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BIOGRACE II

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

www.biograce.net

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The European Commission wants Member States to follow a harmonised approach

In 2010 the European Commission recommended that Members States who introduce national sustainability schemes for electricity, heating and cooling from biomass should ensure that these in almost all respects are the same as those for liquid biofuels laid down in the Renewable Energy Directive (2009/28/EC). This would ensure greater consistency and avoid unwarranted discrimination in the use of raw materials. To this end, the Commission defined the basic calculation methodology to be respected when calculating greenhouse gas (GHG) emission savings from bioenergy; and the Commission published a list of default emission values for common solid and gaseous pathways. In 2014 the methodology was re-evaluated and the list of standard values was updated. The three relevant documents are

- **Report on sustainability requirements** for the use of solid and gaseous biomass sources in electricity, heating and cooling, COM(2010)11
- **State of play on the sustainability** of solid and gaseous biomass used for electricity, heating and cooling in the EU, SWD(2014)259
- **Solid and gaseous bioenergy pathways:** input values and GHG emissions, JRC Science and Policy Reports (Report EUR 26696 EN).

Default pathways

Solid biomass pathways

Woodchips	▶	Feedstock options
Wood briquettes or pellets	▶	Forest residues Short rotation coppice (Eucalyptus) Short rotation coppice (Poplar) Stemwood Industry residues
Agricultural residues		
Straw pellets		
Bagasse pellets		
Palm kernel meal		

Gaseous biomass pathways

Biogas for electricity	▶	Feedstock options
Biogas for biomethane	▶	Wet manure Maize whole plant Biowaste

Pathway options

Poplar cultivation	▶	Fertilised or not fertilised
Transport distance	▶	1 to 500 km 500 to 2500 km 2500 to 10000 km above 10000 km
Pelletising process	▶	Heat from natural gas boiler, electricity from grid Heat from wood chip boiler, electricity from grid Heat and electricity from wood chips CHP generation
Bulk density of agricultural residues	▶	Below or above 0,2t/m^3
Palm kernel mill	▶	With or without CH_4 emissions
Biogas production	▶	Open or close digestate
Biogas upgrading	▶	With or without off-gas combustion

Methodology

Default values	▶	Default values are given for each pathway and variable in $gCO_{2\text{-eq}}$/MJ energy carrier. They represent the sum of the steps cultivation, processing, and transport/distribution and are listed as a total as well as in disaggregated form for each of the steps.
Types of final energy	▶	Electricity Heat Electricity and heat (CHP) Cooling
Fossil fuel comparators for calculation of emission savings	▶	186 g$CO_{2\text{-eq}}$/MJ electricity 80 g$CO_{2\text{-eq}}$/MJ heat 47 g$CO_{2\text{-eq}}$/MJ cooling

BIOGRACE II

… makes GHG calculations transparent

In 2014 the European Commission has published a report on the sustainability of solid and gaseous biomass for electricity, heating and cooling generation. Part of the report is a document of the Joint Research Centre (JRC), "Solid and gaseous bioenergy pathways: input values and GHG emissions". The idea of the project BioGrace-II is to retrace and publish how the listed default values were calculated and elaborate a comprehensive GHG calculation tool based thereon. This tool allows for

- Member States to monitor the greenhouse gas performance of subsidised plants
- Operators to perform own calculations
- Verifiers to easily check the calculation of their clients

By following the same methodology of the European Commission, users are sure to apply a sound and accepted way when performing greenhouse gas calculations.

BIOGRACE II

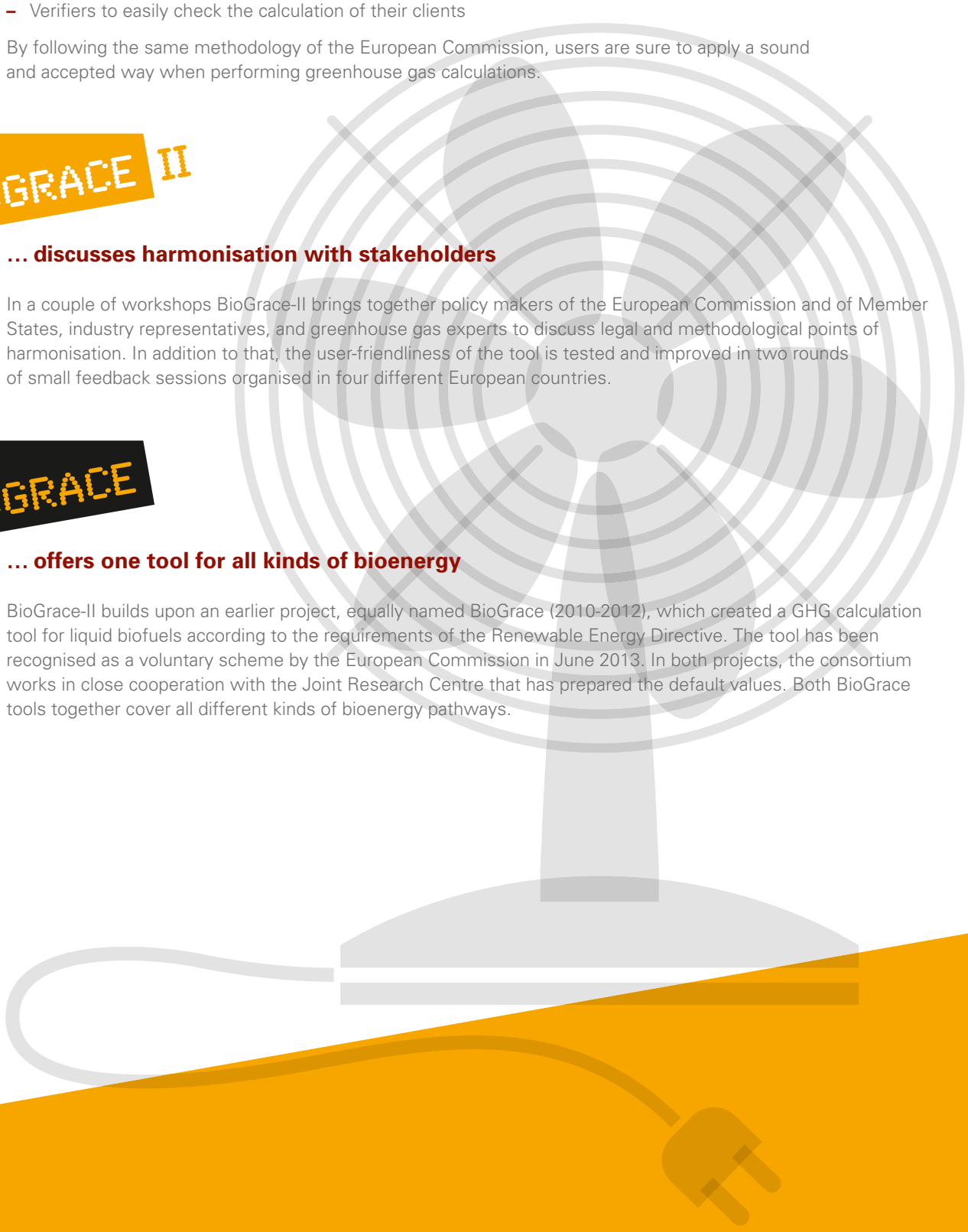
… discusses harmonisation with stakeholders

In a couple of workshops BioGrace-II brings together policy makers of the European Commission and of Member States, industry representatives, and greenhouse gas experts to discuss legal and methodological points of harmonisation. In addition to that, the user-friendliness of the tool is tested and improved in two rounds of small feedback sessions organised in four different European countries.

BIOGRACE

… offers one tool for all kinds of bioenergy

BioGrace-II builds upon an earlier project, equally named BioGrace (2010-2012), which created a GHG calculation tool for liquid biofuels according to the requirements of the Renewable Energy Directive. The tool has been recognised as a voluntary scheme by the European Commission in June 2013. In both projects, the consortium works in close cooperation with the Joint Research Centre that has prepared the default values. Both BioGrace tools together cover all different kinds of bioenergy pathways.



How to use the BioGrace-II Excel greenhouse gas calculation tool

Step 1:
The **download** of the BioGrace-II greenhouse gas calculation tool is freely available on the project website www.biograce.net.

Step 2:
The properties of the biofuel pathway to be calculated have to be chosen in the general settings box:
– final energy
– conversion efficiency
– transport distance
– technical options.

Step 3:
Input numbers are inserted. The numbers shown in the cells are the ones the default values of the JRC report are based on.

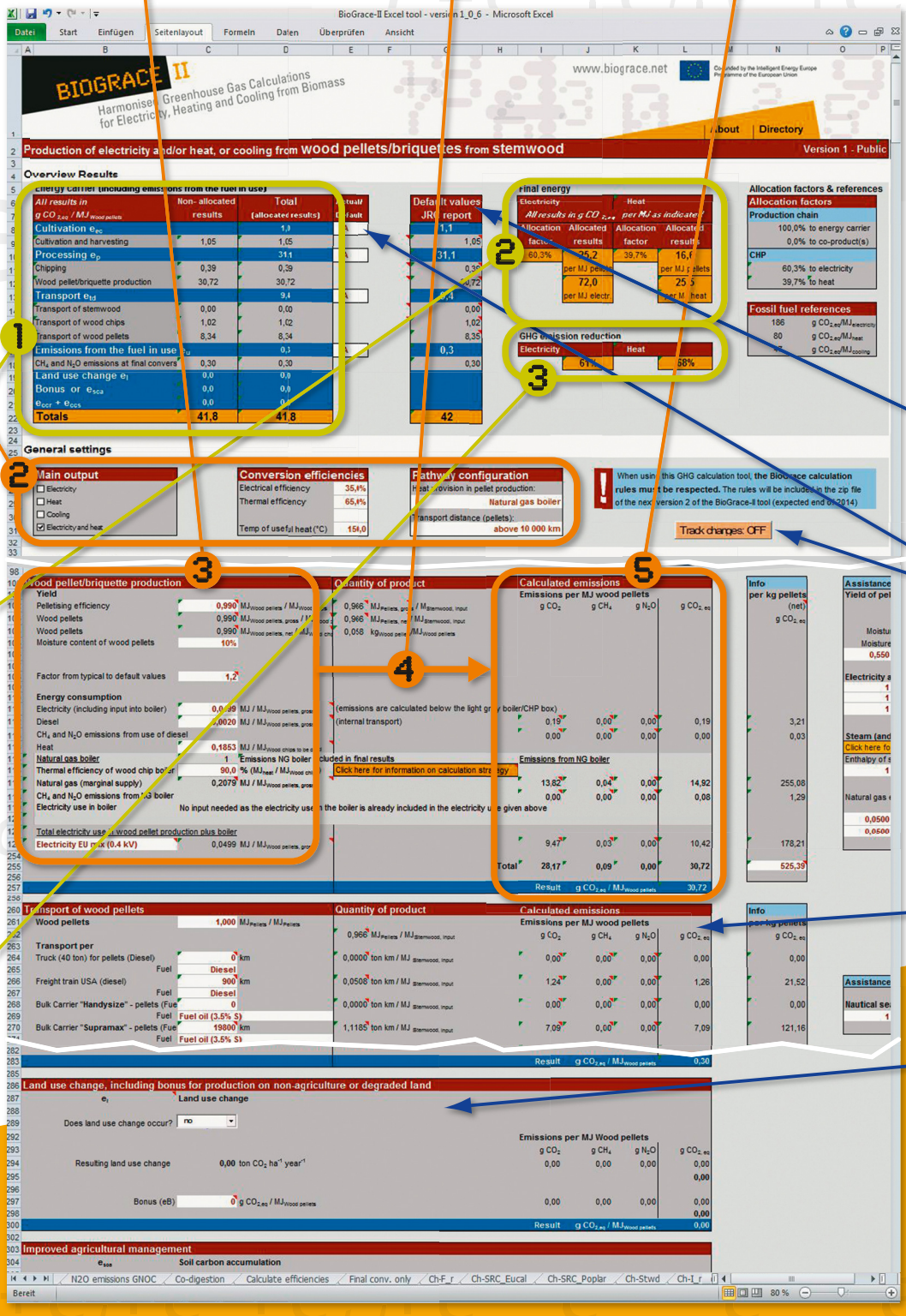
Step 4:
Standard values are used to convert input numbers into greenhouse gas emissions (g CO_2, g N_2O, g CH_4, and finally g $CO_{2\text{-eq}}$). The BioGrace-II calculation tool applies the same standard values that were used for the default values.

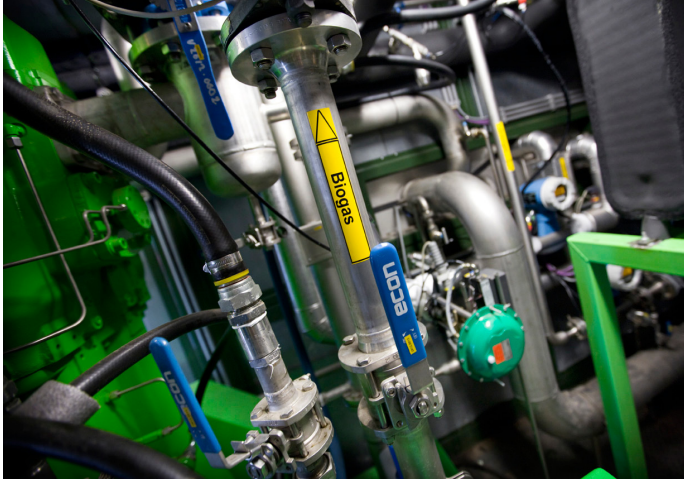
Step 5:
Greenhouse gas emissions as calculated from the input numbers are displayed.

Result 1:
Emissions per energy carrier are shown as the sum of the results of the calculation boxes below.

Result 2:
Emissions per final energy are claculated according to the pathway properties in the general settings. In case of a CHP plant, the allocation between electricity and heat is done on the basis of the Carnot efficiency.

Result 3:
Emission savings of the final energy refer to the fossil fuel comparators as given in the JRC report.





Feature of the complete BioGrace-II greenhouse gas calculation tool

The tool package contains
- Excel file
- list of standard values
- user manual
- document of detailed calculation rules
- methodological background document

Each calculation sheet of the Excel tool represents one of the 20 default production pathways of the JRC report. The sheet shows how the default values are calculated and allows to make individual calculations.

Explanatory notes

Recalculation of default values:
The box shows the precision with which the JRC report default values are reproduced. BioGrace-II aims to bring it down to 0,1 g $CO_{2\text{-eq}}$/MJ energy carrier for the total production chain.

Combine disaggregated default values, values from a supplier and individual numbers:
Users may insert numbers for previous pathway steps that suppliers provide, or they may choose for using a disaggregated default value for one or two of the steps cultivation, processing, and transport/distribution and perform individual calculations for the remaining steps.

The track changes button allows for verifiers to easily follow where users deviate from the default pathway and use actual numbers.

Calculation per phase:
Each calculation box represents one seperate phase of the biofuel production pathway as considered in the calculation of the default values. Users are free to add further process steps.

Specific calculation sheets:
The Excel tool provides extra sheets for the calculation of
- *net electricity and heat efficiencies*
- *emissions from direct land use change*
- *bonus for improved agricultural management*
- *N_2O field emissions according to IPCC Tier*
- *N_2O field emissions with GNOC.*

Results of the extra sheets are filled in the corresponding boxes.

Another extra sheet allows for the calculation of co-digestion of different feedstock in the same biogas plant.

The list of standard values (shortened version)

GHG emission coefficients

Global warming potentials	
CO_2	1 g $CO_{2\text{-eq}}$/g
CH_4	25 g $CO_{2\text{-eq}}$/g
N_2O	298 g $CO_{2\text{-eq}}$/g
Agro inputs	
Synthetic N-fertiliser (kg N)	4567,8 g $CO_{2\text{-eq}}$/kg
Pesticides	13894,6 g $CO_{2\text{-eq}}$/kg
Seeds - corn (whole plant)	317,5 g $CO_{2\text{-eq}}$/kg
Fuels – gases	
Natural gas (marginal supply)	71,75 g $CO_{2\text{-eq}}$/MJ
LPG	73,27 g $CO_{2\text{-eq}}$/MJ
Fuels – liquids	
Diesel	93,95 g $CO_{2\text{-eq}}$/MJ
Gasoline	92,33 g $CO_{2\text{-eq}}$/MJ
Fuel oil	93,30 g $CO_{2\text{-eq}}$/MJ
Fuels / feedstock / co-products – solids	
Hard coal	112,32 g $CO_{2\text{-eq}}$/MJ
Lignite	116,73 g $CO_{2\text{-eq}}$/MJ
Wood pellets	0,62 g $CO_{2\text{-eq}}$/MJ
Electricity	
Electricity EU mix (10–20 kV)	196,35 g $CO_{2\text{-eq}}$/MJ
Electricity EU mix (0,4 kV)	208,82 g $CO_{2\text{-eq}}$/MJ
Emissions from machinery operations incl. chipping (per MJ diesel)	
CH_4 and N_2O emissions from use of diesel	0,97 g $CO_{2\text{-eq}}$/MJ
Emissions from boiler or CHP (per MJ feedstock)	
CH_4 and N_2O emissions from Wood pellet CHP	0,25 g $CO_{2\text{-eq}}$/MJ
CH_4 and N_2O emissions from Straw pellet CHP	0,24 g $CO_{2\text{-eq}}$/MJ
CH_4 and N_2O emissions from Natural gas CHP	0,40 g $CO_{2\text{-eq}}$/MJ

Lower heating values (all values at 0% water)

Residues (feedstock or input)	
Black liquor	12,1 MJ/kg
Manure	12,0 MJ/kg
Vinasse	14,0 MJ/kg
Fuels – gases	
Natural gas (marginal supply)	49,2 MJ/kg
Methane	50,0 MJ/kg
LPG	46,0 MJ/kg
Fuels – liquids	
Diesel	43,1 MJ/kg
Gasoline	43,2 MJ/kg
Fuel oil	40,5 MJ/kg
Fuels / feedstock / co-products – solids	
Hard coal	26,5 MJ/kg
Lignite	9,2 MJ/kg
Eucalyptus (SRC)	19,0 MJ/kg
Miscanthus	17,6 MJ/kg
Poplar (SRC)	19,0 MJ/kg
Stemwood (Pine)	19,0 MJ/kg
Forestry residues	19,0 MJ/kg
Industry residues	19,0 MJ/kg
Sawdust	19,0 MJ/kg
Wood chips	19,0 MJ/kg
Wood pellets	19,0 MJ/kg
Straw bales	17,2 MJ/kg
Wheat straw	17,2 MJ/kg
Biowaste	20,7 MJ/kg

Fuel efficiency

Transport efficiencies	
Truck (40 ton) for pellets (Diesel)	0,87 MJ/t.km
Ocean bulk carrier (Fuel oil)	0,20 MJ/t.km
Inland bulk carrier 8.8 kt (Diesel)	0,32 MJ/t.km
Bulk Carrier "Supramax" – pellets (Fuel oil)	0,07 MJ/t.km
Local (10 km) pipeline	0,00 MJ/t.km
Freight train USA (Diesel)	0,25 MJ/t.km
Rail (Electric, MV)	0,21 MJ/t.km

The complete version of the list of standard values is part of the BioGrace-II greenhouse gas calculation tool.

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French and German versions of this brochure are available as downloads on www.biograce.net

Project overview

April 2012

Start of BioGrace-II
The project consortium starts developing the Methodological background document and the Excel tool on preliminary data from the Joint Research Centre.

September 2012 to April 2013

1st round of train-the-trainers-sessions
In continuation of the first BioGrace project on liquid biofuels, trainings on GHG calculation tools of liquid biofuels are given to trainers of verification schemes. These trainings do not only cover the BioGrace tool but also other biofuel calculation tools that were accepted by the Commission. Three trainings are carried out in Utrecht (the Netherlands), Paris, and Heidelberg (Germany).

October 2012

Experts Workshop in Heidelberg
Invited experts review the 1st draft of the Excel tool, discuss questions concerning GHG data and accounting methodologies and identify key policy recommendations for harmonising solid and gaseous biomass GHG calculations. The outcome of the methodological discussion is communicated to the European Commission.

February to June 2013

1st round of feedback sessions
Small groups of stakeholders are invited to discuss the user-friendliness of the first draft of the Excel tool. Five sessions take place in Amsterdam, London, Brussels, and Wieselburg (Austria).

June 2013

The European Commission approves the BioGrace calculation tool for liquid biofuels (outcome of the first BioGrace project) as a voluntary scheme. Economic operators may use the tool to prove complying with the GHG requirements of the Renewable Energy Directive. The approval applies in all Member States.

October 2013

1st public workshop in Brussels
Some 50 stakeholders come to learn about the BioGrace-II tool and about the latest policy developments.

March 2014

1st policy makers workshop in Brussels
The tool is presented to policy makers from eleven Member States and representatives of the European Commission; steps of harmonisation are discussed.

June to November 2014

2nd round of feedback sessions
Version 1 of the tool is tested by users in Brussels, Utrecht and Vienna.

June 2014

2nd public workshop in Vienna with 40 participants

July 2014

The European Commission releases a new report – SWD(2014)259 – on sustainability of solid and gaseous biomass used for electricity, heating and cooling. The report is accompanied by report of the Joint Research Centre on default and input values for GHG emissions of solid and gaseous bioenergy pathways (Report EUR 26696 EN).

September 2014

Version 1 of the Excel tool is put online

January and February 2015

2nd round of train-the-trainers-sessions
Two trainings are held in Heidelberg and Paris covering both BioGrace tools. Instruction videos are put online.

March 2015

2nd policy makers workshop and 3rd public workshop in Brussels
The final version of the BioGrace-II Excel tool is presented.