JICA Climate-FIT
Version 6.0

Appendicies

Table 1 Net Caloric Value of Fuels

TABLE 1.2
DEFAULT NET CALORIFIC VALUES (NCVS) AND LOWER AND UPPER LIMITS OF THE 95% CONFIDENCE INTERVALS [1]

Fuel type English description		Net calorific value (TJ/Gg)	Lower	Upper
Crude Oil		42.3	40.1	44.8
Orimulsion		27.5	27.5	28.3
Natural Gas Liquids		44.2	40.9	46.9
Gasoline	Motor Gasoline	44.3	42.5	44.8
	Aviation Gasoline	44.3	42.5	44.8
	Jet Gasoline	44.3	42.5	44.8
Jet Kerosene		44.1	42.0	45.0
Other Kerosene		43.8	42.4	45.2
Shale Oil		38.1	32.1	45.2
Gas/Diesel Oil		43.0	41.4	43.3
Residual Fuel Oil		40.4	39.8	41.7
Liquefied Petroleum Gases		47.3	44.8	52.2
Ethane		46.4	44.9	48.8
Naphtha		44.5	41.8	46.5
Bitumen		40.2	33.5	41.2
Lubricants		40.2	33.5	42.3
Petroleum Coke		32.5	29.7	41.9
Refinery Feedstocks		43.0	36.3	46.4
Other Oil	Refinery Gas [2]	49.5	47.5	50.6
	Paraffin Waxes	40.2	33.7	48.2
	White Spirit and SBP	40.2	33.7	48.2
	Other Petroleum Products	40.2	33.7	48.2
Anthracite		26.7	21.6	32.2
Coking Coal		28.2	24.0	31.0
Other Bituminous Coal		25.8	19.9	30.5
Sub-Bituminous Coal		18.9	11.5	26.0
Lignite		11.9	5.50	21.6
Oil Shale and Tar Sands		8.9	7.1	11.1
Brown Coal Briquettes		20.7	15.1	32.0
Patent Fuel		20.7	15.1	32.0
Coke	Coke Oven Coke and Lignite Coke	28.2	25.1	30.2
	Gas Coke	28.2	25.1	30.2
Coal Tar [3]		28.0	14.1	55.0
Derived Gases	Gas Works Gas [4]	38.7	19.6	77.0
	Coke Oven Gas [5]	38.7	19.6	77.0
	Blast Furnace Gas [6]	2.47	1.20	5.00
	Oxygen Steel Furnace Gas [7]	7.06	3.80	15.0
Natural Gas		48.0	46.5	50.4
Municipal Wastes (non-biomass fraction)		10	7	18
Industrial Wastes		NA	NA	NA
Waste Oil [8]		40.2	20.3	80.0
Peat		9.76	7.80	12.5

Source: 2006 IPCC Guidelines for National Greenhouse Gas Inventories, IPCC, Volume 2: Energy, Chapter 1: Introduction, Table 1.2

TABLE 1.2 (CONTINUED)
DEFAULT NET CALORIFIC VALUES (NCVS) AND LOWER AND UPPER LIMITS OF THE 95% CONFIDENCE INTERVALS [1]

Fuel type English description		Net calorific value (TJ/Gg)	Lower	Upper
Solid Biofuels	Wood/Wood Waste [9]	15.6	7.90	31.0
	Sulphite lyes (black liquor) [10]	11.8	5.90	23.0
	Other Primary Solid Biomass [11]	11.6	5.90	23.0
	Charcoal [12]	29.5	14.9	58.0
Liquid Biofuels	Biogasoline [13]	27.0	13.6	54.0
	Biodiesels [14]	27.0	13.6	54.0
	Other Liquid Biofuels [15]	27.4	13.8	54.0
Gas Biomass	Landfill Gas [16]	50.4	25.4	100
	Sludge Gas [17]	50.4	25.4	100
	Other Biogas [18]	50.4	25.4	100
Other non-fossil fuels	Municipal Wastes (biomass fraction)	11.6	6.80	18.0

Notes:
[1] The lower and upper limits of the 95 percent confidence intervals, assuming lognormal distributions, fitted to a dataset, based on national inventory reports, IEA data and available national data. A more detailed description is given in section 1.5.
[2] Japanese data; uncertainty range: expert judgement
[3] EFDB; uncertainty range: expert judgement
[4] Coke Oven Gas; uncertainty range: expert judgement
[5-7] Japan and UK small number data; uncertainty range: expert judgement
[8] For waste oils the values of "Lubricants" are taken
[9] EFDB; uncertainty range: expert judgement
[10] Japanese data ; uncertainty range: expert judgement
[11] Solid Biomass; uncertainty range: expert judgement
[12] EFDB; uncertainty range: expert judgement
[13-14] Ethanol theoretical number; uncertainty range: expert judgement;
[15] Liquid Biomass; uncertainty range: expert judgement
[16-18] Methane theoretical number uncertainty range: expert judgement;

Source: 2006 IPCC Guidelines for National Greenhouse Gas Inventories, IPCC, Volume 2: Energy, Chapter 1: Introduction, Table 1.2

Table 2 CO_2 Emission Factors of Fuels

TABLE 1.4
DEFAULT CO_2 EMISSION FACTORS FOR COMBUSTION [1]

Fuel type English description		Default carbon content (kg/GJ)	Default carbon oxidation factor	Effective CO_2 emission factor (kg/TJ) [2]		
				Default value [3]	95% confidence interval	
					Lower	Upper
		A	B	C=A*B*44/12*1000		
Crude Oil		20.0	1	73 300	71 100	75 500
Orimulsion		21.0	1	77 000	69 300	85 400
Natural Gas Liquids		17.5	1	64 200	58 300	70 400
Gasoline	Motor Gasoline	18.9	1	69 300	67 500	73 000
Gasoline	Aviation Gasoline	19.1	1	70 000	67 500	73 000
Gasoline	Jet Gasoline	19.1	1	70 000	67 500	73 000
Jet Kerosene		19.5	1	71 500	69 700	74 400
Other Kerosene		19.6	1	71 900	70 800	73 700
Shale Oil		20.0	1	73 300	67 800	79 200
Gas/Diesel Oil		20.2	1	74 100	72 600	74 800
Residual Fuel Oil		21.1	1	77 400	75 500	78 800
Liquefied Petroleum Gases		17.2	1	63 100	61 600	65 600
Ethane		16.8	1	61 600	56 500	68 600
Naphtha		20.0	1	73 300	69 300	76 300
Bitumen		22.0	1	80 700	73 000	89 900
Lubricants		20.0	1	73 300	71 900	75 200
Petroleum Coke		26.6	1	97 500	82 900	115 000
Refinery Feedstocks		20.0	1	73 300	68 900	76 600
Other Oil	Refinery Gas	15.7	1	57 600	48 200	69 000
Other Oil	Paraffin Waxes	20.0	1	73 300	72 200	74 400
Other Oil	White Spirit & SBP	20.0	1	73 300	72 200	74 400
Other Petroleum Products		20.0	1	73 300	72 200	74 400
Anthracite		26.8	1	98 300	94 600	101 000
Coking Coal		25.8	1	94 600	87 300	101 000
Other Bituminous Coal		25.8	1	94 600	89 500	99 700
Sub-Bituminous Coal		26.2	1	96 100	92 800	100 000
Lignite		27.6	1	101 000	90 900	115 000
Oil Shale and Tar Sands		29.1	1	107 000	90 200	125 000
Brown Coal Briquettes		26.6	1	97 500	87 300	109 000
Patent Fuel		26.6	1	97 500	87 300	109 000
Coke	Coke oven coke and lignite Coke	29.2	1	107 000	95 700	119 000
Coke	Gas Coke	29.2	1	107 000	95 700	119 000
Coal Tar		22.0	1	80 700	68 200	95 300
Derived Gases	Gas Works Gas	12.1	1	44 400	37 300	54 100
Derived Gases	Coke Oven Gas	12.1	1	44 400	37 300	54 100
Derived Gases	Blast Furnace Gas [4]	70.8	1	260 000	219 000	308 000
Derived Gases	Oxygen Steel Furnace Gas [5]	49.6	1	182 000	145 000	202 000

Source: 2006 IPCC Guidelines for National Greenhouse Gas Inventories, IPCC, Volume 2: Energy, Chapter 1: Introduction, Table 1.4

TABLE 1.4 (CONTINUED)
DEFAULT CO_2 EMISSION FACTORS FOR COMBUSTION [1]

Fuel type English description		Default carbon content (kg/GJ)	Default carbon oxidation Factor	Effective CO_2 emission factor (kg/TJ) [2]		
				Default value	95% confidence interval	
					Lower	Upper
		A	B	C=A*B*44/ 12*1000		
Natural Gas		15.3	1	56 100	54 300	58 300
Municipal Wastes (non-biomass fraction)		25.0	1	91 700	73 300	121 000
Industrial Wastes		39.0	1	143 000	110 000	183 000
Waste Oil		20.0	1	73 300	72 200	74 400
Peat		28.9	1	106 000	100 000	108 000
Solid Biofuels	Wood/Wood Waste	30.5	1	112 000	95 000	132 000
	Sulphite lyes (black liquor)[5]	26.0	1	95 300	80 700	110 000
	Other Primary Solid Biomass	27.3	1	100 000	84 700	117 000
	Charcoal	30.5	1	112 000	95 000	132 000
Liquid Biofuels	Biogasoline	19.3	1	70 800	59 800	84 300
	Biodiesels	19.3	1	70 800	59 800	84 300
	Other Liquid Biofuels	21.7	1	79 600	67 100	95 300
Gas biomass	Landfill Gas	14.9	1	54 600	46 200	66 000
	Sludge Gas	14.9	1	54 600	46 200	66 000
	Other Biogas	14.9	1	54 600	46 200	66 000
Other non-fossil fuels	Municipal Wastes (biomass fraction)	27.3	1	100 000	84 700	117 000

Notes:

[1] The lower and upper limits of the 95 percent confidence intervals, assuming lognormal distributions, fitted to a dataset, based on national inventory reports, IEA data and available national data. A more detailed description is given in section 1.5

[2] TJ = 1000GJ

[3] The emission factor values for BFG includes carbon dioxide originally contained in this gas as well as that formed due to combustion of this gas.

[4] The emission factor values for OSF includes carbon dioxide originally contained in this gas as well as that formed due to combustion of this gas

[5] Includes the biomass-derived CO_2 emitted from the black liquor combustion unit and the biomass-derived CO_2 emitted from the kraft mill lime kiln.

Source: 2006 IPCC Guidelines for National Greenhouse Gas Inventories, IPCC, Volume 2: Energy, Chapter 1: Introduction, Table 1.4

Appendix

Table 3 Grid Emission Factors

Choose appropriate value of the target country taking into account types of the project such as firm energy (hydro, geothermal etc.), intermittent energy (solar, wind, tidal, etc.), energy efficiency and electricity consumption. In case the updated version of emission factors is provided by IFI TWG (The Technical Working Group of the International Financial Institutions), apply these values.

($t\text{-}CO_2$/MWh)

	Combined Margin Grid Emission Factor				Operating Margin Grid Emission Factor (including for use in PCAF GHG accounting)
	Firm Energy (e.g., Hydro, Geothermal)	Intermittent Energy (e.g., Solar, Wind, Tidal)	Energy Efficiency	Electricity Consumption	
Country / Territory / Island					
Afghanistan	0.193	0.331	0.193	0.193	0.414
Albania	0.000	0.000	0.000	0.000	0.000
Algeria	0.397	0.479	0.397	0.397	0.528
American Samoa (U.S.)	0.516	0.664	0.516	0.516	0.753
Andorra	0.070	0.144	0.070	0.070	0.188
Angola	0.748	1.203	0.748	0.748	1.476
Anguilla (U.K.)	0.472	0.647	0.472	0.472	0.753
Antigua and Barbuda	0.489	0.654	0.489	0.489	0.753
Argentina	0.288	0.407	0.288	0.288	0.478
Armenia	0.205	0.321	0.205	0.205	0.390
Aruba	0.421	0.628	0.421	0.421	0.753
Australia	0.421	0.663	0.421	0.421	0.808
Austria	0.113	0.194	0.113	0.113	0.242
Azerbaijan	0.384	0.478	0.384	0.384	0.534
Azores (Portugal)	0.384	0.614	0.384	0.384	0.753
Bahamas	0.441	0.636	0.441	0.441	0.753
Bahrain	0.454	0.624	0.454	0.454	0.726
Bangladesh	0.412	0.484	0.412	0.412	0.528
Barbados	0.484	0.650	0.484	0.484	0.749
Belarus	0.292	0.359	0.292	0.292	0.400
Belgium	0.124	0.204	0.124	0.124	0.252
Belize	0.183	0.320	0.183	0.183	0.403
Benin	0.576	0.682	0.576	0.576	0.745
Bermuda (U.K.)	0.342	0.598	0.342	0.342	0.753
Bhutan	0.000	0.000	0.000	0.000	0.000
Bolivia, Plurinational State of	0.393	0.525	0.393	0.393	0.604
Bonaire (Netherland)	0.400	0.620	0.400	0.400	0.753
Bosnia and Herzegovina	0.739	1.025	0.739	0.739	1.197
Botswana	1.070	1.330	1.070	1.070	1.486
Brazil	0.150	0.234	0.150	0.150	0.284
British Virgin Islands (U.K.)	0.420	0.628	0.420	0.420	0.753
Brunei Darussalam	0.407	0.578	0.407	0.407	0.681
Bulgaria	0.495	0.755	0.495	0.495	0.911
Burkina Faso	0.539	0.672	0.539	0.539	0.753
Burundi	0.197	0.333	0.197	0.197	0.414
Cambodia	0.588	0.874	0.588	0.588	1.046
Cameroon	0.354	0.545	0.354	0.354	0.659
Canada	0.213	0.312	0.213	0.213	0.372
Canary Islands (Spain)	0.435	0.633	0.435	0.435	0.753
Cape Verde	0.505	0.660	0.505	0.505	0.753
Cayman Islands	0.373	0.610	0.373	0.373	0.753
Central African Republic	0.077	0.146	0.077	0.077	0.188
Chad	0.581	0.688	0.581	0.581	0.753
Channel Islands (U.K)	0.389	0.616	0.389	0.389	0.753
Chile	0.235	0.499	0.235	0.235	0.657
China (PRC and Hong Kong)	0.485	0.744	0.485	0.485	0.899
Colombia	0.208	0.334	0.208	0.208	0.410
Comoros	0.589	0.691	0.589	0.589	0.753

Appendix

	Combined Margin Grid Emission Factor				Operating Margin Grid Emission Factor (including for use in PCAF GHG accounting)
	Firm Energy (e.g., Hydro, Geothermal)	Intermittent Energy (e.g., Solar, Wind, Tidal)	Energy Efficiency	Electricity Consumption	
Congo, Democratic Republic of	0.000	0.000	0.000	0.000	0.000
Congo, Republic of	0.405	0.564	0.405	0.405	0.659
Cook Islands	0.422	0.628	0.422	0.422	0.753
Costa Rica	0.039	0.082	0.039	0.039	0.108
Côte d'Ivoire	0.314	0.409	0.314	0.314	0.466
Croatia	0.168	0.247	0.168	0.168	0.294
Cuba	0.391	0.496	0.391	0.391	0.559
Curacao/Netherlands Antilles	0.506	0.737	0.506	0.506	0.876
Cyprus	0.438	0.633	0.438	0.438	0.751
Czech Republic	0.461	0.736	0.461	0.461	0.902
Denmark	0.155	0.284	0.155	0.155	0.362
Djibouti	0.575	0.686	0.575	0.575	0.753
Dominica	0.433	0.633	0.433	0.433	0.753
Dominican Republic	0.426	0.536	0.426	0.426	0.601
Ecuador	0.280	0.455	0.280	0.280	0.560
Egypt	0.406	0.498	0.406	0.406	0.554
El Salvador	0.275	0.445	0.275	0.275	0.547
Equatorial Guinea	0.361	0.531	0.361	0.361	0.632
Eritrea	0.704	0.836	0.704	0.704	0.915
Estonia	0.625	0.895	0.625	0.625	1.057
Eswatini	0.000	0.000	0.000	0.000	0.000
Ethiopia	0.000	0.000	0.000	0.000	0.000
Falkland Islands (U.K.)	0.316	0.589	0.316	0.316	0.753
Faroe Islands (Denmark)	0.320	0.590	0.320	0.320	0.753
Fiji	0.334	0.525	0.334	0.334	0.640
Finland	0.114	0.209	0.114	0.114	0.267
France	0.068	0.124	0.068	0.068	0.158
French Guiana	0.200	0.340	0.200	0.200	0.423
French Polynesia	0.412	0.625	0.412	0.412	0.753
Gabon	0.533	0.791	0.533	0.533	0.946
Gambia	0.591	0.692	0.591	0.591	0.753
Georgia	0.135	0.231	0.135	0.135	0.289
Germany	0.313	0.523	0.313	0.313	0.650
Ghana	0.276	0.413	0.276	0.276	0.495
Gibraltar (U.K.)	0.369	0.625	0.369	0.369	0.779
Greece	0.346	0.447	0.346	0.346	0.507
Greenland	0.105	0.204	0.105	0.105	0.264
Grenada	0.523	0.666	0.523	0.523	0.753
Guadeloupe (France)	0.433	0.633	0.433	0.433	0.753
Guam	0.428	0.631	0.428	0.428	0.753
Guatemala	0.427	0.659	0.427	0.427	0.798
Guinea	0.460	0.643	0.460	0.460	0.753
Guinea-Bissau	0.577	0.687	0.577	0.577	0.753
Guyana	0.616	0.760	0.616	0.616	0.847
Haiti	0.765	0.942	0.765	0.765	1.048
Honduras	0.359	0.548	0.359	0.359	0.662
Hungary	0.191	0.257	0.191	0.191	0.296
Iceland	0.000	0.000	0.000	0.000	0.000
India	0.608	0.822	0.608	0.608	0.951
Indonesia	0.675	0.743	0.675	0.675	0.783
Iran, Islamic Republic of	0.421	0.528	0.421	0.421	0.592
Iraq	0.788	0.971	0.788	0.788	1.080
Ireland	0.189	0.309	0.189	0.189	0.380
Isle of Man (U.K.)	0.204	0.349	0.204	0.204	0.436
Israel	0.258	0.343	0.258	0.258	0.394
Italy	0.224	0.343	0.224	0.224	0.414

Appendix

	Combined Margin Grid Emission Factor				Operating Margin Grid Emission Factor (including for use in PCAF GHG accounting)
	Firm Energy (e.g., Hydro, Geothermal)	Intermittent Energy (e.g., Solar, Wind, Tidal)	Energy Efficiency	Electricity Consumption	
Jamaica	0.498	0.631	0.498	0.498	0.711
Japan	0.408	0.448	0.408	0.408	0.471
Jordan	0.382	0.474	0.382	0.382	0.529
Kazakhstan	0.532	0.698	0.532	0.532	0.797
Kenya	0.274	0.462	0.274	0.274	0.574
Kiribati	0.530	0.669	0.530	0.530	0.753
Korea (North), Democratic People's Republic of	0.359	0.606	0.359	0.359	0.754
Korea (South), Republic of	0.335	0.473	0.335	0.335	0.555
Kosovo	0.843	1.032	0.843	0.843	1.145
Kuwait	0.400	0.572	0.400	0.400	0.675
Kyrgyzstan	0.098	0.172	0.098	0.098	0.217
Lao People's Democratic Republic	0.555	0.876	0.555	0.555	1.069
Latvia	0.117	0.194	0.117	0.117	0.240
Lebanon	0.567	0.709	0.567	0.567	0.794
Lesotho	0.000	0.000	0.000	0.000	0.000
Liberia	0.374	0.564	0.374	0.374	0.677
Libya	0.493	0.602	0.493	0.493	0.668
Liechtenstein	0.052	0.114	0.052	0.052	0.151
Lithuania	0.102	0.170	0.102	0.102	0.211
Luxembourg	0.095	0.173	0.095	0.095	0.220
Madagascar	0.567	0.760	0.567	0.567	0.876
Madeira (Portugal)	0.369	0.552	0.369	0.369	0.663
Malawi	0.243	0.397	0.243	0.243	0.489
Malaysia	0.436	0.508	0.436	0.436	0.551
Maldives	0.524	0.667	0.524	0.524	0.753
Mali	0.623	0.906	0.623	0.623	1.076
Malta	0.295	0.435	0.295	0.295	0.520
Marshall Islands	0.561	0.681	0.561	0.561	0.753
Martinique (France)	0.406	0.623	0.406	0.406	0.753
Mauritania	0.513	0.663	0.513	0.513	0.753
Mauritius	0.543	0.641	0.543	0.543	0.700
Mayotte (France)	0.512	0.662	0.512	0.512	0.753
Mexico	0.359	0.467	0.359	0.359	0.531
Micronesia	0.557	0.679	0.557	0.557	0.753
Moldova, Republic of	0.399	0.488	0.399	0.399	0.541
Monaco	0.068	0.124	0.068	0.068	0.158
Mongolia	1.002	1.230	1.002	1.002	1.366
Montenegro	0.471	0.739	0.471	0.471	0.899
Montserrat	0.517	0.664	0.517	0.517	0.753
Morocco	0.547	0.660	0.547	0.547	0.729
Mozambique	0.111	0.188	0.111	0.111	0.234
Myanmar	0.407	0.602	0.407	0.407	0.719
Namibia	0.139	0.274	0.139	0.139	0.355
Nauru	0.521	0.666	0.521	0.521	0.753
Nepal	0.000	0.000	0.000	0.000	0.000
Netherlands	0.203	0.280	0.203	0.203	0.326
New Caledonia (France)	0.445	0.654	0.445	0.445	0.779
New Zealand	0.108	0.194	0.108	0.108	0.246
Nicaragua	0.372	0.562	0.372	0.372	0.675
Niger	0.718	0.752	0.718	0.718	0.772
Nigeria	0.358	0.463	0.358	0.358	0.526
Niue	0.459	0.642	0.459	0.459	0.753
North Macedonia, Republic of	0.563	0.743	0.563	0.563	0.851
Northern Mariana Islands (U.S.)	0.416	0.626	0.416	0.416	0.753
Norway	0.017	0.036	0.017	0.017	0.047

Appendix

	Combined Margin Grid Emission Factor				Operating Margin Grid Emission Factor (including for use in PCAF GHG accounting)
	Firm Energy (e.g., Hydro, Geothermal)	Intermittent Energy (e.g., Solar, Wind, Tidal)	Energy Efficiency	Electricity Consumption	
Oman	0.320	0.419	0.320	0.320	0.479
Pakistan	0.386	0.515	0.386	0.386	0.592
Palau	0.497	0.657	0.497	0.497	0.753
Palestinian Authority	0.517	0.643	0.517	0.517	0.719
Panama	0.230	0.385	0.230	0.230	0.477
Papua New Guinea	0.315	0.491	0.315	0.315	0.597
Paraguay	0.000	0.000	0.000	0.000	0.000
Peru	0.252	0.390	0.252	0.252	0.473
Philippines	0.525	0.617	0.525	0.525	0.672
Poland	0.532	0.717	0.532	0.532	0.828
Portugal	0.228	0.329	0.228	0.228	0.389
Puerto Rico (U.S.)	0.362	0.508	0.362	0.362	0.596
Qatar	0.258	0.411	0.258	0.258	0.503
Reunion (France)	0.421	0.641	0.421	0.421	0.772
Romania	0.289	0.414	0.289	0.289	0.489
Russian Federation	0.360	0.432	0.360	0.360	0.476
Rwanda	0.416	0.601	0.416	0.416	0.712
Saint Helena (U.K.)	0.456	0.641	0.456	0.456	0.753
Saint Kitts and Nevis	0.477	0.649	0.477	0.477	0.753
Saint Lucia	0.521	0.666	0.521	0.521	0.753
Saint Martin (France)	0.484	0.652	0.484	0.484	0.753
Saint Pierre and Miquelon (France)	0.415	0.626	0.415	0.415	0.753
Saint Vincent and Grenadines	0.499	0.658	0.499	0.499	0.753
Samoa	0.434	0.633	0.434	0.434	0.753
San Marino	0.224	0.343	0.224	0.224	0.414
Sao Tomé & Principe	0.565	0.682	0.565	0.565	0.753
Saudi Arabia	0.374	0.510	0.374	0.374	0.592
Senegal	0.656	0.790	0.656	0.656	0.870
Serbia	0.678	0.933	0.678	0.678	1.086
Seychelles	0.479	0.650	0.479	0.479	0.753
Sierra Leone	0.246	0.398	0.246	0.246	0.489
Singapore	0.200	0.311	0.200	0.200	0.379
Sint Martin (Netherlands)	0.463	0.644	0.463	0.463	0.753
Slovak Republic	0.164	0.269	0.164	0.164	0.332
Slovenia	0.285	0.494	0.285	0.285	0.620
Solomon Islands	0.563	0.681	0.563	0.563	0.753
Somalia	0.582	0.689	0.582	0.582	0.753
South Africa	0.786	0.964	0.786	0.786	1.070
South Sudan	0.704	0.820	0.704	0.704	0.890
Spain	0.209	0.329	0.209	0.209	0.402
Sri Lanka	0.506	0.646	0.506	0.506	0.731
Sudan	0.398	0.609	0.398	0.398	0.736
Suriname	0.565	0.855	0.565	0.565	1.029
Sweden	0.025	0.052	0.025	0.025	0.068
Switzerland	0.020	0.038	0.020	0.020	0.048
Syrian Arab Republic	0.546	0.650	0.546	0.546	0.713
Taiwan (Chinese Taipei)	0.331	0.427	0.331	0.331	0.484
Tajikistan	0.106	0.199	0.106	0.106	0.255
Tanzania, United Republic of	0.336	0.458	0.336	0.336	0.531
Thailand	0.351	0.413	0.351	0.351	0.450
Timor-Leste	0.589	0.691	0.589	0.589	0.753
Togo	0.597	0.761	0.597	0.597	0.859
Tonga	0.533	0.670	0.533	0.533	0.753
Trinidad and Tobago	0.370	0.488	0.370	0.370	0.559
Tunisia	0.348	0.423	0.348	0.348	0.468
Turkey	0.309	0.351	0.309	0.309	0.376

Appendix

	Combined Margin Grid Emission Factor				Operating Margin Grid Emission Factor (including for use in PCAF GHG accounting)
	Firm Energy (e.g., Hydro, Geothermal)	Intermittent Energy (e.g., Solar, Wind, Tidal)	Energy Efficiency	Electricity Consumption	
Turkmenistan	0.676	0.833	0.676	0.676	0.927
Turks and Caicos Islands (U.K.)	0.451	0.639	0.451	0.451	0.753
Tuvalu	0.497	0.657	0.497	0.497	0.753
Uganda	0.116	0.218	0.116	0.116	0.279
Ukraine	0.435	0.643	0.435	0.435	0.768
United Arab Emirates	0.310	0.464	0.310	0.310	0.556
United Kingdom	0.219	0.320	0.219	0.219	0.380
United States	0.246	0.352	0.246	0.246	0.416
Uruguay	0.065	0.133	0.065	0.065	0.174
Uzbekistan	0.467	0.558	0.467	0.467	0.612
Vanatu	0.504	0.659	0.504	0.504	0.753
Venezuela, Bolivarian Republic of	0.368	0.582	0.368	0.368	0.711
Viet Nam	0.381	0.493	0.381	0.381	0.560
Virgin Islands (U.S.)	0.373	0.546	0.373	0.373	0.650
Yemen	0.615	0.735	0.615	0.615	0.807
Zambia	0.197	0.334	0.197	0.197	0.416
Zimbabwe	0.880	1.315	0.880	0.880	1.575

Note 1: For methodology and sources used to derive the default emission factors, please refer to the document "AHG-001: Methodological Approach for the Common Default Grid Emission Factor Dataset".
Note 2: Partnership for Carbon Accounting Financials (PCAF) is a global partnership of financial institutions that work together to develop and implement a harmonized approach to assess and disclose the GHG emissions associated with their loans and investments.
https://carbonaccountingfinancials.com/

出典：Harmonized IFI Default Grid Factors 2022 v3.2. IFI TWG (The Technical Working Group of the International Financial Institutions).
https://unfccc.int/climate-action/sectoral-engagement/ifis-harmonization-of-standards-for-ghg-accounting/ifi-twg-list-of-methodologies

Table 4 CO_2 Emission Factors for Standalone Power Generation

Table 2. Emission factors for diesel generator systems (in kg CO2e/kWh[(a)]) for three different levels of load factors[(b)]

Cases	Mini-grid with 24 hour service	(a) Mini-grid with temporary service (4-6 hr/day); (b) Productive applications; (c) Water pumps	Mini-grid with storage
Load factors [%]	**25%**	**50%**	**100%**
<15 kW	2.4	1.4	1.2
>=15 <35 kW	1.9	1.3	1.1
>=35 <135 kW	1.3	1.0	1.0
>=135<200 kW	0.9	0.8	0.8
> 200 kW[(c)]	0.8	0.8	0.8

(a) A conversion factor of 3.2 kg CO_2 per kg of diesel has been used (following revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories);

(b) Values derived from figures reported in RETScreen International's PV 2000 model retrieved from: <http://retscreen.net/>;

(c) Default values.

Source: Small Scale CDM Methodology: AMS I.F. ver.3

Table 5 Default Values of Boiler Efficiencies

Table 1: Default baseline efficiency for different technologies

Technology of the energy generation system	Default efficiency
New natural gas fired boiler (w/o condenser)	92%
New oil fired boiler	90%
Old natural gas fired boiler (w/o condenser)	87%
New coal fired boiler	85%
Old oil fired boiler	85%
Old coal fired boiler	80%

Source: CDM Tool to determine the baseline efficiency of thermal or electric energy generation systems, ver.1

Table 6 CO_2 Emission Factors for Different Transport Modes

CO_2 emission factors per km (g-CO_2/km)

Vehicle Type	Emission Factors
Car	304.1
2-Wheeler	45.9
3-Wheeler	125.2
Taxi	290.6
Bus	1337.9
Jeepney/RTV	420.5

Source: Manual for Calculating Greenhouse Gas Benefits of Global Environment Facility Transportation Projects (GEF, 2012)

CO_2 emission factors per passenger km (g-CO_2/passenger-km)

Vehicle Type	Emission Factors
Passenger car	130
Aviation	98
Bus	57
Railway	17
Motorbike	50

Source: MLIT Ministry of Land, Infrastructure, Transport and Tourism, Japan (FY2019). Sustainable Transport : A Sourcebook for Policy-makers in Developing Cities (GTZ, 2007)

Table 7 CO_2 Emission Factors in g-CO_2/t-km for Different Transport Modes

Vehicle Type		Emission Factors
Road	Commercial standard sized vehicles	173
	Commercial small size vehicles	808
	Commercial small mini vehicles	1,951
	Private standard sized vehicles	394
	Private small size vehicles	3,443
Railway		22
Domestic vessels		39
Domestic airway		1,490

Source: CO_2 Emission Estimation Guideline for Logistics, Version 3.1, METI and MLIT, Japan

Type of cargo transported	**Emission factor (g CO_2/tonne.km)**
Agricultural products and live animals	83
Beverage	61
Groceries	76
Perishable and semi-perishable foodstuff and canned food	94
Other food products and fodder	74
Solid mineral fuels and petroleum products	76
Ores and metal waste	90
Metal products	80
Mineral products	57
Other crude and manufactured minerals and building materials	70
Fertilizers	76
Chemicals	70
Transport equipment	100
Machinery and metal products	119
Glass and ceramic and porcelain products	84
Grouped goods	94
Other manufactured articles	113

Source: Approved baseline and monitoring methodology AM0090: Modal shift in transportation of cargo from road transportation to water or rail transportation.

Table 8 (1) Fraction of degradable organic carbon by waste type (DOC_j)

Waste type *j*	**DOC_j (% wet waste)**
Wood and wood products	43
Pulp, paper and cardboard (other than sludge)	40
Food, food waste, beverages and tobacco (other than sludge)	15
Textiles	24
Garden, yard and park waste	20
Glass, plastic, metal, other inert waste	0

Source: CDM Methodological Tool: Emissions from solid waste disposal sites [version 8.1] (original source: 2006 IPCC Guidelines for National Greenhouse Gas Inventories, IPCC, Volume 5, Table 2.4 and 2.5)

Table 8 (2) Fraction of degradable organic carbon which decomposes by waste type ($DOC_{f,j}$)

TABLE 3.0 (NEW)
FRACTION OF DEGRADABLE ORGANIC CARBON WHICH DECOMPOSES (DOC_F) FOR DIFFERENT WASTE TYPES

Type of Waste	**Recommended Default DOC_f Values**	**Remark**
Less decomposable wastes e.g. wood, engineered wood products, tree branches (wood)	0.1	An average value of 0.088 was derived from DOC_f values for engineered wood products, sawn woods, tree branches reported in 3 references[1-3]
Moderately decomposable wastes e.g. paper, textile, nappies	0.5	An average value of 0.523 was derived from DOC_f values for paper products, textile and nappies reported in 4 references[4-7].
Highly decomposable wastes, e.g. food wastes, grasses (garden and park waste excluding tree branches)	0.7	An average value of 0.706 was derived from DOC_f values for food wastes and grasses reported in 3 references[4-6]
Bulk waste*	0.5	

[1] Wang *et al.* (2011); [2] Wang and Barlaz (2016); [3] Ximenes *et al.* (2018); [4] Eleazer *et al.* (1997); [5] Bayard *et al.* (2017); [6] Jeong (2016); [7] Wang *et al.* (2015)

* It is used when the fractions of less, moderately and highly decomposable wastes in MSW are not known.

Source: 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 5, Table 3.0 (New)

Table 9(1) Methane Correction Factor (for SWDS)

TABLE 3.1 (UPDATED)
SWDS CLASSIFICATION AND METHANE CORRECTION FACTORS (MCF)

Type of Site	Methane Correction Factor (MCF) Default Values	Remarks
Managed – anaerobic	1.0[a]	These must have controlled placement of waste (i.e., waste directed to specific deposition areas, a degree of control of scavenging and a degree of control of fires) and will include at least one of the following: (i) cover material; (ii) mechanical compacting; or (iii) levelling of the waste.
Managed well – semi-aerobic	0.5[b]	When semi-aerobic managed SWDS type is managed under one of the following condition, it is regarded as well magement ; (i) permeable cover material; (ii) leachate drainage system without sunk; (iii) regulating pondage; and (iv) gas ventilation system without cap, (v) connection of leachate drainage system and gas ventilation system.
Managed poorly – semi-aerobic	0.7[c]	When semi-aerobic managed SWDS type is managed under one of the following condition, it is regarded as poor management; (i) condition of sunk of leachate drainage system; (ii) closing of valve of drainage or atmosphere-unopening of drainage exit; (iii) capping of gas ventilation exit.
Managed well – active-aeration	0.4[d,e,f]	Active aeration of managed landfills includes the technology of in-situ low pressure aeration, air sparging, bioventing, passive ventilation with extraction (suction). These must have controlled placement of waste and will include leachate drainage system to avoid the blockage of air penetration, and (i) cover material; (ii) air injection or gas extraction system without drying of waste.
Managed poorly – active-aeration	0.7[f,g,h]	When SWDS, that is equipped as well as active aeration of managed SWDS, is managed under one of the following condition, it is judged as poor management; (i) blockage of aeration system due to failure of drainage; (ii) lack of available moisture for microorganisms due to high- pressure aeration.
Unmanaged – deep (>5 m waste) and /or high water table	0.8 [a]	All SWDS not meeting the criteria of managed SWDS and which have depths of greater than or equal to 5 metres and/or high water table at near ground level. Latter situation corresponds to filling inland water, such as pond, river or wetland, by waste.
Unmanaged – shallow (<5 m waste)	0.4 [a]	All SWDS not meeting the criteria of managed SWDS and which have depths of less than 5 metres.
Uncategorised SWDS	0.6 [a]	Only if countries cannot categorise their SWDS into above four categories of managed and unmanaged SWDS, the MCF for this category can be used.

Sources: [a]IPCC (2000); [b]Matsufuji *et al*. (1996); [c]Yamada *et al*. (2013); [d]Hrad *et al*. (2013); [e]Ishigaki *et al*. (2003); [f]Ritzkowski & Stegmann (2013); [g]Raga & Cossu (2014); [h]Ritzkowski *et al*. (2016)

Source: 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 5, Table 3.1 (Updated)

Table 9(2) Methane Correction Factor (for wastewater)

Type of wastewater treatment and discharge pathway or system	***MCF* value**
Discharge of wastewater to sea, river or lake	0.1
Land application	0.1
Aerobic treatment, well managed	0.0
Aerobic treatment, poorly managed or overloaded	0.3
Anaerobic digester for sludge without methane recovery	0.8
Anaerobic reactor without methane recovery	0.8
Anaerobic shallow lagoon (depth less than 2 metres)	0.2
Anaerobic deep lagoon (depth more than 2 metres)	0.8
Septic system	0.5
Land application[(a)]	0.1

(a) Please refer SSC_664, "Clarification on methane correction factors for treated water used for irrigation under AMS-III.H ver. 16".

Source: CDM Methodology: AMS-III.H. Methane recovery in wastewater treatment [Version 19.0]

Table 10 Decay Rates of Wastes

<table>
<tr><th colspan="2" rowspan="2">Waste type j</th><th colspan="2">Boreal and Temperate (MAT≤20°C)</th><th colspan="2">Tropical (MAT>20°C)</th></tr>
<tr><th>Dry (MAP/PET <1)</th><th>Wet (MAP/PET >1)</th><th>Dry (MAP< 1000mm)</th><th>Wet (MAP> 1000mm)</th></tr>
<tr><td rowspan="2">Slowly degrading</td><td>Pulp, paper, cardboard (other than sludge), textiles</td><td>0.04</td><td>0.06</td><td>0.045</td><td>0.07</td></tr>
<tr><td>Wood, wood products and straw</td><td>0.02</td><td>0.03</td><td>0.025</td><td>0.035</td></tr>
<tr><td>Moderately degrading</td><td>Other (non-food) organic putrescible garden and park waste</td><td>0.05</td><td>0.10</td><td>0.065</td><td>0.17</td></tr>
<tr><td>Rapidly degrading</td><td>Food, food waste, sewage sludge, beverages and tobacco</td><td>0.06</td><td>0.185</td><td>0.085</td><td>0.40</td></tr>
</table>

Source: 2006 IPCC Guidelines for National Greenhouse Gas Inventories, IPCC, Volume 5, Table 3.3

Table 11 Degradable Organic Content of the Untretaed Sludge

<table>
<tr><th colspan="2" rowspan="2">Sludge type</th><th colspan="2">Default DOC(-)</th></tr>
<tr><th>Wet matter</th><th>Dry matter</th></tr>
<tr><td colspan="2">Domestic sludge</td><td>0.05</td><td>0.50</td></tr>
<tr><td rowspan="4">Industrial sludge</td><td>Rough default</td><td>0.09</td><td>0.35</td></tr>
<tr><td>Pulp and paper industry</td><td>-</td><td>0.27</td></tr>
<tr><td>Food industry</td><td>-</td><td>0.30</td></tr>
<tr><td>Chemical industry</td><td>-</td><td>0.52</td></tr>
</table>

Source: 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 5: Waste, p.2.13

Table 12 Default Quantity of Waste Disposed in the SWDS (W_y)

TABLE 2.1
MSW GENERATION AND TREATMENT DATA - REGIONAL DEFAULTS

Region	MSW Generation Rate[1, 2, 3] (tonnes/cap/yr)	Fraction of MSW disposed to SWDS	Fraction of MSW incinerated	Fraction of MSW composted	Fraction of other MSW management, unspecified[4]
Asia					
Eastern Asia	0.37	0.55	0.26	0.01	0.18
South-Central Asia	0.21	0.74	-	0.05	0.21
South-East Asia	0.27	0.59	0.09	0.05	0.27
Africa[5]	0.29	0.69	-	-	0.31
Europe					
Eastern Europe	0.38	0.90	0.04	0.01	0.02
Northern Europe	0.64	0.47	0.24	0.08	0.20
Southern Europe	0.52	0.85	0.05	0.05	0.05
Western Europe	0.56	0.47	0.22	0.15	0.15
America					
Caribbean	0.49	0.83	0.02	-	0.15
Central America	0.21	0.50	-	-	0.50
South America	0.26	0.54	0.01	0.003	0.46
North America	0.65	0.58	0.06	0.06	0.29
Oceania[6]	0.69	0.85	-	-	0.15

[1] Data are based on weight of wet waste.

[2] To obtain the total waste generation in the country, the per-capita values should be multiplied with the population whose waste is collected. In many countries, especially developing countries, this encompasses only urban population.

[3] The data are default data for the year 2000, although for some countries the year for which the data are applicable was not given in the reference, or data for the year 2000 were not available. The year for which the data are collected, where available, is given in the Annex 2A.1.

[4] Other, unspecified, includes data on recycling for some countries.

[5] A regional average is given for the whole of Africa as data are not available for more detailed regions within Africa.

[6] Data for Oceania are based only on data from Australia and New Zealand.

Source:2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 5 Waste Table2.1

Table A-1 Default values of biomass conversion and expansion factors（BCEF）

TABLE 4.5
DEFAULT BIOMASS CONVERSION AND EXPANSION FACTORS (BCEF), TONNES BIOMASS (M^3 OF WOOD VOLUME)$^{-1}$

BCEF for expansion of merchantable growing stock volume to above-ground biomass ($BCEF_S$), for conversion of net annual increment ($BCEF_I$) and for conversion of wood and fuelwood removal volume to above-ground biomass removal ($BCEF_R$)

Climatic zone	Forest type	BCEF	Growing stock level (m^3)			
			<20	21-50	51-100	>100
Boreal	pines	$BCEF_S$	**1.2** (0.85-1.3)	**0.68** (0.5-0.72)	**0.57** (0.52-0.65)	**0.5** (0.45-0.58)
		$BCEF_I$	0.47	0.46	0.46	0.463
		$BCEF_R$	1.33	0.75	0.63	0.55
	larch	$BCEF_S$	**1.22** (0.9-1.5)	**0.78** (0.7-0.8)	**0.77** (0.7-0.85)	**0.77** (0.7-0.85)
		$BCEF_I$	0.9	0.75	0.77	0.77
		$BCEF_R$	1.35	0.87	0.85	0.85
	firs and spruces	$BCEF_S$	**1.16** (0.8-1.5)	**0.66** (0.55-0.75)	**0.58** (0.5-0.65)	**0.53** (0.45-0.605)
		$BCEF_I$	0.55	0.47	0.47	0.464
		$BCEF_R$	1.29	0.73	0.64	0.59
	hardwoods	$BCEF_S$	**0.9** (0.7-1.2)	**0.7** (0.6-0.75)	**0.62** (0.53-0.7)	**0.55** (0.5-0.65)
		$BCEF_I$	0.65	0.54	0.52	0.505
		$BCEF_R$	1.0	0.77	0.69	0.61

Climatic zone	Forest type	BCEF	Growing stock level (m^3)				
			<20	21-40	41-100	100 -200	>200
Temperate	hardwoods	$BCEF_S$	**3.0** (0.8-4.5)	**1.7** (0.8-2.6)	**1.4** (0.7-1.9)	**1.05** (0.6-1.4)	**0.8** (0.55-1.1)
		$BCEF_I$	1.5	1.3	0.9	0.6	0.48
		$BCEF_R$	3.33	1.89	1.55	1.17	0.89
	pines	$BCEF_S$	**1.8** (0.6 -2.4)	**1.0** (0.65 -1.5)	**0.75** (0.6-1.0)	**0.7** (0.4-1.0)	**0.7** (0.4-1.0)
		$BCEF_I$	1.5	0.75	0.6	0.67	0.69
		$BCEF_R$	2.0	1.11	0.83	0.77	0.77
	other conifers	$BCEF_S$	**3.0** (0.7-4.0)	**1.4** (0.5-2.5)	**1.0** (0.5-1.4)	**0.75** (0.4-1.2)	**0.7** (0.35-0.9)
		$BCEF_I$	1.0	0.83	0.57	0.53	0.60
		$BCEF_R$	3.33	1.55	1.11	0.83	0.77
			<20	21-40	41-80	>80	
Mediterranean, dry tropical, subtropical	hardwoods	$BCEF_S$	**5.0** (2.0-8.0)	**1.9** (1.0-2.6)	**0.8** (0.6-1.4)	**0.66** (0.4-0.9)	
		$BCEF_I$	1.5	0.5	0.55	0.66	
		$BCEF_R$	5.55	2.11	0.89	0.73	
	conifers	$BCEF_S$	**6.0** (3.0-8.0)	**1.2** (0.5-2.0)	**0.6** (0.4-0.9)	**0.55** (0.4-0.7)	
		$BCEF_I$	1.5	0.4	0.45	0.54	
		$BCEF_R$	6.67	1.33	0.67	0.61	

Climatic zone	Forest type	BCEF	Growing stock level (m^3)							
			<10	11-20	21-40	41-60	61-80	80-120	120-200	>200
Humid tropical	conifers	$BCEF_S$	**4.0** (3.0-6.0)	**1.75** (1.4-2.4)	**1.25** (1.0-1.5)	**1.0** (0.8-1.2)	**0.8** (0.7-1.2)	**0.76** (0.6-1.0)	**0.7** (0.6-0.9)	**0.7** (0.6-0.9)
		$BCEF_I$	2.5	0.95	0.65	0.55	0.53	0.58	0.66	0.70
		$BCEF_R$	4.44	1.94	1.39	1.11	0.89	0.84	0.77	0.77
	natural forests	$BCEF_S$	**9.0** (4.0-12.0)	**4.0** (2.5-4.5)	**2.8** (1.4-3.4)	**2.05** (1.2-2.5)	**1.7** (1.2-2.2)	**1.5** (1.0-1.8)	**1.3**(0.9-1.6)	**0.95** (0.7-1.1)
		$BCEF_I$	4.5	1.6	1.1	0.93	0.9	0.87	0.86	0.85
		$BCEF_R$	10.0	4.44	3.11	2.28	1.89	1.67	1.44	1.05

Note: Lower values of the ranges for $BCEF_S$ apply if growing stock definition includes branches, stem tops and cull trees; upper values apply if branches and tops are not part of growing stock, minimum top diameters in the definition of growing stock are large, inventoried volume falls near the lower category limit or basic wood densities are relatively high. Continuous graphs, functional forms and updates with new studies can be found at the forest- and climate- change website at: http://www.fao.org/forestry/

Average BCEF for inhomogeneous forests should be derived as far as possible as weighted averages. It is good practice to justify the factors chosen. To apply $BCEF_I$, an estimate of the current average growing stock is necessary. It can be derived from FRA 2005 at http://www.fao.org/forestry/

$BCEF_R$ values are derived by dividing $BCEF_S$ by 0.9

Sources: *Boreal forests*: Alexeyev V.A. and R.A. Birdseye, 1998; Fang J. and Z.M. Wang, 2001; *temperate forests*: Fang J. *et al.*, 2001; Fukuda M. *et al.*, 2003; Schroeder P. *et al.*, 1997; Snowdon P. *et.al.*, 2000; Smith J. *et. al.*, 2002; Brown S., 1999; Schoene D. and A. Schulte, 1999; Smith J. *et al.*, 2004; *Mediterranean forests*: Vayreda *et al.*, 2002; Gracia *et al.*, 2002; *tropical forests*: Brown S. *et al.*, 1989; Brown S. and A. Lugo, 1992; Brown S., 2002; Fang J.Y., 2001.

Source：2006 IPCC Guidelines for National Greenhouse Gas Inventories

Table A-2 Carbon fraction of aboveground forest biomass（CF）

TABLE 4.3
CARBON FRACTION OF ABOVEGROUND FOREST BIOMASS

Domain	Part of tree	Carbon fraction, (CF) [tonne C (tonne d.m.)$^{-1}$]	References
Default value	All	0.47	McGroddy *et al.*, 2004
Tropical and Subtropical	All	0.47 (0.44 - 0.49)	Andreae and Merlet, 2001; Chambers *et al.*, 2001; McGroddy *et al.*, 2004; Lasco and Pulhin, 2003
	wood	0.49	Feldpausch *et al.*, 2004
	wood, tree d < 10 cm	0.46	Hughes *et al.*, 2000
	wood, tree d ≥ 10 cm	0.49	Hughes *et al.*, 2000
	foliage	0.47	Feldpausch *et al.*, 2004
	foliage, tree d < 10 cm	0.43	Hughes *et al.*, 2000
	foliage, tree d ≥ 10 cm	0.46	Hughes *et al.*, 2000
Temperate and Boreal	All	0.47 (0.47 - 0.49)	Andreae and Merlet, 2001; Gayoso *et al.*, 2002; Matthews, 1993; McGroddy *et al.*, 2004
	broad-leaved	0.48 (0.46 - 0.50)	Lamlom and Savidge, 2003
	conifers	0.51 (0.47 - 0.55)	Lamlom and Savidge, 2003

Source：2006 IPCC Guidelines for National Greenhouse Gas Inventories

Table A-3 Above-ground net biomass growth in natural forests (t-d.m./ha/year)

TABLE 4.9 (UPDATED)
ABOVE-GROUND NET BIOMASS GROWTH IN NATURAL FORESTS[1,2,3,4] (TONNES D.M. HA^{-1} YR^{-1})

Domain	Ecological Zone[4]	Continent	Status/ Condition	Aboveground biomass growth [tonnes d.m. ha^{-1} yr^{-1}]	Uncertainty	Uncertainty type	References
Tropical	Tropical rainforest	Africa	Primary	1.3	3.5	SD	1, 2
			Secondary> 20 years	3.5	3.3	SD	3-8
			Secondary≤ 20 years	7.6	5.9	SD	3-7, 9
		North and South America	Primary	1.0	2.0	SD	2, 10, 11
			Secondary> 20 years	2.3	1.1	SD	3, 4, 12-15
			Secondary≤ 20 years	5.9	2.5	SD	3, 4, 6, 12-14
		Asia	Primary	0.7	2.2	SD	2, 16
			Secondary> 20 years	2.7	3.1	SD	3, 4, 17
			Secondary≤ 20 years	3.4	3.9	SD	3, 4, 17-19
	Tropical moist deciduous forest	Africa	Primary[6]	0.4	±90%	default	
			Secondary> 20 years	0.9	0.7	SD	20, 21
			Secondary≤ 20 years	2.9	1.0	SD	20, 21
		North and South America	Primary	0.4	2.1	SD	2, 10, 11
			Secondary> 20 years	2.7	1.7	SD	3, 4, 12, 13, 15, 22
			Secondary≤ 20 years	5.2	2.3	SD	3, 4, 12, 13, 22
		Asia	Primary	0.4	±90%	default	7
			Secondary> 20 years	0.9	±90%	default	8
			Secondary≤ 20 years	2.4	0.3	SD	3, 4
	Tropical dry forest	Africa	Primary	-	-	-	
			Secondary> 20 years	1.6	±90%	default	9
			Secondary≤ 20 years	3.9	±90%	default	10
		North and South America	Primary	-	-	-	
			Secondary> 20 years	1.6	1.1	SD	12, 13
			Secondary≤ 20 years	3.9	2.4	SD	12, 13, 23

TABLE 4.9 (UPDATED) (CONTINUED)
ABOVE-GROUND NET BIOMASS GROWTH IN NATURAL FORESTS[1,2,3,4] (TONNES D.M. HA^{-1} YR^{-1})

Domain	Ecological Zone[4]	Continent	Status/ Condition	Aboveground biomass growth [tonnes d.m. ha^{-1} yr^{-1}]	Uncertainty	Uncertainty type	References
Tropical	Tropical dry forest	Asia	Primary	-	-	-	
			Secondary> 20 years	1.6	±90%	default	11
			Secondary≤ 20 years	3.9	±90%	default	12
	Tropical shrublands	Africa	Primary	0.9 (0.2-1.6)*	±90%	default	24
			Secondary> 20 years	0.9 (0.2-1.6)*	±90%	default	24
			Secondary≤ 20 years	0.2-0.7	±90%	default	24
		North and South America	Primary	1.0*	±90%	default	24
			Secondary> 20 years	1.0*	±90%	default	24
			Secondary≤ 20 years	4.0	±90%	default	24
		Asia (Continental)	Primary	1.3 (1.0-2.2)*	±90%	default	24
			Secondary> 20 years	1.3 (1.0-2.2)*	±90%	default	24
			Secondary≤ 20 years	5.0	±90%	default	24
		Asia (insular)	Primary	1.0*	±90%	default	24
			Secondary> 20 years	1.0*	±90%	default	24
			Secondary≤ 20 years	2.0	±90%	default	24
	Tropical mountain system	Africa	Primary	0.5	±90%	default	13
			Secondary> 20 years	1.8	±90%	default	14
			Secondary≤ 20 years	5.5	6.8	SD	25-27
		North and South America	Primary	0.5	1.9	SD	2, 10, 11
			Secondary> 20 years	1.8	0.8	SD	3, 4, 12, 13
			Secondary≤ 20 years	4.4	1.6	SD	3, 4, 12, 13, 22
		Asia	Primary	-0.7	3.1	SD	2, 16
			Secondary> 20 years	1.1	0.4	SD	3, 4, 28, 29
			Secondary≤ 20 years	2.9	0.1	SD	3, 4, 28-30

TABLE 4.9 (UPDATED) (CONTINUED) ABOVE-GROUND NET BIOMASS GROWTH IN NATURAL FORESTS[1,2,3,4] (TONNES D.M. HA^{-1} YR^{-1})							
Domain	**Ecological Zone[4]**	**Continent**	**Status/ Condition**	**Aboveground biomass growth [tonnes d.m. ha^{-1} yr^{-1}]**	**Uncert ainty**	**Uncer tainty type**	**References**
Sub-tropical	Subtropica l humid forest	Africa	Primary	-	-	-	
			Secondary >20 years	1.0	±90%	default	15
			Secondary ≤20 years	2.5	±90%	default	16
		North and South America	Primary	-	-	-	
			Secondary >20 years	1.0	±90%	default	17
			Secondary ≤20 years	2.5	±90%	default	18
		Asia	Primary	-	-	-	
			Secondary >20 years	1.0	0.9	SD	3, 4, 31
			Secondary ≤20 years	2.5	0.8	SD	3, 4, 31
	Subtropica l dry forest	Africa	Primary	1.8 (0.6-3.0)*	±90%	default	24
			Secondary >20 years	1.8 (0.6-3.0)*	±90%	default	24
			Secondary ≤20 years	2.4 (2.3-2.5)	±90%	default	24
		North and South America	Primary	1.0*	±90%	default	24
			Secondary >20 years	1.0*	±90%	default	24
			Secondary ≤20 years	4.0	±90%	default	24
		Asia (continent al)	Primary	1.5*	±90%	default	24
			Secondary >20 years	1.5*	±90%	default	24
			Secondary ≤20 years	6.0	±90%	default	24
		Asia (insular)	Primary	2.0*	±90%	default	24
			Secondary >20 years	2.0*	±90%	default	24
			Secondary ≤20 years	7.0	±90%	default	24
	Subtropica l steppe	Africa	Primary	0.9 (0.2-1.6)*	±90%	default	24
			Secondary >20 years	0.9 (0.2-1.6)*	±90%	default	24
			Secondary ≤20 years	1.2 (0.8-1.5)	±90%	default	24
		North and South America	Primary	1.0*	±90%	default	24
			Secondary >20 years	1.0*	±90%	default	24
			Secondary ≤20 years	4.0	±90%	default	24

TABLE 4.9 (UPDATED) (CONTINUED)
ABOVE-GROUND NET BIOMASS GROWTH IN NATURAL FORESTS[1,2,3,4] (TONNES D.M. HA^{-1} YR^{-1})

Domain	Ecological Zone[4]	Continent	Status/ Condition	Aboveground biomass growth [tonnes d.m. ha^{-1} yr^{-1}]	Uncertainty	Uncertainty type	References
Subtropical	Subtropical steppe	Asia (continental)	Primary	1.3 (1.0-2.2)*	±90%	default	24
			Secondary >20 years	1.3 (1.0-2.2)*	±90%	default	24
			Secondary ≤20 years	5.0	±90%	default	24
		Asia (insular)	Primary	1.0*	±90%	default	24
			Secondary >20 years	1.0*	±90%	default	24
			Secondary ≤20 years	2.0	±90%	default	24
	Subtropical mountain system	Africa	Primary	-	-	-	
			Secondary >20 years	0.5	±90%	default	19
			Secondary ≤20 years	2.5	±90%	default	20
		North and South America	Primary	-	-	-	
			Secondary >20 years	0.5	±90%	default	21
			Secondary ≤20 years	2.5	±90%	default	22
		Asia	Primary	-	-	-	
			Secondary >20 years	0.5	0.3	SD	3, 4, 32
			Secondary ≤20 years	2.5	0.03	SD	3, 4, 32
Temperate	Oceanic	New Zealand	Primary	0.37	±0.85	95%CI	33
			Secondary >20 years	2.12	±0.82	95%CI	33
			Secondary ≤20 years	3.12	0.83	SE	34
		Europe	All	2.3	-	-	35
		North and South America	Secondary >20 years	9.1	20.2	SD	36
			Secondary ≤20 years	6.3	7.4	SD	36
	Continental	North and South America	Secondary >20 years	3.6	15.0	SD	36
			Secondary ≤20 years	3.3	5.2	SD	36
	Mountain	North and South America	Secondary >20 years	4.4	100.7	SD	36
			Secondary ≤20 years	3.1	3.6	SD	36

TABLE 4.9 (UPDATED) (CONTINUED)
ABOVE-GROUND NET BIOMASS GROWTH IN NATURAL FORESTS[1,2,3,4] (TONNES D.M. HA^{-1} YR^{-1})

Domain	Ecological Zone[4]	Continent	Status/ Condition	Aboveground biomass growth [tonnes d.m. ha^{-1} yr^{-1}]	Uncertainty	Uncertainty type	References
Temperate	Desert	North and South America	Secondary >20 years	0.6	0.9	SD	36
			Secondary ≤20 years	0.5	1.2	SD	36
	Steppe	North and South America	Secondary >20 years	3.5	13.3	SD	36
			Secondary ≤20 years	2.3	3.2	SD	36
Boreal	Coniferous	Asia, Europe, North America	All	0.1-2.1	-	-	35
	Tundra woodland	Asia, Europe, North America	All	0.4	(0.2-0.5)	Range	24
	Mountain	Asia, Europe, North America	Primary or secondary >20 years	1.1-1.5	-	-	24
			Secondary ≤20 years	1.0-1.1	-	-	24

[1] Aboveground net biomass growth is defined as net change in total aboveground biomass over time. In this respect, both forest productivity and mortality are accounted for.

[2] Some categories include sub-strata for primary forests defined as old growth forests that are intact or with no active human intervention, and secondary forests which include all other forests. The table considers a forest definition of at least 10% tree canopy cover.

[3] For above-ground biomass growth rates with no standard deviation, IPCC Tier 1 default uncertainties apply.

[4] Forest Resources Assessment (FRA). (2015). *Global Eological Zones for FAO Forest Reporting 2010 Update. Forest Resources Assessment Working Paper 179.*

Observations on ecological zone and continent columns

Above-ground biomass growth rate was taken from: Tropical moist deciduous forest - North and South America (Primary); Tropical moist deciduous forest - North and South America (Primary); Tropical moist deciduous forest - Africa (Secondary>20 years); Tropical dry forest – North and South America (Secondary>20 years); Tropical dry forest – North and South America (Secondary≤20 years); Tropical dry forest – North and South America (Secondary>20 years); Tropical dry forest – North and South America (Secondary≤20 years); Tropical mountain system – North and South America (Primary); Tropical mountain system – North and South America (Secondary>20 years); Subtropical humid forest – Asia (Secondary>20 years); Subtropical humid forest – Asia (Secondary≤20 years)

Subtropical humid forest – Asia (Secondary>20 years); Subtropical humid forest – Asia (Secondary≤20 years); Subtropical mountain system – Asia (Secondary>20 years); Subtropical mountain system – Asia (Secondary≤20 years); Subtropical mountain system – Asia (Secondary>20 years); Subtropical mountain system – Asia (Secondary≤20 years).

Note: SD = standard deviation, CI = confidence interval, SE = standard error.

*Recommendation based on IPCC 2006 estimates for Forests > 20 years.

References

1Lewis, S. L., et al., 2009; 2Lopez-Gonzalez, G. et al., 2011; 3Anderson-Teixeira, K. J., et al., 2018a; 4Anderson-Teixeira, K. J., et al., 2018b; 5Omeja, P. A. et al., 2011; 6Palm, C.A., et al., 1999; 7N'Guessan, A. E., et al., 2019; 8Gourlet-Fleury, S., et al., 2013; 9Thenkabail, P. S., et al., 2004; 10Brienen, R. J. W., et al., 2014: 11Brienen, R. J. W., et al., 2015; 12Poorter, L. et al., 2016a; 13L. Poorter et al., 2016b; 14Salimon, C. I., Brown, I. F., 2000; 15Rutishauser, E., et al., 2015; 16Qie, L., et al., 2017; 17Mukul, S. A., Herbohn, J., Firn, F., 2016; 18Hiratsuka, M., et al., 2006; 19Ewel, J. J., Chai, P., Tsai, L. M., 1983; 20Kalaba, F. K., et al., 2013; 21Manlay, R., et al., 2002; 22Peña, M. A., Duque, A., 2013; 23Salinas-Mendoza, M. A. et al., 2017; 24IPCC, 2003; 25Otuoma, J., et al., 2016; 26Giday, K., et al., 2013; 27Mekurja, W., Veldkamp, E., Corre, M. D., 2010; 28Tang, J. W., et al., 1998; 29Fujiki, S., 2017; 30Chan, N., Takeda, S., 2016; 31Schomakers, J., et al., 2017; 32Dang, C. L., Wu, Z. L., 1991; 33Holdaway, R.J., et al. 2017; 34Beets P.N., et al. 2014; 35IPCC 2006; 36June 18, 2018. Forest Inventory and Analysis Database, St. Paul, MN: U.S. Department of Agriculture, Forest Service, Northern Research Station. (Available only on internet: https://apps.fs.usda.gov/fia/datamart/datamart.html).

Source: 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories

Table A-4 Above-ground net biomass growth in forest plantations (t-d.m./ha/year)

TABLE 4.10 (UPDATED)
ABOVE-GROUND NET BIOMASS GROWTH IN TROPICAL AND SUB-TROPICAL PLANTATION FORESTS (TONNES D.M. HA^{-1} YR^{-1})

Domain	Ecological zone[1]	Continent	Species	Above-ground biomass [tonnes d.m. ha^{-1} yr^{-1}]	Range [tonnes d.m. ha^{-1} yr^{-1}][2]	References
Tropical	Tropical rainforest	Africa	*Pinus* sp. ≤ 20 y	20		1
			Other ≤ 20 y	6	5-8	1
		North and South America	*Eucalyptus* sp.	20	6-40	1
			Pinus sp.	20		1
			Tectona grandis	15		1
			Other broadleaf	20	5-35	1
		Asia	*Eucalyptus* sp.	5	4-8	1
			Other	5	2-8	1
	Tropical moist deciduous forest	Africa	*Eucalyptus* sp. >20 y	25		1
			Eucalyptus sp. ≤20 y	20		1
			Other ≤ 20 y	9	3-15	1
		North and South America	*Eucalyptus* sp.	16		2
			Tectona grandis	8	4-12	1
			Other broadleaf	6-20	6-20	3
		Asia		8		1
	Tropical dry forest	Africa	*Eucalyptus* sp. ≤20 y	13		1
			Pinus sp. > 20 y	9	7-10	4
			Pinus sp. ≤ 20 y	6	5-8	4
			Other ≤ 20 y	10	4-20	1
		North and South America	*Eucalyptus* sp.	20	6-30	1
			Pinus sp.	7	4-10	1
			Tectona grandis	8	4-12	1
			Other broadleaf	10	3-12	1
		Asia	*Eucalyptus* sp.	15	5-25	1
			Other	7	2-13	1
	Tropical shrubland	Africa	*Eucalyptus* sp. >20 y	8	5-14	1
			Eucalyptus sp. ≤20 y	5	3-7	1
			Pinus sp. > 20 y	2.5		1
			Pinus sp. ≤ 20 y	3	0.5-6	1
			Other > 20 y	10		1
			Other ≤ 20 y	15		1
		North and South America	*Eucalyptus* sp.	20		1
			Pinus sp.	5		1
		Asia		6	1-12	1

TABLE 4.10 (UPDATED) (CONTINUED)
ABOVE-GROUND NET BIOMASS GROWTH IN TROPICAL AND SUB-TROPICAL PLANTATION FORESTS (TONNES D.M. HA^{-1} YR^{-1})

Domain	Ecological zone[1]	Continent	Species	Above-ground biomass [tonnes d.m. ha^{-1} yr^{-1}]	Range [tonnes d.m. ha^{-1} yr^{-1}][2]	References
Tropical	Tropical mountain systems	Africa		10		1
		North and South America	Eucalyptus sp.	10	8-18	1
			Pinus sp.	10		1
		Asia	Tectona grandis	2		1
			other broadleaf	4		1
			Eucalyptus sp.	3		1
			Other	5	1-10	1
Sub-tropical	Subtropical humid forest	North and South America	Eucalyptus sp.	20	6-32	1
			Pinus sp.	7	4-10	1
			Tectona grandis	8	4-12	1
			Other broadleaf	10	3-12	1
		Asia		8		1
	Subtropical dry forest	Africa	Eucalyptus sp. ≤20 y	13		1
			Pinus sp. > 20 y	10		1
			Pinus sp. ≤ 20 y	8		1
			Other ≤ 20 y	10	4-20	1
		North and South America	Eucalyptus sp.	20	6-30	1
			Pinus sp.	7	4-10	1
			Tectona grandis	8	4-12	1
			Other broadleaf	10	3-12	1
		Asia	Eucalyptus sp.	15	5-25	1
			Other	7	2-13	1
	Subtropical steppe	Africa	Eucalyptus sp. >20 y	8	5-14	1
			Eucalyptus sp. ≤20 y	5	3-7	1
			Pinus sp. > 20 y	2.5		1
			Pinus sp. ≤ 20 y	3	0.5-6	1
			Other > 20 y	10		1
			Other ≤ 20 y	15		1
		North and South America	Eucalyptus sp.	20		1
			Pinus sp.	5		1
		Asia		6	1-12	1
	Subtropical mountain systems	Africa		10		1
		North and South America	Eucalyptus sp.	10	8-18	1
			Pinus sp.	10		1
			Tectona grandis	2		1
			Other broadleaf	4		1

TABLE 4.10 (UPDATED) (CONTINUED)
ABOVE-GROUND NET BIOMASS GROWTH IN TROPICAL AND SUB-TROPICAL PLANTATION FORESTS (TONNES D.M. HA^{-1} YR^{-1})

Domain	Ecological zone[1]	Continent	Species	Above-ground biomass [tonnes d.m. ha^{-1} yr^{-1}]	Range [tonnes d.m. ha^{-1} yr^{-1}][2]	References
Subtropical	Subtropical mountain systems	Asia	Eucalyptus sp.	3		1
			Other	5	1-10	1
Temperate	Continental	North and South America	Secondary >20 years	4	5	5
			Secondary ≤20 years	5	4	5
	Mountain	North and South America	Secondary >20 years	9	7	5
			Secondary ≤20 years	10	86	5
	Oceanic	North and South America	Secondary >20 years	10	8	5
			Secondary ≤20 years	6	4	5
	Steppe	North and South America	Secondary >20 years	11	56	5
			Secondary ≤20 years	4	3	5
Boreal	Coniferous	Asia, Europe, North America	Secondary >20 years	1.0		1
			Secondary ≤20 years	1.0		1
	Tundra woodland	Asia, Europe, North America	Secondary >20 years	0.4		1
			Secondary ≤20 years	0.4		1
	Mountain	Asia, Europe, North America	Secondary >20 years	1.0		1
			Secondary ≤20 years	1.0		1

[1] Forest Resources Assessment (FRA). (2015). Global Eological Zones for FAO Forest Reporting 2010 Update. Forest Resources Assessment Working Paper 179.

[2] If a single estimate is included in this column it refers to the standard deviation of the mean estimate.

References

1IPCC 2003; 2Stape et al., 2004; 3Lugo et al., 1990; 4Masota et al 2016; 5June 18, 2018. Forest Inventory and Analysis Database, St. Paul, MN: U.S. Department of Agriculture, Forest Service, Northern Research Station (Available only on internet: http://apps.fs.fed.us/fiadb-downloads/datamart.html).

Source: 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories

Table A-5 Average belowground to aboveground biomass ratio (Root-Shoot ratio)（R）

TABLE 4.4 (UPDATED)
RATIO OF BELOW-GROUND BIOMASS TO ABOVE-GROUND BIOMASS (R) [TONNE ROOT D.M. (TONNE SHOOT D.M.)$^{-1}$]

Domain	Ecological zone[1]	Continent	Origin (Natural/Plantation)	Above-ground biomass (tonnes ha^{-1})	R [tonne root d.m. (tonne shoot d.m.)$^{-1}$]	Uncertainty	Uncertainty type	References
Tropical	Tropical Rainforest	Africa	Natural	≤ 125	0.825	±90%	default	1, 2
			Natural	> 125	0.532	±90%	default	2, 3
		North and South America	Natural	≤ 125	0.221	0.036	SD	4
			Planted	≤ 125	0.170	0.11	SD	5
			Natural	> 125	0.221	0.036	SD	4
			Planted	> 125	0.170	0.11	SD	5
		Asia	Natural	≤ 125	0.207	0.072	SD	6, 7, 8
			Planted	≤ 125	0.325	0.025	SD	8
			Natural	> 125	0.212	0.077	SD	7, 8, 9, 10, 11
	Tropical Moist	Africa	Natural	≤ 125	0.232	±90%	default	12
			Natural	> 125	0.232	±90%	default	12
		North and South America	Natural	≤ 125	0.2845	0.061	SD	12
			Natural	> 125	0.284	0.061	SD	12
		Asia	Natural	≤ 125	0.323	0.073	SD	1, 13, 14, 5
			Natural	> 125	0.246	0.036	SD	12, 16
	Tropical Dry	Africa	Natural	≤ 125	0.332	0.247	SD	1, 12, 17, 18, 19
			Natural	> 125	0.379	0.040	SD	12
		North and South America	Natural	≤ 125	0.334	0.040	SD	4, 12, 20
			Natural	> 125	0.379	0.040	SD	12
		Asia	Natural	≤ 125	0.440	±90%	default	12
			Natural	> 125	0.379	0.040	SD	12
	Tropical Mountain	North and South America	Natural	≤ 125	0.348	±90%	default	4
			Planted	≤ 125	2.158	±90%	default	12
			Natural	> 125	0.283	0.16	SD	21
		Asia	Natural	≤ 125	0.322	0.084	SD	22, 23
			Natural	> 125	0.345	0.280	SD	22, 23

TABLE 4.4 (UPDATED) (CONTINUED)
RATIO OF BELOW-GROUND BIOMASS TO ABOVE-GROUND BIOMASS (R) [TONNE ROOT D.M. (TONNE SHOOT D.M.)$^{-1}$]

Domain	Ecological zone[1]	Continent	Origin (Natural/ Plantation)	Above-ground biomass (tonnes ha^{-1})	R [tonne root d.m. (tonne shoot d.m.)$^{-1}$]	Uncertainty	Uncertainty type	References
Sub-tropical	Sub-tropical Humid	Africa	Natural	≤ 125	0.232	±90%	default	12
			Natural	> 125	0.232	±90%	default	12
		North and South America	Natural	≤ 125	0.175	±90%	default	12
			Natural	> 125	0.284	±90%	default	12
		Asia	Natural	≤ 125	0.230	±90%	default	12
			Natural	> 125	0.246	±90%	default	12
	Sub-tropical Dry	North and South America	Natural	≤ 125	0.336	±90%	default	12
			Natural	> 125	0.352	0.047	SD	12
		Asia	Natural	≤ 125	0.440	0.184	SD	12
			Natural	> 125	0.440	0.184	SD	12
	Sub-tropical Steppe	North and South America	Natural	≤ 125	1.338	±90%	default	12
		Asia	Natural	> 125	1.338	±90%	default	12
			Planted	≤ 125	2.158	±90%	default	12
Temperate	Oceanic	Europe	Natural/Planted (Other Broadleaf)	all size classes	0.192	±90%	default	24
			Natural (Conifer)	≤ 125	0.359	±90%	default	12
			Natural (Other Broadleaf)	>125	0.172	±90%	default	12
			Planted (Conifer)	>125	0.206	±90%	default	12, 25, 26, 27
			Planted (Conifer)	all size classes	0.359	0.145	SD	28
			Planted (Quercus)	≤ 125	1.400	±90%	default	29
		North and South America	Natural (Conifer)	≤ 125	0.337	±90%	default	12
			Natural (Conifer)	>125	0.338	±90%	default	12
			Natural (Other Broadleaf)	≤ 125	0.466	±90%	default	12, 30
			Natural (Other Broadleaf)	>125	0.190	±90%	default	12, 31
			Planted (Conifer)	>125	0.203	±90%	default	12, 32

TABLE. 4.4 (UPDATED) (CONTINUED)
RATIO OF BELOW-GROUND BIOMASS TO ABOVE-GROUND BIOMASS (R) [TONNE ROOT D.M. (TONNE SHOOT D.M.)$^{-1}$]

Domain	Ecological zone[1]	Continent	Origin (Natural/Plantation)	Above-ground biomass (tonnes ha^{-1})	R [tonne root d.m. (tonne shoot d.m.)$^{-1}$]	Uncertainty	Uncertainty type	References
Temperate	Oceanic	Oceania	Natural (Eucalyptus)	≤ 125	0.464	±90%	default	12
			Natural (Eucalyptus)	>125	0.257	±90%	default	12
			Natural (Other Broadleaf)	≤ 125	0.213	±90%	default	34-36
			Natural (Other Broadleaf)	>125	0.313	±90%	default	37, 38
			Planted (Conifer)	all size classes	0.190	±90%	default	39
			Planted (Conifer)	≤ 125	0.634	±90%	default	12
			Planted (Conifer)	>125	0.294	±90%	default	12
			Planted (Eucalyptus)	≤ 125	0.391	±90%	default	12
			Natural (Eucalyptus)	>125	0.188	±90%	default	12, 40
	Continental	Europe	Natural (Quercus)	>125	0.477	±90%	default	12
			Planted (Conifer)	≤ 125	0.340	±90%	default	12
		North and South America	Natural (Other Broadleaf)	≤ 125	0.481	±90%	default	12
			Natural (Other Broadleaf)	>125	0.277	±90%	default	12
			Planted (Conifer)	≤ 125	0.237	±90%	default	12
	Oceanic Continental Mountain	Asia	Natural (Conifer)	≤ 125	0.243	±90%	default	33
			Natural (Conifer)	>125	0.262	±90%	default	33
			Natural (Other Broadleaf)	≤ 125	0.225	±90%	default	33
			Natural (Other Broadleaf)	>125	0.229	±90%	default	33

TABLE. 4.4 (UPDATED) (CONTINUED)
RATIO OF BELOW-GROUND BIOMASS TO ABOVE-GROUND BIOMASS (R) [TONNE ROOT D.M. (TONNE SHOOT D.M.)$^{-1}$]

Domain	Ecological zone[1]	Continent	Origin (Natural/Plantation)	Above-ground biomass (tonnes ha^{-1})	R [tonne root d.m. (tonne shoot d.m.)$^{-1}$]	Uncertainty	Uncertainty type	References
Temperate	Oceanic Continental Mountain	Asia	Planted (Conifer)	≤ 125	0.224	±90%	default	33
			Planted (Conifer)	>125	0.232	±90%	default	33
			Planted (other Broadleaf)	≤ 125	0.307	±90%	default	33
			Planted (other Broadleaf)	>125	0.248	±90%	default	33
Boreal	Coniferous, tundra woodland, mountain systems	-	-	≤ 75	0.390	0.23 - 0.96	Range	12, 46
				>75	0.240	0.15 - 0.37	Range	12, 46

[1] Forest Resources Assessment (FRA). (2015). Global Eological Zones for FAO Forest Reporting 2010 Update. Forest Resources Assessment Working Paper 179.

References:

1Masota, A.M., et al., 2016; 2Njana, M.A., et al., 2015; 3Masota, A.M., et al., 2015; 4FAO, 2015; 5Sanquetta, et al., 2011; 6Saner, P., et al., 2012; 7Murdiyarso, M., et al., 2015; 8Kotowska, M.M., et al., 2015; 9Lu, X.T., et al., 2010; 10Niiyama K, et al., 2010; 11Krisnawati, H., et al., 2014; 12Mokany, K., et al., 2006; 13Wang, X.P., et al., 2008; 14Li, X., et al., 2010; 15Monda, Y., et al., 2016; 16Gautum, T.P., Mandal, T.N., 2016; 17Mugasha, W.A., et al., 2013; 18Malimbwi, R.E., et al., 2016; 19Makero, et al., 2016; 20Sato, T., et al., 2015; 21Moser, G., 2011; 22Iqbal, K., et al., 2014; 23Sharma, D.P., 2009; 24Skovsgaard, J.P., Nord-Larsen, T., 2012; 25Green C., et al., 2007; 26Urban, J., et al., 2015; 27Xiao, C.W., et al., 2003; 28Levy, P.E., et al., 2004; 29Cotillas, M., et al., 2016; 30Gargaglione, et al., 2010; 31Frangi, J.L., et al., 2005; 32Miller, A.T., et al., 2006; 33Luo, Y., et al., 2014; 34Schwendenmann, L., Mitchell, N., 2014; 35Watson, A,. O'Loughlin, C., 1985; 36Watson, A., 1995; 37Beets, P.N., 1980; 38Miller, R. B. 1963; 39Beets PN, et al. 2007; 40Oliver GR, et al. 2009; 41Battles, J. J., et al. 2002; 42Laclau P. 2003; 43Grimm, U., Fassbender, H., 1981, 44Edwards, P., Grubb, P., 1977; 45Scott, N.A., et al., 2005; 46Li, et al., 2003.

Source：2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories

Table A-6 CO_2 Emissions from Fertilizer, lLakages and Effects of GHG emissions Reduction[1]

Project	Host Parties	fertilizer (tonnes of CO2 e)	Estimation of baseline net GHG removals by sinks (tonnes of CO2 e)	Estimation of actual net GHG removals by sinks (tonnes of CO2 e)	Estimation of leakage (tonnes of CO2 e) [A]	Estimation of net anthropogenic GHG removals by sinks (tonnes of CO2 e) [B]	Ratio of leakage [A]/[B]
CARBON SEQUESTRATION THROUGH REFORESTATION IN THE [illegible]	Bolivia	zero	0	11,529	24,124	91,165	26%
Reforestation of croplands and grasslands in low income communities [illegible]	Paraguy	3	8,737	58,188	18,983	30,468	62%
Facilitating Reforestation for Guangxi Watershed Management in Pearl River Basin	China	zero	531	794,225	19,852	773,842	3%
The International Small Group and Tree Planting Program (TIST), Tamil Nadu, India	India	zero	0	107,810	0	107,810	0%
Moldova Soil Conservation Project	Moldova	zero	109,962	3,702,513	7,705	3,584,846	0%
Southern Nicaragua CDM Reforestation Project	Nicaragua	zero	0	237,448	0	237,448	0%
Uganda Nile Basin Reforestation Project No 3	Uganda	zero	0	111,798	0	111,798	0%
Reforestation, sustainable production and carbon sequestration project [illegible]	Peru	zero	171,545	1,145,332	0	973,788	0%
Reforestation on Degraded Lands in Northwest Guangxi	China		15,394	1,761,552	0	1,746,158	0%
Reforestation of grazing Lands in Santo Domingo, Argentina	Argentina	zero	21,366	1,342,140	0	1,320,775	0%
Assisted Natural Regeneration of Degraded Lands in Albania	Albania	zero	6,250	465,537	0	459,287	0%
[illegible]" afforestation on degraded extensive grazing land	Uruguay	zero	0	659	0	659	0%
[illegible] and Productive Alternative for the City and the Region .	Columbia	zero	0	755,678	0	755,678	0%
[illegible]	Congo	zero	0	1,635,338	0	1,635,338	0%
[illegible]	Brasil	—	59,257	4,788,332	0	4,729,074	0%
Humbo Ethiopia Assisted Natural Regeneration Project	Ethiopia	zero	0	880,296	0	880,296	0%
Cao Phong Reforestation Project	Vietnam	22	0	53,735	11,090	42,645	26%
[illegible]	India	zero	0	828,016	0	828,016	0%
Improving Rural Livelihoods Through Carbon Sequestration By Adopting Environment Friendly Technology based Agroforestry Practices	India	—	0	146,888	0	146,888	0%
Reforestation as Renewable Source of Wood Supplies for Industrial Use in Brazil	Brasil	—	751,894	30,409,091	15,522	2,273,493	1%
Argos CO2 Offset Project, through reforestation activities for commercial use.	Columbia	—	133,021	1,079,384	23,100	923,263	3%
Small Scale Cooperative Afforestation CDM Pilot Project Activity on Private Lands Affected by Shifting Sand Dunes in Sirsa, Haryana.	India	zero	43	29,785	0	231,920	0%
Nerquihue Small-Scale CDM Afforestation Project using Mycorrhizal Inoculation in Chile	Chile	zero	0	185,836	0	185,836	0%
Forestry Project in Strategic Ecological Areas of the Colombian Caribbean Savannas	Columbia	zero	279	1,999,849	0	1,999,571	0%

[1] UNFCCC CDM http://cdm.unfccc.int/Projects/projsearch.html

Table A-7 Examples of Stratification in Afforestation Projects（CDM Project）[2]

Country： Paraguay
Project participants：Japan International Research Center for Agricultural Sciences
Instituto Forestal Nacional (Public entity)
https://cdm.unfccc.int/Projects/DB/TUEV-SUED1245074838.6/view
Title： Reforestation of croplands and grasslands in low income communities of Paraguari Department, Paraguay
CDM registered 2009

Stratum	Tree species	Tree spacing(m)	Plant age	Forested area (ha)
S1	Eucalyptus grandis	3.0×2.5	2007	30.05
S2	Eucalyptus grandis	3.0×2.5	2008	31.17
S3	Eucalyptus camaldulensis	3.0×2.5	2007	16.36
S4	Eucalyptus camaldulensis	3.0×2.5	2008	64.48
S5	Grevillea robusta	3.0×2.5	2007	5.59
S6	Grevillea robusta	3.0×2.5	2008	15.16
S7	Grevillea robusta	5.0×4.0	2007	14.05
S8	Grevillea robusta	5.0×4.0	2008	38.30
Total				215.16

Country： India
Project participants：Haryana CDM Variksh Kisan Samiti, Ellenabad, Sirsa
Title： Small Scale Cooperative Afforestation CDM Pilot Project Activity on Private Lands Affected by Shifting Sand Dunes in Sirsa, Haryana.
https://cdm.unfccc.int/Projects/DB/TUEV-SUED1229620290.53/view
CDM registered 2008

Stratum	Tree species	Tree spacing(m)	Plant age	Forested area (ha)
S1	*Eucalyptus hybrid*		2007	26.30
S2	*Ailanthus excelsa*		2007	57.86
S3	*Acacia tortilis*		2007	61.65
S4	*Dalbergia sissoo*		2007	53.65
S5	*Acacia nilotica*		2007	60.75
S6	*Prosopis cineraria*		2007	74.20
S7	*Zizyphus mauritiana*		2007	35.46
Total				369.87

[2] UNFCCC: http://cdm.unfccc.int/Projects/projsearch.html

Country： Bolivia
Project participants：FECAR (community organization), (Private entity)
Foundation Centro Tecnico Forestal (CETEFOR) (Private entity)
Asociación Accidental Cetefor-Sicirec (Private entity)
Vlaams Gewest (Public entry)
Title： CARBON SEQUESTRATION THROUGH REFORESTATION IN THE BOLIVIAN TROPICS BY SMALLHOLDERS OF "The Federación de Comunidades Agropecuarias de Rurrenabaque (FECAR)" Version 2.03
https://cdm.unfccc.int/Projects/DB/JACO1239802765.75/view
CDM registered 2009

Stratum	Tree species	Tree spacing(m)	Plant age	Forested area (ha)
S1	*Fast growing/ plantation*	—	—	—
S2	*Fast growing/Agroforestry System*	—	—	—
S3	*Fast growing/ Silvipastoral System*	—	—	—
S4	*Midium growing/ plantation*	—	—	—
S5	*Midiumgrowing/AgroforestrySystem*	—	—	—
S6	*Midium growing/ Silvipastoral System*	—	—	—
S7	*Slow growing/ plantation*	—	—	—
S8	*Slow growing/Agroforestry System*	—	—	—
S9	*Slow growing/ Silvipastoral System*	—	—	—
Total				317ha

Table A-8 Example of Stratification for Deforestation and Forest Degradation Prpjects

Comparison of land use category classification between IPCC and Ministry of Forestry, Indonesia

林業省土地区分	IPCC 土地区分対応
23 土地区分	6 土地区分
1. Forest (7 categories)	1. Forest land (4 sub categories)
1) Primary Dry land Forest	1) Dry land Forest
2) Secondary Dry land Forest	2) Mangrove Forest
3) Primary Mangrove Forest	3) Swamp Forest
4) Secondary Mangrove Forest	4) Forest Plantation
5) Primary Swamp Forest	2. Crop land (3 subcategories),
6) Secondary Swamp Forest	5) Dry land Agriculture
7) Plantation Forest	6) Plantation
2. Non-forest (14 categories) :	7) Rice
8) Agriculture dry land	3. Grass Land (1 sub categories),:
9) Dry land Agriculture and shrubs	8) Grass Land
10) Plantation	4. Wetlands (1 sub categories),
11) Rice	9) Swamp
12) shrub / scrub	5. Settlements (1 sub categories),
13) Savanna	10) Settlement
14) Kingfisher swamp	6. Other Lands (1 sub categories),
15) Swamp	11) Pond, Cloud
16) Transmigration	
17) Settlement	
18) Pond	
19) Land open	
20) Mining	
21) Port of air / sea	
3. No data (category 2),	
22) Cloud	
23) No data	

Source: Survey on REDD in Indonesia (Global Warming Mitigation Technology Promotion Projects in 2010 (METI))

Stratification and LULUC

Class Identifier		Average carbon density (tCO2.ha-1)		
ID	Name	CD_{AB}	CD_{BB}	Total average carbon density
Native1	Floresta Arbórea Densa	90,99	379,13	470,13
Native2	Floresta Arbórea Aberta	91,16	42,91	134,08
Native3	Vegetação gramínio-lenhosa	51,87	16,03	67,90
Native4	Solo-exposto natural	51,87	16,03	67,90
Antrop1	Área cultivada	N.A.	N.A.	17,23
Antrop2	Pastagem	N.A.	N.A.	27,75

Note:
CD_{AB} – Average Carbon Density in the above-ground biomass carbon pool; tCO2.ha-1
CD_{BB} – Average Carbon Density in the below-ground biomass carbon pool; tCO2.ha-1
N.A. – denotes Not Available
Sources:
Native1 to Native4 - Castro and Kauffman, 1998
Antrop1 and Antrop2 - IPCC, 2006

The reference, leakage and project emission are determined based on the aboveground and belowground biomasses stock changes as for 6 stratum defined

Source: REDD survey in Mato Grosso, Brasil (2009, CDM/JICA)。

Stratification by Forest Types and Regions

Arrangement of the national forest inventory data Results (Mean AGB+BGB par Regions and F.Types

(CO_2t/ha)

※2 / ※1	1	2	3	4	5	6	7	8	9	10	11	12
1			181	157								75
2	604	282	144	157	178		279					
3										115		104
4	798	299										
5	508	275	158	131		78	219	92				67
6	516	272	135	94		66	118				165	103
7	417	272	171	116		82	181	146				70
8												
9		271	110	115		86	122		105	4		85
10	465	282	158	148	196	138	249					94
11	502	291	162	135	153	91	199	253	292			163
12	511	280	120	128	189	104	240		271			106
14												102

※1 (Bio-ecoregions): 1=Cardamom Mountains rain forests, 2=Central Indochina dry forests, 3=Indochina mangroves, 4=Luang Prabang montane rain forests, 5=Northern Annamites rain forests, 6=Northern Indochina subtropical forests, 7=Northern Vietnam lowland rain forests, 8=Red River freshwater swamp forests, 9=South China-Vietnam subtropical evergreen forests, 10=Southeastern Indochina dry evergreen forests
11=Southern Annamites montane rain forests, 12=Southern Vietnam lowland dry forests, 14=Tonle Sap-Mekong peat swamp forests

※2（Forest types）; 1=Evergreen broadleaf forest(rich forest), 2=Evergreen broadleaf forest(medium forest), 3=Evergreen broadleaf forest(poor forest), 4=Evergreen broadleaf forest(rehabilitationr forest), 5=Deciduous forest, 6=Bamboo forest, 7=Mixed timber and bamboo forest, 8=Coniferous forest, 9=Mixed broadleaf and coniferous forest, 10=Mangrove forest, 11=Limestone forest, 12=Plantation

Source : Baseline Scenario Survey in Vietnam (Japan Forest Technology Association)