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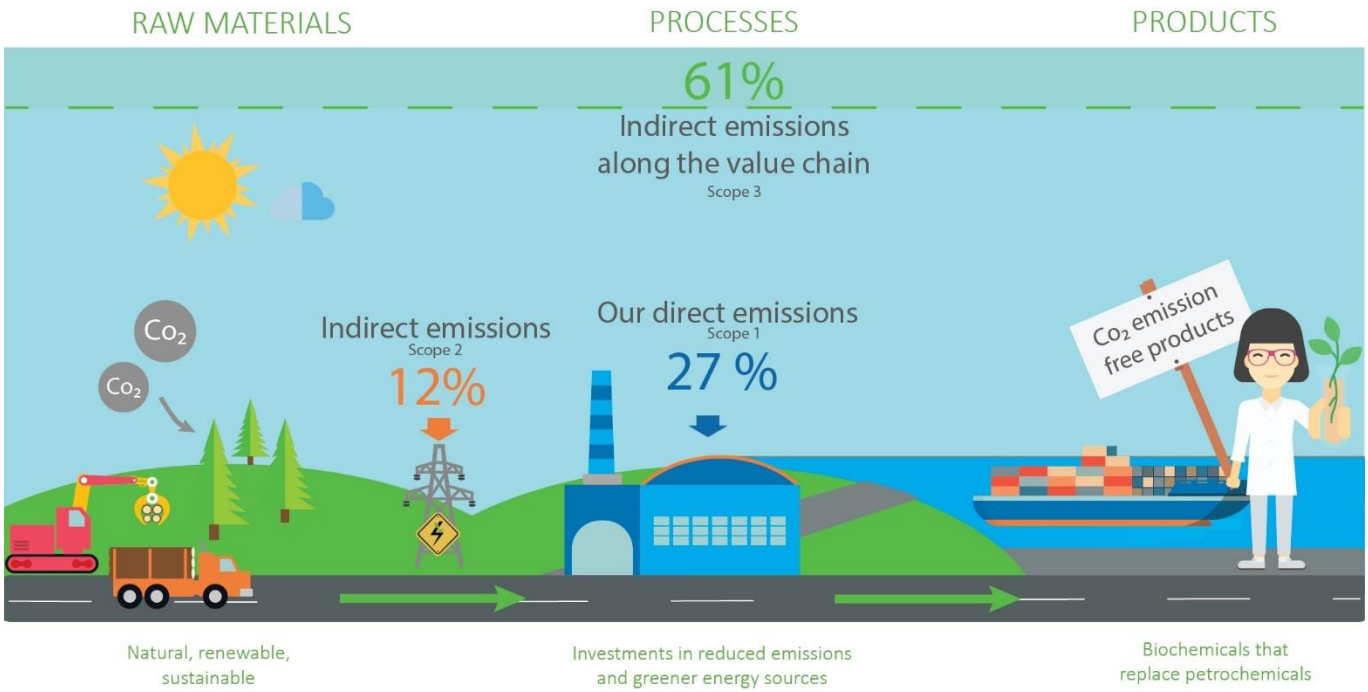
GHG protocol Scope 3 reporting – Borregaard 2019



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Sample Scope 3 GHG Inventory Reporting Template

This greenhouse gas reporting has been calculated in alignment with the GHG Protocol Corporate Value Chain (Scope 3) Accounting and Reporting Standard

Part 1: Descriptive information

Descriptive information	Company response
Company name	Borregaard
Description of the company	Borregaard is a biorefinery that produces advanced biochemicals that can replace oil-based products. Borregaard employs 1010 man-years in plants and sales offices in 16 countries throughout Europe, America, Asia and Africa.
Chosen consolidation approach (equity share, operational control or financial control)	Operations under full control of Borregaard are included.
Description of the businesses and operations included in the company's organizational boundary	Operations in Norway, UK, USA, Spain, Czech Republic and Germany are included.
The reporting period covered	01/01/2019 -12/31/2019
A list of scope 3 activities included in the report	Category 1: Purchased goods & services Category 2: Capital goods Category 3: Fuel- and energy-related activities (not incl. in Scope 1 or 2) Category 4: Upstream transportation and distribution Category 5: Waste generated in operations Category 6: Business travel Category 7: Employee commuting Category 9: Downstream transportation and distribution Category 10: Processing of sold products

	Category 11: Use of sold products Category 12: End-of-life treatment of sold products Category 15: Operation of investments
A list of scope 1, scope 2, and scope 3 activities excluded from the report with justification for their exclusion	Category 8 (Upstream leased assets), Category 13 (Downstream leased assets) and Category 14 (Franchises) are excluded because they are not relevant to Borregaard.
The year chosen as base year and rationale for choosing the base year	2017
Once a base year has been established, the chosen base year emissions recalculation policy. If base year emissions have been recalculated, the context for any significant emissions changes that triggered the recalculation.	

Part 2: Greenhouse gas emissions data

Scopes and categories	Metric tons CO_2e
Scope 1: Direct emissions from owned/controlled operations	141 616
Scope 2: Indirect emissions from the use of purchased electricity, steam, heating, and cooling	62 126
Upstream scope 3 emissions	
Category 1: Purchased goods and services	146 122
Category 2: Capital goods	1 756
Category 3: Fuel- and energy-related activities (not included in scope 1 or scope 2)	4 263
Category 4: Upstream transportation and distribution	19 373
Category 5: Waste generated in operations	1 867
Category 6: Business travel	1 970
Category 7: Employee commuting	864
Category 8: Upstream leased assets	-
Other	-
Downstream scope 3 emissions	
Category 9: Downstream transportation and distribution	38 793
Category 10: Processing of sold products	47 209
Category 11: Use of sold products	0
Category 12: End-of-life treatment of sold products	7 729
Category 13: Downstream leased assets	-
Category 14: Franchises	-
Category 15: Investments	57 805
Other	-

Part 3: Biogenic CO_2 emissions data

Scopes and categories	Metric tons biogenic CO_2
Direct biogenic CO_2 emissions from owned/controlled operations	131 682
Indirect biogenic CO_2 emissions from the use of purchased electricity, steam, heating, and cooling	74 658
Indirect biogenic CO_2 emissions - Upstream	
Purchased goods and services	44 870
Capital goods	100
Fuel- and energy-related activities (not included in scope 1 or scope 2)	9
Upstream transportation and distribution	66
Waste generated in operations	12 501
Business travel	3
Employee commuting	54
Upstream leased assets	-
Other	-
Indirect biogenic CO_2 emissions - Downstream	
Downstream transportation and distribution	181
Processing of sold products	15 860
Use of sold products	112 894
End-of-life treatment of sold products	825 547
Downstream leased assets	-
Franchises	-
Investments	133 129
Other	-

Part 4: Description of methodologies and data used

Scope and category	Description of the types and sources of data used to calculate emissions	Description of the data quality of reported emissions	Description of the methodologies, allocation methods, and assumptions used to calculate emissions	Percentage of emissions calculated using data obtained from suppliers or other value chain partners
Upstream scope 3 emissions				
Category 1: Purchased goods and services	Activity data (primary data) obtained from Borregaard and some suppliers. Secondary data obtained as cradle-to-gate emissions factors from the commercially and publicly available database ecoinvent ver. 3.6 (Wernet et al. 2016).	Good	Hybrid method. For characterization of the GHG emissions and emissions of biogenic CO_2, the Greenhouse Gas Protocol method has been applied (Goedkoop 2010, updated in 2016).	16%
Category 2: Capital goods	Activity data (primary data) obtained from Borregaard. Secondary data obtained as cradle-to-gate emissions	Good	Hybrid method. For characterization of the GHG emissions and emissions of biogenic CO_2, the Greenhouse Gas Protocol method has	0%

	factors from the commercially and publicly available database ecoinvent ver. 3.6 (Wernet et al., 2016).		been applied (Goedkoop 2010, updated in 2016).	
Category 3: Fuel- and energy-related activities (not included in scope 1 or scope 2)	Activity data (primary data) obtained from Borregaard. Secondary data for fuels obtained as cradle-to-gate emissions factors, not included in Scope 1 and 2, from the commercially and publicly available database ecoinvent ver. 3.6 (Wernet et al. 2016).	Good	Hybrid method. For characterization of the GHG emissions and emissions of biogenic CO_2, the Greenhouse Gas Protocol method has been applied (Goedkoop 2010, updated in 2016).	0%
Category 4: Upstream transportation and distribution	Activity data (primary data) obtained from Borregaard. Secondary data (emissions factors) obtained from the commercially and publicly available database ecoinvent ver. 3.6 (Wernet et al. 2016).	Good	Hybrid method. Assume that road transport is performed by lorry Euro V. This class is the most dominant in Norway (2016). For characterization of the GHG emissions and emissions of biogenic CO_2, the Greenhouse Gas	75%

			Protocol method has been applied (Goedkoop 2010, updated in 2016).	
Category 5: Waste generated in operations	Activity data (primary data) obtained from Borregaard. Secondary data obtained from the commercially and publicly available database ecoinvent ver. 3.6 (Wernet et al. 2016).	Good	Hybrid method. For characterization of the GHG emissions and emissions of biogenic CO_2, the Greenhouse Gas Protocol method has been applied (Goedkoop 2010, updated in 2016).	0%
Category 6: Business travel	Activity data (number of business travels and km travelled) obtained from Borregaard. Emissions factors (secondary data) obtained from the publicly available emissions factors from (DEFRA, 2017) and from Brekke et al. (2018).	Good	Only air travels and hotel nights are included. Information on air travel is a mix between information on distances and calculated CO_2/passenger km. Emissions factor for hotel night: 10.1 kg CO_2-eq/night (Brekke et al. 2018). For characterization of the GHG emissions and emissions of biogenic CO_2, the Greenhouse Gas Protocol method has been applied	0%

			(Goedkoop 2010, updated in 2016).	
Category 7: Employee commuting	Number of employees and postal address obtained from Borregaard. National statistic on work travel habits assumed to be relevant for Borregaard Norway (Hjorthol et al. 2014). Emissions factors for commuting by car, is based on the average Norwegian passenger in 2018 (SSB, 2018). Emissions factors (secondary data) obtained from the commercially and publicly available database ecoinvent ver. 3.6 (Wernet et al. 2016).	Good	Combination of distance from home of employees to Borregaard Sarpsborg and national statics on work travel habits, were the basis for calculation of person km (pkm) travelled by different modes of transport: on feet (0 g CO_2-eq/pkm), bike (0 g CO_2-eq/pkm), car (190 g CO_2-eq/pkm), bus (90 g CO_2-eq/pkm), train (1.75 g CO_2-eq/pkm), and air (109 g CO_2-eq/pkm). For characterization of the GHG emissions and emissions of biogenic CO_2, the Greenhouse Gas Protocol method has been applied (Goedkoop 2010, updated in 2016).	0%
Category 8: Upstream leased assets	-			
Other	-			

Part 4: Description of scope 3 methodologies and data used (continued)

Scope and category	Description of the types and sources of data used to calculate emissions	Description of the data quality of reported emissions	Description of the methodologies, allocation methods, and assumptions used to calculate emissions	Percentage of emissions calculated using data obtained from suppliers or other value chain partners
Downstream scope 3 emissions				
Category 9: Downstream transportation and distribution	Modes of transport for each product and amount of product obtained from Borregaard. Transport distances not available. Emissions factors (secondary data) obtained from the commercially and publicly available database ecoinvent ver. 3.6 (Wernet et al. 2016).	Fair	Because actual transport distances lacked, 1000 km of transport is used (as in EPD developed for Borregaard). Due to lack of data, category 9 includes only transport of eight out of nine products. For characterization of the GHG emissions and emissions of biogenic CO_2, the Greenhouse Gas Protocol method has been applied (Goedkoop 2010, updated in 2016).	0%
Category 10: Processing of sold products	Data on amount of sold products obtained from	Fair	For several of the products, there is no processing, or the	14%

	Borregaard. Emissions factors (secondary data) obtained from the commercially and publicly available database ecoinvent ver. 3.6 (Wernet et al. 2016).		processing is marginal. The two largest products are cellulose and lignin. Lignin is mostly used in construction, and energy consumed during mixing with cement is used. For cellulose, it is assumed that 1/4 of the sold cellulose goes into viscose production, half in China and half in Spain. For the rest, it is assumed that dispersing of cellulose consumes the same amount of energy as dispersing of microfibrillated cellulose. For sodium hypochlorite it is assumed that processing includes energy for mixing with water for disinfectant purposes. For characterization of the GHG emissions and emissions of biogenic CO_2, the Greenhouse Gas	

			Protocol method has been applied (Goedkoop 2010, updated in 2016).	
Category 11: Use of sold products	Data on amounts of sold products obtained from Borregaard.	Good	There are no direct emissions in the use phase of all products except ethanol, alvamix and bark which are combusted and lead to emissions of biogenic CO_2. The amount of biogenic CO_2 is calculated based on carbon content of the products multiplied with the molecular weight ratio carbon to CO_2. For characterization of the GHG emissions and emissions of biogenic CO_2, the Greenhouse Gas Protocol method has been applied (Goedkoop 2010, updated in 2016).	0%
Category 12: End-of-life treatment of sold products	Specific information on carbon content and amount of sold products obtained from Borregaard.	Good	Due to biological origin, the sold products are assumed to not cause emissions of GHG in end-of-life	0%

	Sodium hypochlorite and hydrochloric acid are treated as hazardous waste at end of life. Data on the amount of sodium hypochlorite and hydrochloric acid are given by Borregaard. Emissions factors (secondary data) obtained from the commercially and publicly available database ecoinvent ver. 3.6 (Wernet et al. 2016).		treatment. Emissions of biogenic CO_2 from end-of-life treatment calculated based on carbon content of sold products multiplied with the molecular weight ratio carbon to CO_2. For characterization of the GHG emissions and emissions of biogenic CO_2, the Greenhouse Gas Protocol method has been applied (Goedkoop 2010, updated in 2016).	
Category 13: Downstream leased assets	-			
Category 14: Franchises	-			
Category 15: Investments	Activity data (primary data) obtained from Borregaard. Emissions factors (secondary data) obtained from the commercially and publicly available database ecoinvent	Good	Borregaard has a 50% interest in Umkomaas Ligning Ltd. In South-Africa, and accounts proportionally for emissions from the joint venture. In addition to input of energy, input of lignin is also included.	0%

	ver. 3.6 (Wernet et al. 2016), except from emissions due to consumption of fuel oil, which was provided by Borregaard.		For characterization of the GHG emissions and emissions of biogenic CO_2, the Greenhouse Gas Protocol method has been applied (Goedkoop 2010, updated in 2016).	
Other				

Part 5: Greenhouse gas emissions in the base year

Please state your base year emissions here. If base year emissions were recalculated, note the year the recalculation occurred

Scopes and categories[1]	Metric tons CO_2e
Scope 1: Direct emissions from owned/controlled operations	128 414
Scope 2: Indirect emissions from the use of purchased electricity, steam, heating, and cooling	58 213
Upstream scope 3 emissions	
Category 1: Purchased goods and services	150 405
Category 2: Capital goods	1 797
Category 3: Fuel- and energy-related activities (not included in scope 1 or scope 2)	7 279
Category 4: Upstream transportation and distribution	13 875
Category 5: Waste generated in operations	786
Category 6: Business travel	1 175
Category 7: Employee commuting	1 104
Category 8: Upstream leased assets	-
Other	-
Downstream scope 3 emissions	
Category 9: Downstream transportation and distribution	34 851
Category 10: Processing of sold products	56 102
Category 11: Use of sold products	0
Category 12: End-of-life treatment of sold products	8686
Category 13: Downstream leased assets	-
Category 14: Franchises	-
Category 15: Investments[2]	58 899
Other	-

[1] Further disaggregation of certain categories may be necessary. Additionally, if categorization of scope 3 activities is not followed as prescribed in the standard, indicate where they are included.

[2] If the reporting company is an initial sponsor or lender of a project, also account for the projected lifetime emissions of relevant projects financed during the reporting year and report those emissions separately from scope 3.

Part 6: Optional Information

Method

Name Greenhouse Gas Protocol V1.02

Table 1 and 2 give the characterization factors used in this reporting, fossil and biogenic CO_2 respectively.

Table 1 Characterization factors for substances contributing to emissions of fossil CO2-equivalents. The unit is kg CO2-eq./kg substance.

Substances	Characterization factor
(E)-1-Chloro-3,3,3-trifluoroprop-1-ene	1
(E)-1,2,3,3,3-Pentafluoroprop-1-ene	0.079
(Perfluorobutyl)ethylene	0.136
(Perfluoroctyl)ethylene	0.0929
(Perfluorohexyl)ethylene	0.108
(Z)-1,1,1,4,4,4-Hexafluorobut-2-ene	2
(Z)-1,2,3,3,3-Pentafluoroprop-1-ene	0.233
(Z)-1,3,3,3-Tetrafluoroprop-1-ene	0.285
1-Propanol, 3,3,3-trifluoro-2,2-bis(trifluoromethyl)-, HFE-7100	421
1-Propanol, i-3,3,3-trifluoro-2,2-bis(trifluoromethyl)-, i-HFE-7100	407
1-Propanol, n-3,3,3-trifluoro-2,2-bis(trifluoromethyl)-, n-HFE-7100	486
1-Undecanol, 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,11-nonadecafluoro-	0.188
1,1,1,3,3,3-Hexafluoropropan-2-ol	182
1,2,2-Trichloro-1,1-difluoroethane	59
2,3,3,3-Tetrafluoropropene	0.352
Acetate, 1,1-difluoroethyl 2,2,2-trifluoro-	31
Acetate, 2,2,2-trifluoroethyl 2,2,2-trifluoro-	7

Acetate, difluoromethyl 2,2,2-trifluoro-	27
Acetate, methyl 2,2-difluoro-	3
Acetate, methyl 2,2,2-trifluoro-	52
Acetate, perfluorobutyl-	2
Acetate, perfluoroethyl-	2
Acetate, perfluoropropyl-	2
Acetate, trifluoromethyl-	2
Butane, 1,1,1,2,2,3,3,4,4-nonafluoro-, HFC-329p	2360
Butane, 1,1,1,3,3-pentafluoro-, HFC-365mfc	804
Butane, perfluoro-	9200
Butane, perfluorocyclo-, PFC-318	9540
Butanol, 2,2,3,3,4,4,4-heptafluoro-	34
Butanol, 2,2,3,3,4,4,4-heptafluoro-1-	16
Butanol, 2,2,3,4,4,4-hexafluoro-1-	17
Carbon dioxide	1
Carbon dioxide, fossil	1
Carbon dioxide, land transformation	1
Chloroform	16
Cis-perfluorodecalin	7240
Decane, 1,1,...,15,15-eicosafluoro-2,5,8,11,14-Pentaoxapenta-	3630
Decane, 1,1,3,3,4,4,6,6,7,7,9,9,10,10,12,12-hexadecafluoro-2,5,8,11-tetraoxado-	2850
Decane, 1,1,3,3,5,5,7,7,8,8,10,10-dodecafluoro-2,4,6,9-tetraoxa-	3890
Decane, 1,1,3,3,5,5,7,7,9,9-decafluoro-2,4,6,8-tetraoxanonane-	7330
Decane, 3,3,4,4,6,6,7,7,9,9,10,10-dodecafluoro-2,5,8,11-tetraoxado-	221
Dinitrogen monoxide	265
EPTE-furan	56
Ethane, 1-(difluoromethoxy)-1,1,2,2-tetrafluoro-	4240

Ethane, 1-chloro-1,1-difluoro-, HCFC-142b	1980
Ethane, 1-chloro-2,2,2-trifluoro-(difluoromethoxy)-, HCFE-235da2	491
Ethane, 1-ethoxy-1,1,2,2,2-pentafluoro-	58
Ethane, 1,1'-oxybis[2-(difluoromethoxy)-1,1,2,2-tetrafluoro-	4920
Ethane, 1,1-dichloro-1-fluoro-, HCFC-141b	782
Ethane, 1,1-dichloro-1,2-difluoro-, HCFC-132c	338
Ethane, 1,1-difluoro-, HFC-152a	138
Ethane, 1,1,1-trichloro-, HCFC-140	160
Ethane, 1,1,1-trifluoro-, HFC-143a	4800
Ethane, 1,1,1-trifluoro-2-bromo-	173
Ethane, 1,1,1,2-tetrafluoro-, HFC-134a	1300
Ethane, 1,1,1,2-tetrafluoro-2-bromo-, Halon 2401	184
Ethane, 1,1,2-trichloro-1,2-difluoro-, HCFC-122a	258
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-, CFC-113	5820
Ethane, 1,1,2-trifluoro-, HFC-143	328
Ethane, 1,1,2,2-tetrafluoro-, HFC-134	1120
Ethane, 1,1,2,2-tetrafluoro-1-(fluoromethoxy)-	871
Ethane, 1,1,2,2-tetrafluoro-1-methoxy-2-(1,1,2,2-tetrafluoro-2-methoxyethoxy)-	236
Ethane, 1,1,2,2-tetrafluoro-1,2-dimethoxy-	222
Ethane, 1,2-dibromotetrafluoro-, Halon 2402	1470
Ethane, 1,2-dichloro-	0.898
Ethane, 1,2-dichloro-1,1,2-trifluoro-, HCFC-123a	370
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-, CFC-114	8590
Ethane, 1,2-difluoro-, HFC-152	16
Ethane, 2-chloro-1,1,1,2-tetrafluoro-, HCFC-124	527
Ethane, 2-chloro-1,1,2-trifluoro-1-methoxy-	122
Ethane, 2,2-dichloro-1,1,1-trifluoro-, HCFC-123	79

Ethane, chloropentafluoro-, CFC-115	7670
Ethane, fluoro-, HFC-161	4
Ethane, hexafluoro-, HFC-116	11100
Ethane, pentafluoro-, HFC-125	3170
Ethanol, 2-fluoro-	0.88
Ethanol, 2,2-difluoro-	3
Ethanol, 2,2,2-trifluoro-	20
Ethene, 1,1-difluoro-, HFC-1132a	0.0422
Ethene, 1,1,2-trifluoro-2-(trifluoromethoxy)-	0.209
Ether, 1,1,1-trifluoromethyl methyl-, HFE-143a	523
Ether, 1,1,2,2-Tetrafluoroethyl 2,2,2-trifluoroethyl-, HFE-347mcf2	854
Ether, 1,1,2,2-Tetrafluoroethyl 2,2,2-trifluoroethyl-, HFE-347pcf2	889
Ether, 1,1,2,2-Tetrafluoroethyl methyl-, HFE-254cb2	301
Ether, 1,1,2,3,3,3-Hexafluoropropyl methyl-, HFE-356mec3	387
Ether, 1,1,2,3,3,3-Hexafluoropropyl methyl-, HFE-356pcc3	413
Ether, 1,1,2,3,3,3-Hexafluoropropyl methyl-, HFE-356pcf2	719
Ether, 1,1,2,3,3,3-Hexafluoropropyl methyl-, HFE-356pcf3	446
Ether, 1,2,2-trifluoroethyl trifluoromethyl-, HFE-236ea2	1240
Ether, 1,2,2-trifluoroethyl trifluoromethyl-, HFE-236fa	979
Ether, 2-chloro-1,1,2-trifluoroethyl difluoromethyl-, HCFE-235ca2 (enflurane)	583
Ether, 2,2,3,3,3-Pentafluoropropyl methyl-, HFE-365mcf3	0.928
Ether, bis(2,2,2-trifluoroethyl)-	17
Ether, di(difluoromethyl), HFE-134	5560
Ether, difluoromethyl 1,2,2,2-tetrafluoroethyl-, HFE-236ea2 (desflurane)	1790
Ether, difluoromethyl 2,2,2-trifluoroethyl-, HFE-245cb2	654
Ether, difluoromethyl 2,2,2-trifluoroethyl-, HFE-245fa1	828
Ether, difluoromethyl 2,2,2-trifluoroethyl-, HFE-245fa2	812
Ether, ethyl 1,1,2,2-tetrafluoroethyl-, HFE-374pc2	627

Ether, ethyl trifluoromethyl-, HFE-263m1	29
Ether, i-nonafluorobutane ethyl-, HFE569sf2 (i-HFE-7200)	44
Ether, n-nonafluorobutane ethyl-, HFE569sf2 (n-HFE-7200)	65
Ether, nonafluorobutane ethyl-, HFE569sf2 (HFE-7200)	57
Ether, pentafluoromethyl-, HFE-125	12400
Fluoridate, 1,1-difluoroethyl carbono-	27
Fluoridate, methyl carbono-	95
Fluoroxene	0.0542
Formate, 1,1,1,3,3,3-hexafluoropropan-2-yl-	333
Formate, 1,2,2,2-tetrafluoroethyl-	470
Formate, 2,2,2-trifluoroethyl-	33
Formate, 3,3,3-trifluoropropyl-	17
Formate, perfluorobutyl-	392
Formate, perfluoroethyl-	580
Formate, perfluoropropyl-	376
Formate, trifluoromethyl-	588
Halothane	41
Heptanol, 3,3,4,4,5,5,6,6,7,7,7-undecafluoro-	0.426
Hexane, perfluoro-	7910
HFE-227EA	6450
HFE-236ca12 (HG-10)	5350
HFE-263fb2	1
HFE-329mcc2	3070
HFE-338mcf2	929
HFE-338pcc13 (HG-01)	2910
HFE-43-10pccc124 (H-Galden1040x)	2820
HG-02	2730
HG-03	2850

Methane	30.5
Methane, (difluoromethoxy)((difluoromethoxy)difluoromethoxy)difluoro-	5300
Methane, bromo-, Halon 1001	2
Methane, bromochlorodifluoro-, Halon 1211	1750
Methane, bromodifluoro-, Halon 1201	376
Methane, bromotrifluoro-, Halon 1301	6290
Methane, chlorodifluoro-, HCFC-22	1760
Methane, chlorotrifluoro-, CFC-13	13900
Methane, dibromo-	1
Methane, dibromodifluoro-, Halon 1202	231
Methane, dichloro-, HCC-30	9
Methane, dichlorodifluoro-, CFC-12	10200
Methane, dichlorofluoro-, HCFC-21	148
Methane, difluoro-, HFC-32	677
Methane, difluoro(fluoromethoxy)-	617
Methane, difluoro(methoxy)-	144
Methane, fluoro-, HFC-41	116
Methane, fluoro(fluoromethoxy)-	130
Methane, fluoro(methoxy)-	13
Methane, fossil	30.5
Methane, land transformation	30.5
Methane, monochloro-, R-40	12
Methane, tetrachloro-, CFC-10	1730
Methane, tetrafluoro-, CFC-14	6630
Methane, trichlorofluoro-, CFC-11	4660
Methane, trifluoro-, HFC-23	12400
Methane, trifluoro(fluoromethoxy)-	751
Methyl perfluoroisopropyl ether	363

Nitrogen fluoride	16100
Nonanol, 3,3,4,4,5,5,6,6,7,7,8,8,9,9,9-pentadecafluoro-	0.327
Octa deca fluoro octane	7620
Pentafluorobutene-1	0.126
Pentane, 2,3-dihydroperfluoro-, HFC-4310mee	1650
Pentane, perfluoro-	8550
Pentanol, 2,2,3,3,4,4,5,5-octafluorocyclo-	13
Pentanone, 1,1,1,2,2,4,5,5,5-nonafluoro-4-(trifluoromethyl)-3-	0.0997
Perfluorobut-1-ene	0.0914
Perfluorobut-2-ene	2
Perfluorobuta-1,3-diene	0.00359
Perfluorocyclopentene	2
Perfluorodecalin (mixed)	7190
Perfluorodecalin (trans)	6290
Perfluoroheptane	7820
Perfluoropropene	0.07
PFPMIE	9710
Propanal, 3,3,3-trifluoro-	0.0108
Propane, 1-ethoxy-1,1,2,2,3,3,3-heptafluoro	61
Propane, 1-ethoxy-1,1,2,3,3,3-hexafluoro-	23
Propane, 1,1,1-trifluoro-, HFC-263fb	76
Propane, 1,1,1,2,2-pentafluoro-, HFC-245cb	4620
Propane, 1,1,1,2,2,3-hexafluoro-, HFC-236cb	1210
Propane, 1,1,1,2,2,3,3-heptafluoro-, HFC-227ca	2640
Propane, 1,1,1,2,2,3,3-heptafluoro-3-(1,2,2,2-tetrafluoroethoxy)-	6490
Propane, 1,1,1,2,3-pentafluoro-, HFC-245eb	290
Propane, 1,1,1,2,3,3-hexafluoro-, HFC-236ea	1330
Propane, 1,1,1,2,3,3-hexafluoro-3-(trifluoromethoxy)-, HFE-329me3	4550

Propane, 1,1,1,2,3,3,3-heptafluoro-, HFC-227ea	3350
Propane, 1,1,1,3,3-pentafluoro-, HFC-245fa	858
Propane, 1,1,1,3,3,3-hexafluoro-, HCFC-236fa	8060
Propane, 1,1,1,3,3,3-Hexafluoro-2-(difluoromethoxy)	2620
Propane, 1,1,1,3,3,3-hexafluoro-2-(fluoromethoxy)-	216
Propane, 1,1,1,3,3,3-hexafluoro-2-methoxy-(9CI)	14
Propane, 1,1,2,2-tetrafluoro-3-methoxy-	0.525
Propane, 1,1,2,2,3-pentafluoro-, HFC-245ca	716
Propane, 1,1,2,3,3-pentafluoro-, HFC-245ea	235
Propane, 1,3-dichloro-1,1,2,2,3-pentafluoro-, HCFC-225cb	525
Propane, 2,2-difluoro-, HFC-272ca	144
Propane, 3,3-dichloro-1,1,1,2,2-pentafluoro-, HCFC-225ca	127
Propane, perfluoro-	8900
Propane, perfluorocyclo-	9200
Propane,1,1,1,2,2,3,3-heptafluoro-3-methoxy-, HFE-347mcc3 (HFE-7000)	530
Propanol, 2,2,3,3-tetrafluoro-1-	13
Propanol, 3,3,3-trifluoro-1-	0.39
Propanol, pentafluoro-1-	19
Sulfur hexafluoride	23500
Sulfuryl fluoride	4090
Tetrafluoroethylene	0.00292
trans-1,3,3,3-Tetrafluoropropene	0.953
Trifluorobutanol	0.0189
Trifluoroethyl acetate	1
Trifluoromethylsulfur pentafluoride	17400
Trifluoropropene, HFC-1243zf	0.149
Vinylfluoride	65
Carbon dioxide, to soil or biomass stock	-1

Table 2 Characterization factors for substances contributing to emissions of biogenic CO2-equivalents. The unit is kg CO2-eq./kg substance.

Substances	Characterization factor
Carbon dioxide, biogenic	1

Comment: The Greenhouse Gas Protocol method has been developed especially for the Road Testing process of the WRI/WBCSD, which aims to test the usability of the draft Greenhouse Gas Protocol carbon footprint standards. See http://www.ghgprotocol.org/ for the latest version of the standard.

The characterisation factors per substance are identical to the IPCC 2007 GWP (100a) method in SimaPro. The only difference is that carbon uptake and biogenic carbon emissions are included in this method and that a distinction is made between:

1. Fossil based carbon (carbon originating from fossil fuels)
2. Biogenic carbon (carbon originating from biogenic sources such as plants and trees)
3. Carbon from Land transformation (direct impacts)
4. Carbon uptake (CO2 that is stored in plants and trees as they grow)

The draft standards require fossil and biogenic carbon to be report separately. Reporting of carbon caused by direct land use change is currently defined as optional, depending on the product category while reporting of carbon uptake is not required.

Data Limitations:

Currently only the ecoinvent datasets specify carbon in these four sub categories. If you use other data, eg. from the Input Output libraries, you will not get a correct specification of biogenic carbon, carbon uptake and land use related carbon. This is due to the different data collection strategies used in these libraries. In the process contribution tab in the results section you can see the relative share of the contribution of each process.

Of course you should specify the four sub category emissions in the data you enter your self to obtain a correct split in the results.

Please note that the Road Testing process ends in 2010, and that the current method may not be suitable for the final version of the WRI/WBCSD methods.

Produced: February 2010 by MJ Goedkoop, PRé Consultants bv.

Adaptation (February 2011, v1.01):

- Weighting factor for carbon uptake was changed to -1.

Other adaptations (November 2016, version 1.02):

- Characterisation factors were updated according to IPCC 2013.

- Factors for Methane, Methane, biogenic and Methane, fossil were implemented according to Munoz and Schmidt (2016)*.

Methane, biogenic as 27.75 kg CO2eq/kg CH4 (28 + 2.5 for correction of methane degradation to carbon dioxide - 2.75 for correction of not characterized carbon dioxide uptake)

Methane, fossil and Methane as 30.5 kg CO2eq/kg CH4 (28 + 2.5 for correction of methane degradation to carbon dioxide)

- For substances, which in the IPCC report have a factor "<1", characterization factors from Hodnebrog et al. (2013)** are applied.

- 7 new substances were added: HG-02; HG-03; Ether, i-nonafluorobutane ethyl-, HFE569sf2 (i-HFE-7200); Ether, n-nonafluorobutane ethyl-, HFE569sf2 (n-HFE-7200); 1-Propanol, i-3,3,3-trifluoro-2,2-bis(trifluoromethyl)-, i-HFE-7100; 1-Propanol, n-3,3,3-trifluoro-2,2-bis(trifluoromethyl)-, n-HFE-7100 and Decane, 1,1,...,15,15-eicosafluoro-2,5,8,11,14-Pentaoxapenta- This name is abbreviated, the full name is: Decane, 1,1,3,3,4,4,6,6,7,7,9,9,10,10,12,12,13,13,15,15-eicosafluoro-2,5,8,11,14-Pentaoxapenta-

- Carbon dioxide, to soil or biomass stock (emission to soil) is included due to a change in the modelling of land tenure in ecoinvent.

*Munoz, I. and Schmidt, J.H. (2016), Methane oxidation, biogenic carbon, and the IPCC's emission metrics. Proposal for a consistent greenhouse-gas accounting. The International Journal of Life Cycle Assessment, 21:1069-1075.

**Hodnebrog, Ø., M. Etminan, J. S. Fuglestvedt, G. Marston, G. Myhre, C. J. Nielsen, K. P. Shine, and T. J. Wallington (2013), Global warming potentials and radiative efficiencies of halocarbons and related compounds: A comprehensive review. Rev. Geophys., 51, 300-378, doi:10.1002/rog.20013. Spreadsheet: http://folk.uio.no/oivinho/halocarbonmetrics/

Litterature

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