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CARBON FOOTPRINT REFERENCE VALUES

ENERGY EFFICIENCY AND GREENHOUSE GAS EMISSIONS

IN EUROPEAN MINERAL FERTILIZER PRODUCTION AND USE

SUSTAINABLE
AGRICULTURE
IN EUROPE

Mineral fertilizers are an essential component of sustainable agriculture. They bridge the gap between the nutrients required for optimal crop development and the nutrients supplied by the soil and available organic sources.

Although the production and use of mineral fertilizers consumes energy and emits carbon dioxide (CO_2) and other greenhouse gases (GHGs), their use should not be evaluated without considering their benefits in agricultural and energy production.

By converting solar energy into crop biomass, the energy balance of crop production is positive. Appropriate use of mineral fertilizers further improves this positive balance and, depending on the crop, helps fix 10 to 15 times more energy than that used in the production, transportation and application of the fertilizer.

Fertilizers Europe's DAN initiative promotes the benefits of the use of Directly Available Nitrogen fertilizers, such as ammonium nitrate, calcium ammonium nitrate, ammonium nitrosulphate and calcium nitrate, in European agriculture. These compound nitrogen fertilizers offer farmers and agronomists a precise and reliable means of increasing food and bio-energy production and reducing environmental emissions.

The energy use and GHG emissions for the production and use of the major mineral fertilizers is given opposite.

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MINERAL FERTILIZER CARBON FOOTPRINT REFERENCE VALUES: 2011

			GHG emissions (GWP 100 yrs: IPCC, 2007)								Energy consumption*
Fertilizer product		Nutrient content	Fertilizer production	Fertilizer use (soil effects)					Fertilizer production + use		Fertilizer production
			At plant gate	CO_2 from urea hydrolysis	Direct N_2O from use	Indirect N_2O via NH_3	Indirect N_2O via NO_3^-	CO_2 from liming and CAN	Total	Total	On-site
			kg CO_2-eq/ kg product						kg CO_2-eq/kg product	kg CO_2-eq/kg nutrient	MJ/kg product
Ammonium nitrate	AN	33.5% N	1.18	0.00	1.26	0.01	0.35	0.27	3.06	9.14	14.02
Calcium ammonium nitrate	CAN	27% N	1.00	0.00	0.89	0.01	0.28	0.20	2.40	8.88	11.78
Ammonium nitrosulphate	ANS	26% N, 14% S	0.83	0.00	1.10	0.02	0.27	0.40	2.62	10.09	10.61
Calcium nitrate	CN	15.5% N	0.68	0.00	0.65	0.00	0.16	0.00	1.50	9.67	7.23
Ammonium sulphate	AS	21% N, 24% S	0.58	0.00	0.98	0.02	0.22	0.50	2.30	10.95	8.07
Ammonium phosphates	DAP	18% N, 46% P_2O_5	0.73	0.00	0.76	0.01	0.19	0.34	2.03	11.27	6.76
Urea	Urea	46% N	0.91	0.73	2.37	0.28	0.48	0.36	5.15	11.19	23.45
Urea ammonium nitrate	UAN	30% N	0.82	0.25	1.40	0.10	0.32	0.24	3.13	10.43	13.84
NPK 15-15-15	NPK	15% N, 15% P_2O_5, 15% K_2O	0.76	0.00	0.56	0.01	0.16	0.12	1.61	10.71	7.59
Triple superphosphate	TSP	48% P_2O_5	0.26	0.00	0.00	0.00	0.00	0.01	0.27	0.56	0.18
Muriate of potash	MOP	60% K_2O	0.25	0.00	0.00	0.00	0.00	0.00	0.25	0.43	3.00

FERTILIZER PRODUCTION

GHG emissions and energy consumption representing European production technology in 2011, as provided by Fertilizers Europe in 2014 (calculated with FertEU Carbon Footprint calculator V 1.0).

Key assumptions:

- Emission and energy figures for fertilizer production are simple averages, i.e. not weighted according to production volumes per site
- Feedstock for ammonia production is natural gas
- Emissions from supply of energy (feedstock and fuel) are included (EU average European Ecoinvent 2.0, not weighted according to production volumes per site)
- Emissions from typical transport of raw material is included (for details see FertEU Carbon Footprint calculator V 1.0)
- Steam export from ammonia, nitric acid and sulphuric acid units is fully utilized in the site steam network.

GHGs are converted into CO_2 equivalents (IPCC 2007, i.e. 1 kg N_2O = 298 kg CO_2-eq).

TRANSPORT AND HANDLING

Only included for raw materials, not for final products, which are all assumed to be produced in Europe (usually not very relevant for nitrogen fertilizers produced and used in Europe; could be significant for import/export).

FERTILIZER USE (SOIL EFFECTS)

CO_2 from urea hydrolysis

Only relevant for urea and urea-containing fertilizers. Urea is hydrolysed shortly after application in the field. This process releases CO_2 (the amount is equivalent to the amount fixed during urea production, 733 kg CO_2/t urea).

N_2O from fertilized soils

N_2O emissions due to microbial conversion of the fertilizer-N in the soil (nitrification and denitrification, so called "direct N_2O emission"). Emission rates are based on fertilizer-specific emission factors developed by Bouwman et al. (2002). N_2O is converted into CO_2 equivalents (N_2O = 298 x CO_2).

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** Energy consumption refers only to energy used on the production site.*

N_2O from NH_3 volatilization

N_2O emissions from fertilizer-N that has been first emitted to air via NH_3 volatilization and deposited afterwards (so-called "indirect N_2O emission"). NH_3 volatilization losses estimated according to EMEP/UNECE Guidebook (2009). N_2O-N emission from deposited NH_3-N = 1% (IPCC, 2006). N_2O is converted into CO_2 equivalents (N_2O = 298 x CO_2).

N_2O from NO_3 leaching

N_2O emissions from fertilizer-N that has been first lost to water via NO_3 leaching and that is denitrified afterwards (so called "indirect N_2O emission"). Average leaching loss = 30% of all nitrogen applied (IPCC, 2006). N_2O-N emission from leached NO_3-N = 0.75% (IPCC, 2006). N_2O is converted into CO_2 equivalents (N_2O = 298 x CO_2).

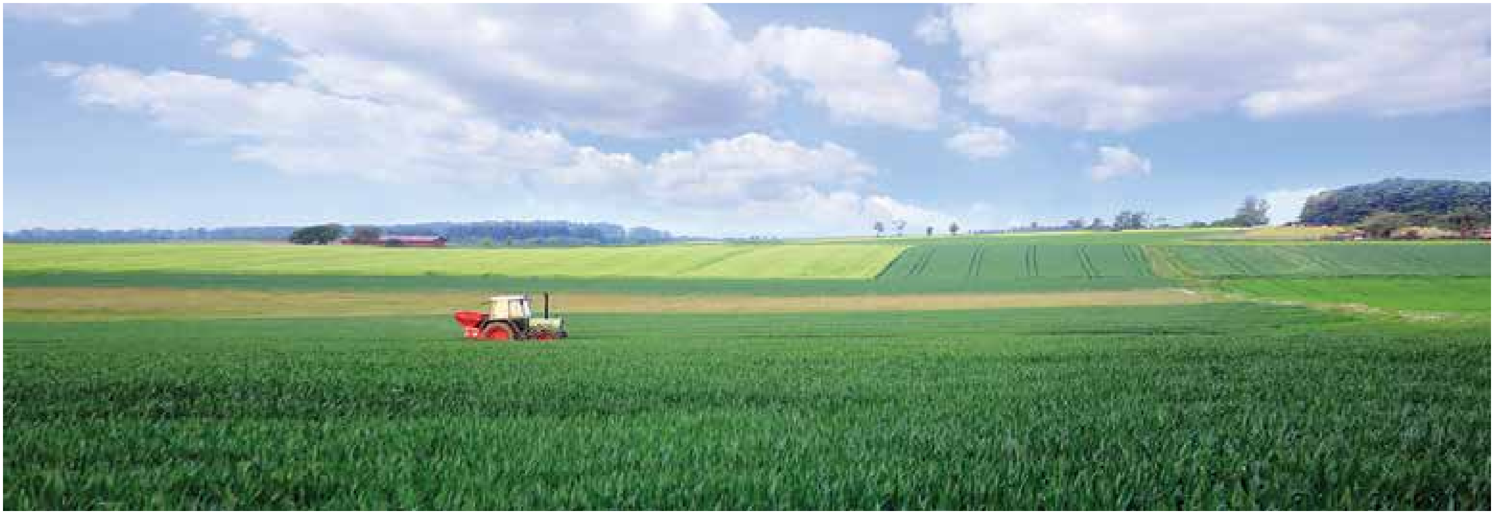
CO_2 from applied lime and CAN

Direct CO_2 emission from limestone or lime/dolomite containing CAN (0.1 kg CO_2/kg CAN) applied to soil. Liming rate according to lime demand to counteract the acidification of different N fertilizers (see table below, $CaCO_3$ x 0.44 = CO_2). No indirect figures from production and spreading for limestone.

Lime demand of different N fertilizers
(in kg $CaCO_3$/kg nutrient)

Ammonium nitrate	1.8
Calcium ammonium nitrate	0.86
Ammonium nitrosulphate	3.5
Calcium nitrate	-1.51
Ammonium sulphate	5.4
Mono-ammonium phosphate	6.05
Di-ammonium phosphate	4.28
Urea	1.8
Liquid urea ammonium nitrate	1.8
Triple superphosphate	0.07
Muriate of potash	0

Source: KTBL (2005)



Fertilizers Europe represents the majority of fertilizer producers in Europe and is recognized as the dedicated industry source of information on mineral fertilizers. The association communicates with a wide variety of institutions, legislators, stakeholders and members of the public who seek information on fertilizer technology and topics relating to today's agricultural, environmental and economic challenges. The Fertilizers Europe website provides information on subjects of relevance to all those interested in fertilizers contribution to global food security.

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