- HVO from palm oil
- HVO from palm oil (methane capture)
- PVO from rape seed
- Biogas from MSW
- Biogas from wet manure
- Biogas from dry manure

BioGrace will not add biofuel production pathways that are not included in the Red Annex V, such as ethanol from barley. New pathways will be included in the BioGrace list of standard values and the BioGrace excel greenhouse gas calculation tool only after they have been included by the European Commission in an updated version of the RED Annex V. The BioGrace calculation tools, however, allow economic operators for setting up calculations of new pathways on their own responsibility.

Explanatory notes

Recalculation of default values

The box shows the precision with which RED Annex V default values are reproduced. BioGrace aims to bring it down to 0,1 g $CO_{2\text{-eq}}$/MJ for the total production chain.

Global warming potentials inconsistency

During the BioGrace project an inconsistency was found between the way the biofuel greenhouse gas default values have been calculated, and the methodology as listed in RED Annex V part C. The input provided by the JEC consortium to the Commission (from which the Commission calculated its default values) used global warming potentials of 25 for CH_4 (methane) and 298 for N_2O (nitrous oxide), whereas the Annex V part C prescribes that global warming potentials of 23 for CH_4 and 296 for N_2O should be used. The BioGrace excel calculation includes both calculation options, from which users can choose.

Calculation per phase

Each calculation box represents one phase of the biofuel production pathway as stated in the methodology, RED Annex V part C. Users are free to add further process steps.

The list of standard values (shortened version)

GHG emission coefficients

Global warming potentials	
CO_2	1 g $CO_{2\text{-eq}}$/g
CH_4	23 g $CO_{2\text{-eq}}$/g
N_2O	296 g $CO_{2\text{-eq}}$/g
Agro inputs	
N-fertiliser	5880,6 g $CO_{2\text{-eq}}$/kg
P_2O_5-fertiliser	1010,7 g $CO_{2\text{-eq}}$/kg
K_2O-fertiliser	576,1 g $CO_{2\text{-eq}}$/kg
CaO-fertiliser	129,5 g $CO_{2\text{-eq}}$/kg
Pesticides	10971,3 g $CO_{2\text{-eq}}$/kg
Seeds - rapeseed	729,9 g $CO_{2\text{-eq}}$/kg
Seeds - sugarbeet	3540,3 g $CO_{2\text{-eq}}$/kg
Seeds - sugarcane	1,6 g $CO_{2\text{-eq}}$/kg
Seeds - sunflower	729,9 g $CO_{2\text{-eq}}$/kg
Seeds - wheat	275,9 g $CO_{2\text{-eq}}$/kg
Fuels – gases	
Natural gas (4000 km, Russian NG quality)	66,20 g $CO_{2\text{-eq}}$/MJ
Natural gas (4000 km, EU Mix quality)	67,59 g $CO_{2\text{-eq}}$/MJ
Fuels – liquids	
Diesel	87,64 g $CO_{2\text{-eq}}$/MJ
HFO (heavy fuel oil)	84,98 g $CO_{2\text{-eq}}$/MJ
Methanol	99,57 g $CO_{2\text{-eq}}$/MJ
Fuels / feedstock / byproducts – solids	
Hard coal	111,28 g $CO_{2\text{-eq}}$/MJ
Lignite	116,98 g $CO_{2\text{-eq}}$/MJ
Electricity	
Electricity EU mix MV	127,65 g $CO_{2\text{-eq}}$/MJ
Electricity EU mix LV	129,19 g $CO_{2\text{-eq}}$/MJ
Conversion inputs	
n-Hexane	80,5 g $CO_{2\text{-eq}}$/MJ
Phosporic acid (H_3PO_4)	3011,7 g $CO_{2\text{-eq}}$/kg
Fuller's earth	199,7 g $CO_{2\text{-eq}}$/kg
Hydrocloric acid (HCl)	750,9 g $CO_{2\text{-eq}}$/kg
Sodium carbonate (Na_2CO_3)	1190,2 g $CO_{2\text{-eq}}$/kg
Sodium hydroxide (NaOH)	469,3 g $CO_{2\text{-eq}}$/kg
Hydrogen (for HVO)	87,32 g $CO_{2\text{-eq}}$/MJ
Pure CaO for processes	1030,2 g $CO_{2\text{-eq}}$/kg
Sulphuric acid (H_2SO_4)	207,7 g $CO_{2\text{-eq}}$/kg

Lower heating values (all values at 0% water, unless otherwise stated)

Fuels – liquids	
Diesel	43,1 MJ/kg
Gasoline	43,2 MJ/kg
HFO	40,5 MJ/kg
Ethanol	26,8 MJ/kg
Methanol	19,9 MJ/kg
FAME	37,2 MJ/kg
Syn diesel (BtL)	44,0 MJ/kg
HVO	44,0 MJ/kg
Fuels / feedstock / byproducts – solids	
Hard coal	26,5 MJ/kg
Lignite	9,2 MJ/kg
Corn	18,5 MJ/kg
FFB	24,0 MJ/kg
Rapeseed	26,4 MJ/kg
Soybeans	23,5 MJ/kg
Sugar beet	16,3 MJ/kg
Sugar cane	19,6 MJ/kg
Sunflowerseed	26,4 MJ/kg
Wheat	17,0 MJ/kg
Animal fat	37,1 MJ/kg
BioOil (byproduct FAME from waste oil)	21,8 MJ/kg
Crude vegetable oil	36,0 MJ/kg
DDGS (10 wt% moisture)	16,0 MJ/kg
Glycerol	16,0 MJ/kg
Palm kernel meal	17,0 MJ/kg
Palm oil	37,0 MJ/kg
Rapeseed meal	18,7 MJ/kg
Soybean oil	36,6 MJ/kg
Sugar beet pulp	15,6 MJ/kg

The complete version of the list of standard values, both in Excel as in Word format, can be found on the BioGrace website **www.biograce.net**

Project overview

April 2010

Start of BioGrace

Policy makers from the countries of the project organisations, EU policy makers, and biofuel industry representatives have been involved in the project from the start, discussing the steps forward towards harmonisation of biofuel greenhouse gas calculations and ensuring that the tools to be produced are user-friendly and respond to the needs of the market players.

Industrial associations meetings take place on request.

June 2010

The public list of standard values is published on the BioGrace website as well as the BioGrace Excel calculation tool which reproduces the default values for 4 out of 22 biofuel production pathways that are included in the Renewable Energy Directive.

September 2010

16 out of 22 production pathways available.

November 2010

Policy Makers' Workshops in Greece and Sweden. Policy makers from all EU member states are invited to learn about the BioGrace greenhouse gas calculation tools, give feedback on the BioGrace products, and discuss how to achieve harmonisation of greenhouse gas calculations, i.e. make reference to the list of standard values from national legislation.

December 2010

All 22 production pathways available.

The Renewable Energy Directive and the Fuel Quality Directive have to be implemented into national law by 5 December 2010 and 31 December 2010 respectively.

January to July 2011

Public Workshops. Stakeholders involved in the biofuels field (farmers, biofuel producers, fuel suppliers) as well as auditors, advisors, representatives of voluntary sustainability schemes and greenhouse gas calculation specialists are welcome to participate and learn how to use the BioGrace excel tool and the user-friendly greenhouse gas calculators. These workshops will take place in Austria, France, Greece, Germany, Spain, Sweden and the Netherlands. Please register on the BioGrace website!

March 2012

Official end of BioGrace project.

Imprint

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