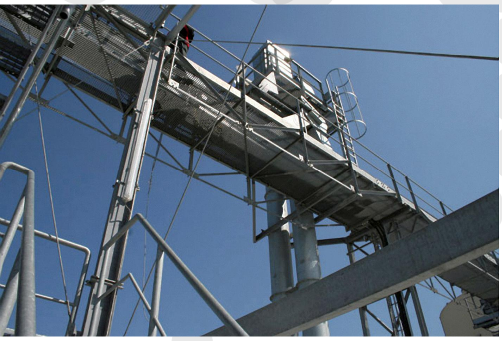
BIOGRACE

Harmonised Calculations of
Biofuel Greenhouse Gas Emissions in Europe



30/11/2011

BioGrace -
List of Additional Standard Values

Version 1

Content

1 Introduction

The **BioGrace GHG calculation tool** includes the **BioGrace list of standard values**[1]. According to the **BioGrace GHG calculation rules** these values shall be taken in order to assure a harmonised data background for the GHG calculation and shall be applied, while deviations are only allowed on conditions laid down by the calculation rules.[2]

BioGrace has developed the **BioGrace list of additional standard values** for a number of inputs, process related emissions and transport modes not listed on the **BioGrace list of standard values** or which contain more specific values. This list shall offer an extended and more specified data background to the user. According to the **BioGrace GHG calculation rules** these values shall be used whenever the **BioGrace list of standard values** does not contain the needed value respectively.

The **BioGrace list of additional standard values** contains data for selections of

- mineral fertilizer types and other agro inputs
- conversion inputs (process chemicals)
- national electricity grids
- solid and gaseous biomass sources for energy
- transport (pipeline).

[1]: The list of standard values is available on the sheet "Standard values" in the BioGrace GHG Excel tool and is also available on-line both in Excel and Word versions at http://www.biograce.net/content/ghgcalculationtools/standardvalues.

[2] See section 2.2 in the *BioGrace GHG calculation rules available at* http://www.biograce.net/content/ghgcalculationtools/

2 Mineral fertilizer types and other agro inputs

Mineral fertilisers are major inputs in the cultivation step and tend to be a relevant parameter in the GHG balance of biofuels. This is particularly true for N-fertilisers. The BioGrace standard value is 5917.2 g CO_2eq/kg N based on an average mix figured out in the E3Database[3]. Half of the value is based on the N_2O from technical nitrification processes. Some N-fertilisers are not connected with this kind of process emissions as well as some production techniques have developed to mitigate these emissions. Brentrup and Pallière (2008) deliver one of the most recognized references for GHG emission data for N-fertilisers. Table 1 shows European average values from this source, as well a few further data from Jenssen and Kongshaug (2003) and GES'TIM (2010). All references are supported by the International Fertiliser Society (IFS).

In addition to European average values related to the year 2006 Brentrup and Pallière (2008) show also data for production according best available technique (BAT). However the recommended additional values refer only to the average data. A distinction within the technical standard of the production process will overload the verification process and enlarge the risk of "cherry picking".

Table 1 includes also values for soybean seeds, since the **BioGrace list of standard values** misses to offer this input and the **BioGrace GHG calculation tool** leaves a blank at the respective entry. Generally recognized literature data for specific soybean seeds are not available. Thus estimation has been made based on the calculation for soybean provided by the tool itself (367.2 g CO_2eq/kg soybeans) considering an additional factor for seed preparation. This factor is estimated to be sufficient for conventional seeds. Genetically modified strains are clearly not covered by this simplified approach.

[3] LBST, which is a consultant to the JEC consortium and a subcontractor to the BioGrace project, uses the LCA tool and database E3database to perform their GHG calculations: http://www.e3database.com/.

Table 1: Additional standard values for mineral fertiliser types and seeds

Agro inputs	GHG emission coefficient g CO_{2-eq}/kg	Source	Remark
N-fertiliser (kg N)			
Ammonium nitrate (AN)	6,209	(a)	35% N
Ammonium sulphate (AS)	1,620	(b)	21% N, 23% SO_3
Anhydrous ammonia	2,926	(c)	waterfree, 82% N
Calcium ammonium nitrate (CAN)	6,340	(a)	26,5% N
Calcium nitrate (CN)	9,606	(a)	15,5% N
Nitrogen solution	5,137	(c)	28 to 32% N
Urea	3,167	(a)	46% N
Urea ammonium nitrate (UAN)	5,932	(a)	32% N
P_2O_5-fertiliser (kg P_2O_5)			
Triple superphosphate (TSP)	731	(a)	48% P_2O_5
Rock phosphate	95	(b)	21% P_2O_5, 28% SO_3
Mono ammonium phosphate (MAP)	596	(b)	52% P_2O_5, 11% N
Di-Ammonium-Phosphate (DAP)	1,527	(a)	46%P_2O_5, 18% N
K_2O-fertiliser (kg K_2O)			
Muriate of Potash (MOP)	308	(a)	60% K_2O
Other fertilisers			
NPK 15-15-15	7,105	(a)	15% N -15% P_2O_5 -15% K_2O
MgO (kg MgO)	769	(b)	
Sodium (Na) fertiliser (kg Na)	1,620	(b)	
Seeds			
Soybean (non GMO)	400	BioGrace tool	Estimation based on the disaggregated default values

Data sources:

(a) IFS proceedings no: 639, Brentrup, F. and Pallière, C. (2008), GHG emissions and energy efficiency in European nitrogen fertiliser production and use.
all values refer to the European technical average in 2006, including the process emissions from production and from CO_2 hydrolysis, excluding other soil effects as well as liming.

(b) IFS proceedings no: 509, Jenssen, T.K. and Kongshaug, G. (2003). Energy consumption and greenhouse gas emissions in fertiliser production.

(c) GES'TIM, guide méthodologique pour l'estimation des impacts des activités agricoles sur l'effet de serre ; version 1.2 ; Institut de l'Elevage ; Paris, 2010

General remark: global warming potential factors were taken from IPCC (2007);
i.e.: 25 for CH_4, 298 for N_2O, the disaggregated data for CO_2 (fossil), CH_4, N_2O can be found in the respective Excel file at http://www.biograce.net/content/ghgcalculationtools/additionalstandardvalues

3 Conversion Inputs (process chemicals)

Table 2 shows values for a number of typical inputs of biofuel conversion processes. Please note that more process chemicals might be in use, however the 0.1% cut-criterion of BioGrace calculation rules should be taken into account.

Table 2: Additional standard values for conversion inputs

Conversion Inputs	**GHG emission coefficient** g $CO_{2\text{-eq}}$/kg	**Source**	**Remark**
Acetic acid (water free)	1,570	(d)	
Citric acid (water free)	963	(e)	Input might undergo the 0.1% cut-criterion of BioGrace calculation rules
Potassium hydroxide (water free)	1,934	(d)	
Sodium methylate (water free)	4,885	(d)	
Sodium silicate (37% in water)	1,145	(d)	
Zeolith	4,000	(d)	
Antioxidant BHT (butylated hydroxytoluene)	10,000	(f)	Input might undergo the 0.1% cut-criterion of BioGrace calculation rules
Isobutene	1,501	(d)	
Nitrogen	434	(d)	

Data sources:

(d) ecoinvent Centre (2007) ecoinvent data v2.0. ecoinvent reports No. 1-25, Swiss Centre for Life Cycle Inventories, Dübendorf, 2007 http://www.ecoinvent.org/

(e) Assessing the GHG emissions of rapeseed and soybean biodiesel, May 2010, Biomass Reasearch center, University of Perugia

(f) Estimation based on ecoinvent data for precursors (phenol, isobutene);

General remark: global warming potential factors were taken from IPCC (2007);
i.e.: 25 for methane, 298 for nitrous oxide,
the disaggregated data for CO_2 (fossil), CH_4, N_2O can be found in the respective Excel file at
http://www.biograce.net/content/ghgcalculationtools/additionalstandardvalues

4 Emission coefficients for national electricity grids

With respect to GHG emission factors for grid electricity the **BioGrace list of standard values** only includes European average values. These values have been applied within the JEC Well-to-Wheels study[4] using the GEMIS database[5] as origin.

The GEMIS database offers a number of emission factors for electricity from the average for further countries outside the EU27. So does the Ecoinvent database. However both of most usually applied sources do not cover the far range of potential biofuel producers at global scale.

It is the objective of this guidance paper to provide a standard value for all potential producer countries. Therefore a complete list of has been worked by IFEU, who maintains life cycle energy models for more than 10 years. Within the following sections there are descriptions of scope, approach, data background and results of the applied model.

4.1 System definition and system boundary of the electricity grid model

The electricity grid model follows a cradle to user approach, referring to the average mix of the respective country. Basically the system boundary encloses:

- Direct GHG emissions by the power plants fired with fossil fuels (hard coal, lignite, natural gas, fuel oil);
- GHG emissions due to fuel supply including extraction, processing and transport (fossil fuels as listed above as well as nuclear fuel and biomass);
- GHG emissions due to other process inputs (chemicals) and outputs (waste disposal) of the power plants (all kinds of power plants);
- The energy efficiency of the power plants taking typical national average rates as well as CHP (if given) into account;

4 WTT appendix 2 (version 3)
http://ies.jrc.ec.europa.eu/uploads/media/WTT%20App%202%20v30%20181108.pdf

5 Globales Emissions-Modell Integrierter Systeme (GEMIS), version 4.1.3.2;
http://www.oeko-institut.org/service/gemis/index.htmm

- The distribution of electricity through the grid including losses due to transport and transformation (referring to low voltage electricity as the final output the overall loss is 6.1 % according to Pehnt, 2003).

The model allows including GHG emission due to infrastructure. However for the purpose of this recommendation of additional standard values those emissions are excluded following the rule in Renewable Energy Directive (2009/28/EC) Annex V part C point 1[6]. Figure 1 shows the modular structure of the electricity grid model.

[6] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0016:0062:en:PDF

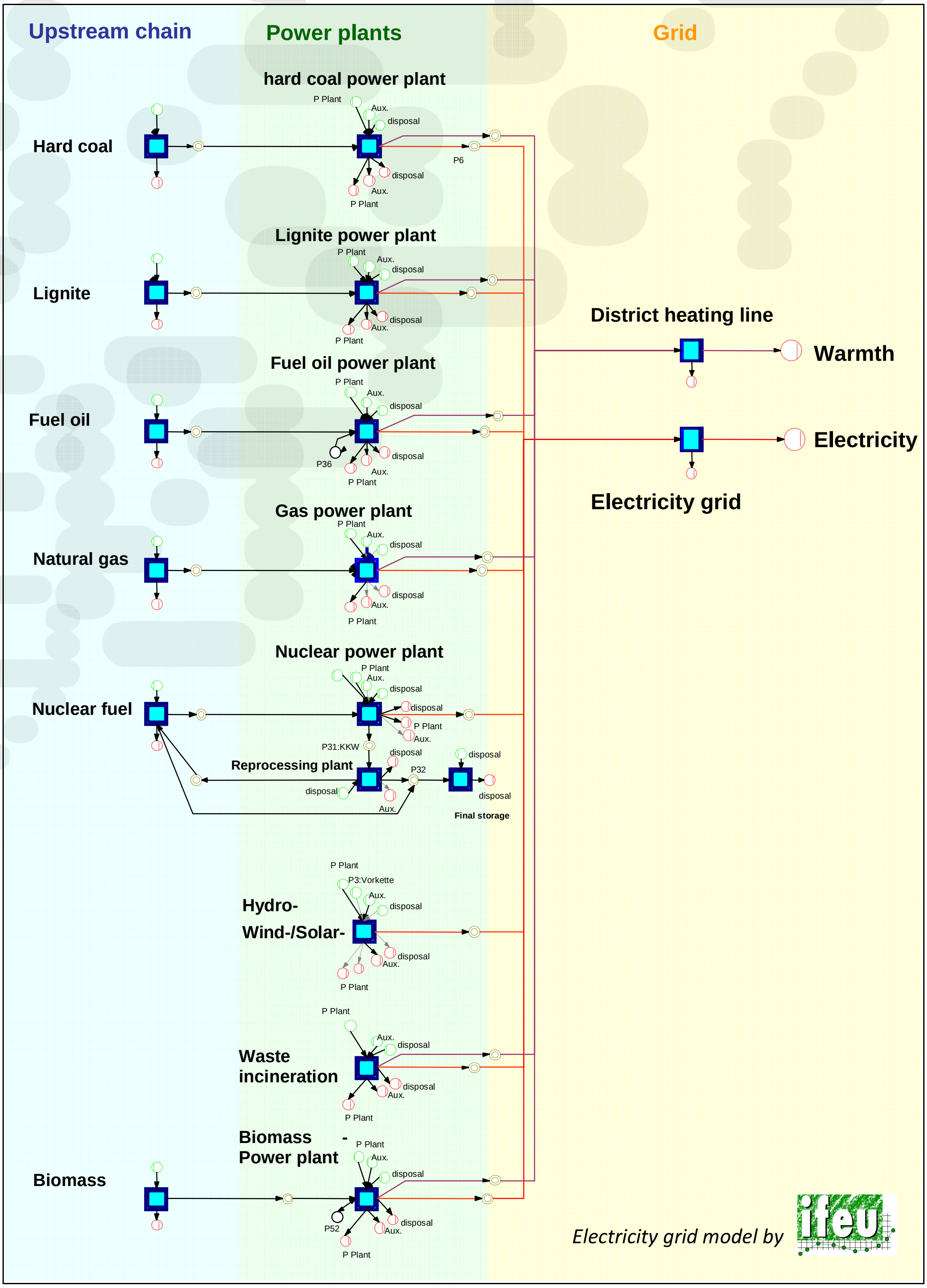


Figure 1: Scheme of the modular structure of the IFEU electricity grid model

4.2 Allocation

4.2.1 Combined heat and power generation (CHP)

In case of CHP, allocation is applied based on exergetic relations: the fraction of exergy in the electricity is set to 100 % (C_{el} = 1), whereas the fraction of exergy in the useful heat is defined by the so called Carnot efficiency C_h, for useful heat at different temperatures:

$$C_h = \frac{T_h - T_0}{T_h}$$

Where:

T_h = Temperature, measured in absolute temperature (kelvin) of the useful heat at point of delivery as final energy

T_0 = Temperature of surroundings, set at 273 kelvin (equal to 0 °C)

4.2.2 Waste as fuel

In some countries waste incinerators are in place and deliver electricity to the public grid. Within this model the portion of electricity from waste is considered as spin-off since the primary purpose of the incinerator is the duly disposal of waste. Therefore electricity from waste is free of charge of the incineration process which is allocated to the waste disposal.

4.2.3 Pump-storage hydro power plants

Power plants of this type do not generate electricity from primary resources but just store power which has been generated by other base load power plants (e.g. coal or nuclear). Since the performance of those other power plants is yet included in the national energy statistics, the contribution of pump-storage hydro power plants is excluded within this model in order to avoid double-counting.

4.3 Defining national fuel mixes

Comprehensive and consistent data are provided by the Electricity Statistics of the International Energy Agency IEA.[7] It includes data showing the energy mix of 136 nations. For nations which are not explicitly listed within the World Energy Statistics average values are given (e.g. for African or Asian countries not listed there is a value for “other Africa” respectively “other Asia”). Thanks to this approach

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[7] http://data.iea.org/IEASTORE/DEFAULT.ASP
(Remark: these data are liable to pay costs)

all countries are covered by the overall list, apart from Melanesian, Polynesian (data only for New Zealand) and Micronesian nations.

The results in Table 3 are based on the reference year 2009. Updates are regularly carried out.

4.4 Modelling the power plants

Fossil-fuel fired power plants are the most relevant emission sources within the electricity grid. The IEA data services provide values concerning CO_2 emissions from fuel combustion. However it does not include other greenhouse gases like methane and nitrous oxide. Therefore the emission calculation is performed within the grid model itself taking types of coals, natural gas and so forth into account.

Next to the fuel type the efficiency factors have most relevant effect on the CO_2 emission factor. The efficiency factors are depending on the technical standard. With respect to the information of the IEA data services this model applies average efficiency factors related to general fuel type (hard coal, lignite, gas etc.) for each country. This approach also considers that a higher technical standard with advanced flue gas mitigation techniques effects a higher self-demand.

The balance of the power plant includes also GHG emission due to the provision of external process materials (e.g. lime for SO_2-abatement), as well as the disposal of process wastes (as far as there is no use as secondary material like gypsum).

The modelling of **nuclear power plants** includes also the reprocessing of nuclear fuel rods as well as the final disposal of the nuclear waste. Direct emissions of GHG do not occur.

Also power generation based on **hydro, solar, wind, geothermic energy** cause no direct emissions. Concerning upstream resources only a minor amount of operational materials (lubricants etc.) is required.

The modelling of **biomass power plants** corresponds to fossil fuelled power plants with the distinction, that direct fossil CO_2 do not occur while combustion-borne CH_4 and N_2O emissions are taken into account.

4.5 Modelling the upstream chains

The model includes the upstream chains of following fuels:

- Hard coal
- Lignite
- Fuel oil
- Natural gas
- Nuclear fuel
- Biomass

For the **hard coal** chain the IEA “Coal Information” is taken into account to define the mix of origins of used coal within the respective countries. The data for the GHG emission per unit of hard coal is taken from Ecoinvent.

As for **lignite** it is assumed that only domestic resources are utilized within the respective countries. The Ecoinvent data base provides emission factors for the extraction typically for the situation in German. For other countries no comparable data are available. Thus the German data are generally applied for all lignite extracting countries.

According to IEA only a few countries are using **fuel oil** to a large extent for power generation. The IEA data are interpreted to refer to the “regular” power plants and do not include the Diesel fuelled engines which are run in case of shortages or black-outs. Process chain for fuel includes extraction, transport, refinery and distribution to the user. There are not enough data to model each country’s crude oil or fuel oil import as well as the national refinery standard. Therefore an average value taken from a situation based on European standard is taken uniformly for all countries. The fuel oil model is designed by IFEU based on original refinery data, on the Reference document for Mineral Oil and Gas Refineries (EIPPCB 2010)[8] and on Ecoinvent data concerning the crude oil chain.

For **natural gas** chain the IE “Natural Gas Information” is not specific enough to define the mix of origins of used gases within the respective countries. Within the EU data from EUROSTAT are applied to specify the origin as well as the portion of technical gases within the national mix (e.g. blast furnace gas). For countries outside the EU these data are not available. Therefore for all European non-EU countries, for all Asian it assumed that Russian gas is mostly in use. For African countries and the Middle East the data set for Algerian gas is applied. For the American continent a uniform emission factor equivalent to the one representing Russian gas is applied. The used databases are GEMIS and Ecoinvent.

The production of **nuclear fuel** includes the extraction of uranium ore and the diverse processing steps. The generic data are taken from Ecoinvent. No distinction is made between the different countries using nuclear power.

Biomass is simply assumed to be woody biomass, neglecting the current increase of biogas in many countries. On the other hand biomass is still of low relevance with regard to its portion within the electricity mix of countries. The chain includes harvesting of wood, chopping and transport.

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[8] ftp://ftp.jrc.es/pub/eippcb/doc/ref_d1_0710.pdf

4.6 Results

Table 3 shows the whole list of country-related emission factors figured out using the model and data bases described within the previous sections.

Table 3: Additional standard values for national electricity grids

	GHG emission coefficient				Source
	gCO_2/MJ	gCH_4/MJ	gN_2O/MJ	gCO_{2-eq}/MJ	
European Union (27 MS)					
European Union standard value MV	119.4	0.3	0.01	128.2	BioGrace standard values
European Union standard value LV	120.8	0.3	0.01	129.8	BioGrace standard values
Europe (Non-EU)					
Albania	2.1	0.00	0.000	2.2	(g)
Bosnia and Herzegovina	199	0.05	0.006	202	(g)
Croatia	119	0.32	0.003	128	(g)
FYR Macedonia	273	0.07	0.008	277	(g)
Serbia (incl. Montenegro and Kosovo)	237	0.06	0.007	240	(g)
Switzerland	2.2	0.00	0.000	2.4	(g)
Norway	3.7	0.01	0.000	4.0	(g)
Iceland	0.3	0.00	0.000	0.3	(g)
Belarus	220	0.49	0.004	233	(g)
Moldova	203	0.52	0.003	217	(g)
Russia	157	0.38	0.004	167	(g)
Ukraine	143	0.47	0.005	156	(g)
Africa					
Algeria	205	0.53	0.003	219	(g)
Angola	71	0.06	0.001	73	(g)
Benin	309	0.25	0.005	317	(g)
Botswana	314	0.46	0.014	330	(g)
Cameroon	81	0.09	0.002	84	(g)
Congo (DR)	1.3	0.00	0.000	1.4	(g)
Congo (Rep.)	71	0.19	0.001	76	(g)
Egypt	205	0.42	0.003	216	(g)
Eritrea	307	0.25	0.005	315	(g)
Ethiopia	37	0.03	0.001	37	(g)

	GHG emission coefficient				Source
	gCO_2/MJ	gCH_4/MJ	gN_2O/MJ	gCO_{2-eq}/MJ	
Gabon	112	0.19	0.002	118	(g)
Ghana	69	0.06	0.001	70	(g)
Ivory Coast	124	0.33	0.003	133	(g)
Kenya	134	0.11	0.005	138	(g)
Libya	266	0.37	0.004	277	(g)
Morocco	268	0.36	0.011	281	(g)
Mozambique	0.5	0.00	0.000	0.6	(g)
Namibia	61	0.08	0.003	64	(g)
Nigeria	169	0.37	0.003	179	(g)
Senegal	274	0.23	0.006	281	(g)
South Africa	294	0.43	0.013	308	(g)
Sudan	157	0.13	0.003	161	(g)
Tanzania	82	0.20	0.002	88	(g)
Togo	73	0.06	0.002	75	(g)
Tunisia	212	0.51	0.003	225	(g)
Zambia	1.3	0.00	0.000	1.3	(g)
Zimbabwe	142	0.21	0.006	149	(g)
Other Africa	*187*	*0.18*	*0.004*	*192*	(g)
Asia					
Armenia	41	0.11	0.001	44	(g)
Azerbaijan	179	0.46	0.003	192	(g)
Bahrain	205	0.54	0.003	219	(g)
Bangladesh	201	0.51	0.003	215	(g)
Brunei	204	0.54	0.003	218	(g)
Cambodia	295	0.24	0.005	302	(g)
China (PR)	242	0.59	0.010	259	(g)
Georgia	26	0.07	0.000	28	(g)
Hong Kong	268	0.67	0.010	287	(g)
India	261	0.57	0.011	279	(g)
Indonesia	256	0.21	0.006	263	(g)
Iran	224	0.45	0.004	237	(g)
Iraq	286	0.23	0.005	294	(g)
Israel	303	0.48	0.012	319	(g)
Japan	138	0.21	0.006	145	(g)

	GHG emission coefficient				Source
	gCO_2/MJ	gCH_4/MJ	gN_2O/MJ	gCO_{2-eq}/MJ	
Jordan	215	0.50	0.003	229	(g)
Kazakhstan	286	0.93	0.011	313	(g)
Korea North	122	0.26	0.005	130	(g)
Korea South	209	0.31	0.008	220	(g)
Kuwait	279	0.33	0.005	289	(g)
Kyrgyzstan	24	0.07	0.001	26	(g)
Lebanon	293	0.24	0.005	300	(g)
Malaysia	232	0.56	0.007	248	(g)
Mongolia	341	0.09	0.009	346	(g)
Myanmar	65	0.12	0.001	68	(g)
Nepal	1.6	0.00	0.000	1.7	(g)
Oman	223	0.49	0.004	237	(g)
Pakistan	174	0.25	0.003	181	(g)
Philippines	179	0.39	0.006	190	(g)
Qatar	205	0.54	0.003	219	(g)
Saudi-Arabia	262	0.38	0.004	273	(g)
Singapore	222	0.49	0.004	235	(g)
Sri Lanka	182	0.15	0.003	187	(g)
Syria	247	0.37	0.004	258	(g)
Taiwan	214	0.48	0.007	228	(g)
Tajikistan	4.2	0.01	0.000	4.6	(g)
Thailand	209	0.46	0.007	222	(g)
Turkey	155	0.25	0.004	163	(g)
Turkmenistan	203	0.54	0.003	217	(g)
United Arab Emirates	206	0.53	0.003	221	(g)
Uzbekistan	171	0.41	0.003	182	(g)
Vietnam	147	0.37	0.004	157	(g)
Yemen	309	0.25	0.005	317	(g)
Other Asia	*98*	*0.10*	*0.002*	*101*	(g)
Australia/Oceania					
Australia	282	0.28	0.011	292	(g)
New Zealand	63	0.13	0.002	67	(g)
North America					
Canada	64	0.05	0.002	66	(g)

	GHG emission coefficient				Source
	gCO_2/MJ	gCH_4/MJ	gN_2O/MJ	$gCO_{2\text{-eq}}$/MJ	
USA	188	0.26	0.008	196	(g)
South and Central America					
Argentina	84	0.17	0.002	89	(g)
Bolivia	108	0.28	0.002	115	(g)
Brazil	23	0.03	0.003	25	(g)
Chile	139	0.09	0.008	144	(g)
Colombia	61	0.11	0.002	64	(g)
Costa Rica	15	0.01	0.001	15	(g)
Cuba	283	0.28	0.006	292	(g)
Dominican Republic	264	0.24	0.006	272	(g)
Ecuador	126	0.13	0.003	130	(g)
El Salvador	133	0.11	0.004	137	(g)
Guatemala	133	0.09	0.021	141	(g)
Haiti	216	0.18	0.004	222	(g)
Honduras	166	0.14	0.004	170	(g)
Jamaica	297	0.24	0.006	305	(g)
Mexico	197	0.35	0.005	208	(g)
Netherlands Antilles	309	0.25	0.005	317	(g)
Nicaragua	212	0.17	0.009	219	(g)
Panama	130	0.11	0.002	134	(g)
Paraguay	0.4	0.00	0.000	0.4	(g)
Peru	87	0.19	0.002	92	(g)
Trinidad and Tobago	204	0.54	0.003	219	(g)
Uruguay	94	0.08	0.006	98	(g)
Venezuela	62	0.10	0.001	65	(g)
Other South and Central America	283	0.27	0.005	292	(g)

Data sources:

(g) Calculation by IFEU (see text in chapter 4)

General remark: global warming potential factors were taken from IPCC (2007);
i.e.: 25 for methane, 298 for nitrous oxide
(please note that the emission factor coefficients in the table are rounded)

A more detailed description of the IFEU electricity grid model respecting the specific settings, assumptions and background data can be found in IFEU (2011).[9]

[9] http://www.ifeu.de/industrieundemissionen/pdf/Documentation%20Electricity%20Mix%20IFEU%20Version10_2011.pdf

5 Solid biomass sources for energy

In some cases biofuel production processes can be fuelled by solid or other biomass which is not a process residue or co-product of the process. Commission's report COM(2010)11 is considered as an appropriate source to define standard values for such types of solid biomass. Table 4 contains a number of data recommended as additional standard values selected from that report. The selection refers to "typical values" and focuses on wood chips and pellets. Furthermore the classification of the pathways is adapted to correspond to the situation of a process fuel. Thus figures for "tropical/subtropical" are assumed to be appropriate as proxy for overseas origin in general.

Fundamental relevant information about GHG emissions from wood fuel pathways is provided by Hagberg et al. (2009), who shows comparable values.

Table 4 Additional standard values for solid biomass sources for energy

	GHG emission coefficient	Source
Solid Biomass as fuel	$gCO_{2\text{-}eq}$/MJ	
Wood chips		
- from forest residues, domestic use	1	(h)
- from SRF, domestic use	3	(h)
- from forest residues, overseas origin	21	(h)
- from short rotation forestry, overseas origin	24	(h)
Wood pellets (or briquettes)		
- from forest residues, domestic use, process fuel: wood	2	(h)
- from forest residues, domestic use, process fuel: nat. gas	17	(h)
- from SRF, domestic use, process fuel: wood	4	(h)
- from SRF, domestic use, process fuel: nat. gas	19	(h)
- from forest residues, overseas origin, process fuel: wood	15	(h)
- from forest residues, overseas origin, process fuel: nat. gas	30	(h)
- from SRF, overseas origin, process fuel: wood	18	(h)
- no further specification	33	according to (h)

Data sources:

(h) COM(2010)11: Report from the Commission to the Council and the European Parliament on sustainability requirements for the use of solid and gaseous biomass sources in electricity, heating and cooling; - Annex II; Brussels 2010
http://ec.europa.eu/energy/renewables/transparency_platform/doc/2010_report/com_2010_0011_3_report.pdf

SRF: Short rotation forestry

General remark: COM(2010)11 does not disclose the disaggregated GHG gases (CO_2, CH_4, N_2O); therefore the respective Excel file (http://www.biograce.net/content/ghgcalculationtools/additionalstandardvalues) contains only CO_2eq values.

6 Transport efficiencies

The **BioGrace list of standard values** includes emission factors for diverse transport means which should cover the majority of transport processes. In some countries liquid biofuels could transported via pipeline. Ecoinvent is providing a useful factor related on ton kilometre (tkm).

Table 6: Additional standard values for transport efficiencies

	GHG emission coefficient	Source
	$gCO_{2\text{-}eq}$/tkm	
Pipeline		
pipeline (oil), onshore	15.74	(i)

Data sources:

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