

Annex I: List of Emission Factors

Disclaimer: The emission factors (EF) in the table below are provided for greenhouse gas emissions quantification and should be updated regularly with the latest, region- and activity-specific data from reliable sources. Consistent with the GHG Protocol, users are encouraged to apply appropriate emission factors reflecting current technologies and conditions to ensure accuracy and transparency. Due to inherent data variability and uncertainties, ongoing review and quality management are essential for reliable emissions accounting. The list of emission factors provided here are for references only and users are recommended to use recent peer reviewed literature articles or emission factor databases with recent versions. Please consider that the EF are mathematically rounded up or down to match the relevant digit numbers showcased.

FREQUENTLY USED EMISSION FACTORS AND THEIR RESPECTIVE SOURCES			
Input	Unit	Standard factor	Source, description
A) Emission factors for cultivation			
Fertilizers			
CaO-fertilizer	kg CO ₂ eq/kg CaO	0.13	European Commission: Standard values for emission factors , v 1.0. 2015
Calcium ammonium nitrate	kg CO ₂ eq/kg CaN	3.67	European Commission: Standard values for emission factors , v 1.0. 2015
Diammonium phosphate (DAP)	kg CO ₂ eq/kg DAP	1.15	Brentrup, Frank & Lammel, Joachim & Stephani, Tiffanie & Christensen, Bjarne. (2018). Updated carbon footprint values for mineral fertilizer from different world regions. For country specific values, please refer to the literature.
K ₂ O-fertilizer	kg CO ₂ eq/kg K ₂ O	0.58	European Commission: Standard values for emission factors , v 1.0. 2015
Limestone (CaCO ₃)	kg CO ₂ eq/kg CaCO ₃	0.07	Brentrup, Frank & Lammel, Joachim & Stephani, Tiffanie & Christensen, Bjarne. (2018). Updated carbon footprint values for mineral fertilizer from different world regions.
Magnesium oxide	kg CO ₂ eq/kg	1.06	https://legacy.winnipeg.ca/finance/findata/matmgt/documents/2012/682-2012/682-2012_appendix_h-

			wstp_south_end_plant_process_selection_report/appendix%207.pdf
Muriate of potash (Potassium chloride)	kg CO ₂ eq/kg K ₂ O	0.25	Brentrup, Frank & Lammel, Joachim & Stephani, Tiffanie & Christensen, Bjarne. (2018). Updated carbon footprint values for mineral fertilizer from different world regions.
Monoammonium phosphate	kg CO ₂ eq/kg N	0.81	Brentrup, Frank & Lammel, Joachim & Stephani, Tiffanie & Christensen, Bjarne. (2018). Updated carbon footprint values for mineral fertilizer from different world regions.
N-fertilizer	kg CO ₂ eq/kg N ¹	5.89	European Commission: Standard values for emission factors , v 1.0. 2015
NPK fertilizer (mixed acid)	kg CO ₂ eq/kg N	1.61	Brentrup, Frank & Lammel, Joachim & Stephani, Tiffanie & Christensen, Bjarne. (2018). Updated carbon footprint values for mineral fertilizer from different world regions.
NPK fertilizer (nitro phosphate)	kg CO ₂ eq/kg N	1.71	Brentrup, F., Lammel, J., Stephani, T., & Christensen, B. (2018, October). Updated carbon footprint values for mineral fertilizer from different world regions. In <i>11th International Conference on Life Cycle Assessment of Food</i> , Kasetsart University (pp. 17-19).
P ₂ O ₅ -fertilizer	kg CO ₂ eq/kg P ₂ O ₅	1.01	European Commission: Standard values for emission factors , v 1.0. 2015
Urea	kg CO ₂ eq/kg N	1.99	Brentrup, F., Lammel, J., Stephani, T., & Christensen, B. (2018, October). Updated carbon footprint values for mineral fertilizer from different world regions. In <i>11th International Conference on Life Cycle Assessment of Food</i> , Kasetsart University (pp. 17-19).

¹ For all N-fertilizers the emission factor refers to the amount of nitrogen in the fertilizer.

Specific fertilizer production emissions for Southeast Asia Region			
Ammonium nitrate - 33.5% N (granulated)	Kg CO ₂ eq/kg of product	2.39	Brentrup et al., 2018, pg 4.
Ammonium nitrate - 33.5% N (prilled)	Kg CO ₂ eq/kg of product	2.34	Brentrup et al., 2018, pg 4.
Ammonium sulphate - 21% N	Kg CO ₂ eq/kg of product	0.65	Brentrup et al., 2018, pg 4.
Ammonium sulphate nitrate - 26% N	Kg CO ₂ eq/kg of product	1.35	Brentrup et al., 2018, pg 4.
Anhydrous ammonia - 82% N	Kg CO ₂ eq/kg of product	2.38	Brentrup et al., 2018, pg 4.
Calcium ammonium nitrate - 27%N	Kg CO ₂ eq/kg of product	1.96	Brentrup et al., 2018, pg 4.
Calcium nitrate - 15.5%N	Kg CO ₂ eq/kg of product	1.68	Brentrup et al., 2018, pg 4.
Compound NPK - 15% N/ 15% K ₂ O/ 15% P ₂ O ₅ (mixed-acid process)	Kg CO ₂ eq/kg of product	1.13	Brentrup et al., 2018, pg 4.
Compound NPK - 15% N/ 15% K ₂ O/ 15% P ₂ O ₅ (nitrophosphate process)	Kg CO ₂ eq/kg of product	1.22	Brentrup et al., 2018, pg 4.
Diammonium phosphate - 18% N /46% P ₂ O ₅	Kg CO ₂ eq/kg of product	0.74	Brentrup et al., 2018, pg 4.
Monoammonium phosphate - 11% N /52% P ₂ O ₅	Kg CO ₂ eq/kg of product	0.55	Brentrup et al., 2018, pg 4.
Super phosphate - 21% P ₂ O ₅	Kg CO ₂ eq/kg of product	0.11	Brentrup et al., 2018, pg 4.

Triple super phosphate - 21% P ₂ O ₅	Kg CO ₂ eq/kg of product	0.25	Brentrup et al., 2018, pg 4.
Urea 46%	Kg CO ₂ eq/kg of product	0.93	Brentrup et al., 2018, pg 4.
Urea ammonium nitrate solution 32%N	Kg CO ₂ eq/kg of product	1.36	Brentrup et al., 2018, pg 4.
Pesticides			
Pesticides (general value) – insecticides, fungicides, etc.	kg CO ₂ eq/kg a.i. ²	10.97	European Commission: Standard values for emission factors, v 1.0. 2015
B) Emission factors for processing			
Process inputs			
Process water	kg CO ₂ eq/m ³	0.42	Zib III, L. J. (2021). Operational Carbon Footprint of the US Water Sector's Energy Consumption.
Packaging material (jute)	kg CO ₂ eq/kg	0.57	SINGH, A. K., KUMAR, M., & MITRA, S. (2018). Carbon footprint and energy use in jute and allied fibre production. <i>The Indian Journal of Agricultural Sciences</i> , 88(8), 1305-1311. https://doi.org/10.56093/ijas.v88i8.82579
Packaging material (plastic)	kg CO ₂ eq/kg	1.7	Benavides, P. T., Lee, U., & Zarè-Mehrjerdi, O. (2020). Life cycle greenhouse gas emissions and energy use of polylactic acid, bio-derived polyethylene, and fossil-derived polyethylene. <i>Journal of Cleaner Production</i> , 277, 124010.
Packaging material (paper)	kg CO ₂ eq/kg	1.7	Brogaard, L. K., Damgaard, A., Jensen, M. B., Barlaz, M., & Christensen, T. H. (2014). Evaluation of life cycle inventory data for recycling systems. <i>Resources, Conservation and Recycling</i> , 87, 30-45.
Electricity consumption from grid (electricity mix)			

² Active ingredient

EU	kg CO ₂ eq/kWh _e 	0.30	N. Scarlat, et.al, (2022). Quantification of the carbon intensity of electricity produced and used in Europe
Brazil	kg CO ₂ eq/kWh _e 	0.12	Ministério da Ciência, Tecnologia e Inovações (2021). Fatores de emissão.
China	kg CO ₂ eq/kWh _e 	0.55	Climate Transparency. Country Profile China 2019.
Colombia	kg CO ₂ eq/kWh _e 	0.12	Unidad de Planeación Minero Energética (2022). Resolución No. 320
Honduras	kg CO ₂ eq/kWh _e 	0.61	CDM Standardized baseline "Honduran Grid Emission Factor Version 01.0 (ASB0042-2019)
India	kg CO ₂ eq/kWh _e 	0.81	Central Electricity Authority (2021). CDM CO2
Indonesia	kg CO ₂ eq/kWh _e 	0.71	Carbon Footprint Ltd. (2020). Emissions Factors & Sources for 2021 Electricity.
Kenya	kg CO ₂ eq/kWh _e 	0.49	CDM Standardized baseline "Grid Emission Factor for the Republic of Kenya" version 01.0 (ASB0050-2020)
Malaysia	kg CO ₂ eq/kWh _e 	0.64	IGES (2017). Grid Emission Factor (GEF) for the Asia-Pacific region
Mexico	kg CO ₂ eq/kWh _e 	0.43	Secretaría de Medio Ambiente y Recursos Naturales (2022). Aviso Factor de Emisión.
Philippines	kg CO ₂ eq/kWh _e 	0.69	Department of Energy, the Philippines 2015-2017 National Grid Emission Factor (NGEF)
Rwanda	kg CO ₂ eq/kWh _e 	0.54	National Inventory Report Rwanda September (2018).
Tanzania	kg CO ₂ eq/kWh _e 	0.51	IGES List of Grid Emission Factors V10.11 (2021)

Thailand	kg CO ₂ eq/kWh _e 	0.56	Thailand Grid Emission Factor for GHG Reduction Project/Activity (2016)
Uganda	kg CO ₂ eq/kWh _e 	0.27	CDM Standardized baseline: "Grid emission factor for the national power grid of Uganda version 01.0" (ASB0054) (2022)
Vietnam	kg CO ₂ eq/kWh _e 	0.72	Ministry of Resources and Environment (2021). Electric emission coefficients Vietnam
Energy consumption from internal production			
Diesel	kg CO ₂ e/L	3.20	U.S.: EPA Center for Corporate Climate Leadership Emission Factors for Greenhouse Gas Inventories (2024), Table 2: https://www.epa.gov/climateleadership/ghg-emission-factors-hub
Petrol	kg CO ₂ eq/L	3.18	Eggleston & Walsh (2000) Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories
Natural gas	kg CO ₂ eq/MJ	4000 km, Russian quality: 0.07 4000 km, EU Mix quality: 0.07	European Commission: Standard values for emission factors, v 1.0. 2015
Solar electricity	kg CO ₂ eq/kWh	0.02	Reichel, C., Müller, A., Friedrich, L., Herceg, S., Mittag, M., Protti, A., & Neuhaus, D. H. (2022, September). CO ₂ Emissions of Silicon Photovoltaic Modules—Impact of Module Design and Production Location. In <i>Proceedings of the 8th World Conference on Photovoltaic Energy Conversion, Milan, Italy</i> (pp. 26-30).
Waste wood – combustion emissions	kg CO ₂ eq/kg	1.75	GHG Protocol's Calculation Tools and Guidance ghgprotocol.org/calculation-tools-and-guidance
Wind electricity	kg CO ₂ eq/kWh	0.01	Dolan, S.L. and Heath, G.A. (2012), Life Cycle Greenhouse Gas Emissions of Utility-Scale Wind Power. <i>Journal of Industrial Ecology</i> ,

			16: S136-S154. https://doi.org/10.1111/j.1530-9290.2012.00464.x
Waste treatment			
Wastewater treatment	kg CO ₂ eq/cbm	0.425	Carbon Footprint across the Coffee Supply Chain: The Case of Costa Rican Coffee. Bernard Killian, Lloyd Rivera, Melissa Soto and David Navichoc DOI:10.17265/2161-6264/2013.03B.001
Coffee wastewater methane emissions (on-site)	kg CO ₂ / kg wastewater	0.375	Federación Nacional de Cafeteros de Colombia Centro Nacional de Investigaciones de Café Cenicafé, Environmental Footprint of Coffee in Colombia - Guidance Document ; Page 47
Composting of residues (aerobically)	kg CO ₂ eq/kg	0.026	Calculation of GHG emissions in waste and waste-to-energy projects Release date: 13 December 2013 Topics: Energy, Circular economy and solid waste Author: Christian Schempp, Dorothee Teichmann https://jaspers.eib.org/files/library/2013/calculation-of-ghg-emissions-in-waste-and-waste-to-energy-projects.pdf
Composting of residues (anaerobically)	kg CO ₂ eq/kg	0.008	Calculation of GHG emissions in waste and waste-to-energy projects Release date: 13 December 2013 Topics: Energy, Circular economy and solid waste Author: Christian Schempp, Dorothee Teichmann https://jaspers.eib.org/files/library/2013/calculation-of-ghg-emissions-in-waste-and-waste-to-energy-projects.pdf
Pulp treatment (decomposition of pulp)	kg CO ₂ eq /kg green coffee	0.644	Federación Nacional de Cafeteros de Colombia Centro Nacional de Investigaciones de Café Cenicafé, Environmental Footprint of Coffee in Colombia - Guidance Document ; Page 48

C) Emission factors for transport & distribution			
Diesel	kg CO ₂ eq/liter	3.14	Biograce v 4d, 2014
Petrol	kg CO ₂ eq/liter	2.34	U.S.: EPA Center for Corporate Climate Leadership Emission Factors for Greenhouse Gas Inventories (2024), Table 2: https://www.epa.gov/climateleadership/ghg-emission-factors-hub
Diesel consumption car (loaded)	L/km	0.08	GFEI (2017) Fuel Economy In Major Car Markets: Technology And Policy Drivers 2005-2017. Working Paper 19
Diesel consumption car (unloaded)	L/km	0.08	GFEI (2017) Fuel Economy In Major Car Markets: Technology And Policy Drivers 2005-2017. Working Paper 19
Diesel consumption motorbike (loaded)	L/km	0.02	lcct (2022) Two-Wheelers In Vietnam: A Baseline Analysis Of Fleet Characteristics And Fuel Consumption In 2019 And 2020. Working Paper 2022-08, Pg. 7.
Diesel consumption motorbike (unloaded)	L/km	0.02	lcct (2022) Two-Wheelers In Vietnam: A Baseline Analysis Of Fleet Characteristics And Fuel Consumption In 2019 And 2020. Working Paper 2022-08, Pg. 7.
Diesel consumption truck (loaded)	L/km	0.49	BLE, 2010, Guideline Sustainable Biomass Production
Diesel consumption: truck (unloaded)	L/km	0.25	BLE, 2010, Guideline Sustainable Biomass Production
Electricity consumption train (electricity)	kWh/ton-km	0.06	Biograce v 4d, 2014. Conversion factor 1 MJ = 0.28 kWh
Heavy fuel oil (HFO)	kg CO ₂ eq/L	3.42	Biograce v 4d, 2014
	kg CO ₂ eq/MJ	0.09	European Commission: Standard values for emission factors
HFO for maritime transport	kg CO ₂ eq/MJ	0.09	European Commission: Standard values for emission factors, v 1.0. 2015