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NORMALISATION IN PRODUCT LIFE CYCLE ASSESSMENT:

An LCA of the Global and European Economic Systems in the year 2000

SUPPORTING INFORMATION 1

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Data collection and data estimations

Direct emission data

Emission data for the most important climate change agents is readily available from reports by UNFCCC (2005). The data is also available on the level of individual countries, making it easy to determine emissions on the European level required. Emission data on acidifying substances and substances that cause photochemical oxidant formation for European countries (and sometimes a small number of Asian countries as well) was extracted from European databases (EMEP, 2006; EEA, 2006b; UNECE, 2003). Some of these databases also provide emission data for a relatively small number of toxic substances, although the number of countries for which this last data is available varies largely. The European database EDGAR (NEAA, 2006) provides emission scenarios for the year 2000 for individual countries on a global level for both climate change and acidifying agents. EDGAR emission scenario data was used to supplement European databases with emission data for Malta and for on the European level and to extend European databases to a global level. Emissions of SF_6 were taken from the same scenario database. EDGAR emission scenario data for carbon dioxide were favoured to UNFCC emission data if this last data was outdated by more than two years, which was the case for most developing or ‘Annex 2’ countries. Global emissions of HFCs were taken from AFEAS (2006). Data on global emissions of phosphorous compounds to water and agricultural soil on the global scale was taken from estimates by Smil (2002).

Depletion of fossil energy resources

Data on the extraction of fossil energy resources was based on the energy statistics of IEA (2006) and the country statistics of USGS (2006). Data for land occupation was based on the land cover data of the CORINE land cover databases CLC1990 and CLC2000 (EEA, 2006a). Data for land occupation on the global scale was taken from WRI (2000). Mainly natural land occupation classes and water surfaces were excluded.

Ozone layer depleting agents and HFCs

Consumption data in the year 2000 (UNEP, 2002) was used as an estimate for the air emissions, caused by production in the year 2000, of CFCs, HCFCs, halons, 1,1,1-dichloroethane, and tetrachloromethane. Data on CFCs, HCFCs and halons was available for most countries in the world, but only for the entire substance groups; not for individual composing substances. Production and/or consumption profiles for individual substances were readily available for certain groups of countries, however (Fraser et al., 1999; WMO, 2002; AFEAS, 2006). The production or consumption fractions of the individual substances were applied to the substance group consumptions, to deliver emission estimates for individual CFCs, HCFCs, and halons. Data on the emissions of HFCs on the European scale was interpolated from global scale data (AFEAS, 2006) on a GDP-basis.

Nitrogen compounds

For ammonia, emission data for air emissions was readily available on both the European and the global scale, but data referred to the year 1990 instead of 2000. In this case, data was either extrapolated in time or recalculated. To account for functional relationships, we used different approaches for the individual ammonia emission sources. We extrapolated emissions from fuel combustion with GDP values, direct crop emissions from crop production areas, and human waste emissions from population magnitudes. Ammonia emission factors for animal manure and fertiliser were included as separate inputs to calculate individual characterisation factors for every individual manure and fertiliser type for the impacts acidification, eutrophication and particulate matter formation. For animal manure, emission factors were calculated from nitrogen excretion per head and ammonia excretion per head for every individual animal type (Bouwman et al., 1997). Emission factors for indiviual fertiliser types were readily available from FAO (2006a), form Bouwman et al. (1997 and 2002) and from IFA (2006). Point emissions of nitrogen compounds to freshwater compartments were calculated on the basis of GDP values, according to an estimation equation provided by Van Drecht et al. (2003).

Phosphorous compounds

Data on the emissions of phosphorous compounds to fresh water on the European scale was interpolated on a GDP-basis from the global scale data estimates provided by Smil (2002). Emissions of phosporous compounds to agricultural soil were derived from the use of phosphate fertiliser (FAO 2006a) and manure (FAO, 2006b and c). The P-content of manure was calculated from the ratio between N- and P-emissions of manure on the global scale, assuming a similar N/P ratio for European manure.

PM_{10}

For the emission of PM_{10}, we had emission data to our disposal for most European countries and a small number of Asian countries, provided by EMEP (2006). The correlation between GDP values and PM_{10} emissions for these countries turned out to be rather weak (r^2=0.291). An analysis of alternative extrapolation bases showed that it was possible to find a better correlation alternative by dividing countries in three different income groups, based on a classification by the World Bank (2000): high, upper-middle and lower-middle plus low (r^2=0.544 by the application of ANOVA). Outlyers were eliminated by use of Chauvenet's criterion (Bevington & Robinson, 1992). Within each income group, the ratio between PM_{10} emission and GDP turned out to be reasonably constant, with large differences between income groups. The ratio between PM_{10}/GDP ratios was 3:20:600 for high, upper middle and lower middle plus low income groups, respectively, suggesting that the investments in cleaner technologies are larger in the more prosperous countries. Average PM_{10}/GDP ratios for the 3 income groups were applied to calculate estimates for PM_{10} emissions for all world countries on the basis of the combination of their respective GDP values and income groups.

Toxic chemicals

For industrial emissions of toxic substances to air and fresh water on a global scale, we extrapolated emission data from the United States, Canada and Japan (US-EPA, 2006; EC, 2006; NITE, 2006) – plus Australian data (AG-DEH, 2006) for metal emissions – to global emission estimates on the basis of GDP values. For some toxic subtances, emission data was also available for a number of European countries (EMEP, 2006; EPER, 2006), which were then included in the extrapolation procedure. European emission estimates were derived equivalently from the same emission data, except the European fresh water emissions of metals, which were based on data provided by EPER (2006). If emission data was available for one or more European countries, emission estimate for Europe were extrapolated from European data only. Emissions of dioxins and furans were extrapolated from European emission data (EMEP, 2006; Pulles, 2006), supplemented with Canadian emission data for the global level (EC, 2006). The emission of chlorine to fresh water in both systems was assumed to correspond to two percent of total production (Van Santen, 1998; Euro Chlor, 2006), which is a rough estimate of the percentage used for water disinfection purposes. For metal emissions to sea water, assumed emissions were extrapolated from emission data on two polluted European sea areas (OSPAR, 2001), with the length of polluted coastline in both Europe and the world (UNESCO, 2006) as a basis for extrapolation factors. Emissions of heavy metals to agricultural soil were estimated on the basis of Dutch data on the heavy metal content of manure and fertilisers (Delahaye et al., 2003) and total assumed application. The application of different types of manure was estimated from manure excretion data (Van Bruggen, 2004) and livestock statistics (FAO, 2006b). Emissions of heavy metals to industrial soil were estimated from Dutch landfill percolate metal loads (Dutch Emission register, 2006), extrapolated on the basis of GDP values.

Specific attention was paid to the estimation of pesticide emissions. FAO (2006d) provides data on the consumption of different pesticide groups for a reasonably large number of European countries. Although these group data could not be used as emission estimates for individual pesticides, they were useful for checking the validity of alternative estimation factors. The correlation between the data for overall pesticide use and GDP values turned out to be rather weak (r^2=0.318), suggesting that another variable might be more determinative. Crop production showed a better correlation with total pesticide use (r^2=0.507). Still better became the image when we used a more specific approach by dividing pesticides up into different classes, and calculated correlations separately for each class. For the use of different classes of pesticides, we analysed correlation coefficients between pesticide use on the one hand and GDP values and crop production areas on the other, respectively. It turned out that for insecticide consumption, the correlation coefficient with the crop production area (r^2=0.62) was much higher than the correlation coefficient with the GDP value (r^2=0.075), while for herbicide, fungicide & bactericide and other pesticide consumption, it was the other way around: higher correlation coefficients with GDP values (r^2=0.701, r^2=0.336 and r^2=0.562, respectively) than with crop production areas (r^2=0.67, r^2=0.163 and r^2=0.101, respectively). Outlyers were eliminated by use of Chauvenet's criterion (Bevington & Robinson, 1992) for all correlation calculations. Estimation factors were chosen in correspondence with the results of the correlation analyses for the individual pesticides in each of the pesticide classes. The use of individual pesticides on both the global and the European scale was derived from pesticide consumption data in The Netherlands (CBS, 2006), the United Kingdom (CSL, 2006), and the United States (Gianessi and Marcelli, 2000; Kiely et al., 2004).

A schematic overview of data sources and estimation procedures for all individual emissions and extractions for the EU_{25+3} and the world is given in table 1 and 2.

Table 1 Emission data: data sources and extrapolation basis (EU_{25+3})

Impact category	Substances	Compartment	Reported data			Estimated data	
			region	database	sources	formula	add. sources
global warming	CO_2, CH_4, N_2O	air	EU_{25+3} except Malta		UNFCCC (2005)		
global warming	CO_2	air	Malta		NEAA (2006)		
global warming, acidification, respiratory effects	CH_4, N_2O, CO, NO_x, SO_2, NMVOC	air	Malta		UNECE (2003)		
global warming	CO	air	EU_{25+3} except Malta (which is accounted for separately)	WebDab 2005	EMEP (2006)		
global warming	HFCs	air	world total		AFEAS (2006)	$E_{EU25+3}=E_{world}/GDP_{world}*GDP_{EU25+3}$	GDP: WRI (2006)
global warming	SF_6	air	most countries of the world	EDGAR 32FT2000	NEAA (2006)		
ozone depletion	CFCs, HCFCs	air	group consumption data for EU_{25+3}; world production of individual substances for limited group of countries		substance group consumption data: UNEP (2002)	$E_{subs}=CONSUMPTION_{group}*PRODUCTION_{subs}/PRODUCTON_{group}$	world production of individual CFCs and HCFCs: AFEAS (2006)
ozone depletion	Halons	air	group consumption data for EU_{25+3}; world production of individual substances for limited group of countries		substance group consumption data: UNEP (2002)	$E_{subs}=CONSUMPTION_{group}*PRODUCTION_{subs}/PRODUCTON_{group}$	world production of individual halons: Fraser et al. (1999)
ozone depletion; toxicity	$CHCl_3$, CCl_4	air	Canada, Japan, USA	NPRI Canada PRTR Japan TRI USA	EC (2006) NITE (2006) US-EPA (2006)	$E_{EU25+3}=(E_{CA}+E_{JP}+E_{US})/(GDP_{CA}+GDP_{JP}+GDP_{US})*GDP_{EU25+3}$	GDP: WRI (2006)
acidification; respiratory effects	NO_x, SO_2	air	EU_{25+3} except Malta (which is accounted for separately)	WebDab 2005	EMEP (2006)		

acidification; respiratory effects	NH_3	air	EU_{25+3} except Malta (which is neglected)	WebDab 2005	EMEP (2006)		
respiratory effects	PM_{10}	air	EU_{25+3} except Malta (which is accounted for separately)	WebDab 2005	EMEP (2006)	$E_{Malta}=E_{av,income\ group}/GDP_{tot,income\ group}*GDP_{Malta}$	GDP: WRI (2006) income group: World Bank (2000)
respiratory effects	NMVOC	air	EU_{25+3} except Malta (which is accounted for separately)	WebDab 2005	EMEP (2006)		
toxicity	As, Cd, Cr, Cu, Hg, Ni, Pb, Se, Zn	air	some EU_{25+3} countries	Webdab 2005 database	EMEP (2006)	$E_{EU25+3}=E_a/GDP_a*GDP_{EU25+3}$	GDP: WRI (2006)
toxicity	Ag, Al, Ba, Be, Co, Mn, Sb, Tl, V	air	Australia, Canada, Japan, USA	NPI Australia NPRI Canada PRTR Japan TRI USA	AG-DEH (2006); EC (2006); NITE (2006); US-EPA (2006)	$E_{EU25+3}=E_a/GDP_{AU,CA,JP,US}*GDP_{EU25+3}$	GDP: WRI (2006)
toxicity	cyanides 1,2-dichloroethane benzene chloroform dichloromethane tetrachloroethylene trichloroethylene chlorine	air	some EU_{25+3} countries	EPER	EEA (2006b)	$E_{EU25+3}=E_a/GDP_a*GDP_{EU25+3}$	GDP: WRI (2006)
toxicity	hexachlorobenzene benzo(a)pyrene aldrin chlordane lindane pentachlorophenol toxaphene	air	some EU_{25+3} countries	WebDab 2005	EMEP (2006)	$E_{EU25+3}=E_a/GDP_a*GDP_{EU25+3}$	GDP: WRI (2006)
toxicity; ozone depletion	other organics, other PAHs, PCBs, other inorganics	air	Canada, Japan, USA	NPRI Canada PRTR Japan TRI USA	EC (2006) NITE (2006) US-EPA (2006)	$E_{EU25+3}=(E_{CA}+E_{JP}+E_{US})/(GDP_{CA}+GDP_{JP}+GDP_{US})*GDP_{EU25+3}$	GDP: WRI (2006)
toxicity	dioxins and furans	air	some EU_{25+3} countries	EMEP (2006): Webdab 2005	EMEP (2006); Pulles et al. (2006)	$E_{EU25+3}=E_a/GDP_a*GDP_{EU25+3}$	GDP: WRI (2006)
radiation	radioactive substances	air	United Kingdom	Pollution Inventory	EA (2006)	$E_{EU25+3}=E_{UK}/\text{nuclear capacity}_{UK}*\text{nuclear capacity}_{EU25+3}$	nuclear capacity: ANU (2006)
eutrophication	N-total	fresh water				$E_{EU25+3}=365*\text{population}_{EU25+3}*(8+11*\sqrt{(GDP_{EU25+3}/GDP_{Switzerland})})$	formula: Van Drecht et al. (2003)

							population: FAO (2006d) GDP: WRI (2006)
eutrophication	P-total	fresh water	world total		Smil (2002)	$E_{EU25+3}=E_{world}/GDP_{world}*GDP_{EU25+3}$	GDP: WRI (2006)
toxicity	Heavy metals	fresh water	EU_{15} countries	EPER	EEA (2006b)	$E_{EU25+3}=E_{EU15}/GDP_{EU15}*GDP_{EU25+3}$	GDP: WRI (2006)
toxicity	additional heavy metals	fresh water				$E_{EU25+3}=E_{AU,CA,JP,US}/GDP_{AU,CA,JP,US}*GDP_{EU25+3}$	GDP: WRI (2006
toxicity	1,2-dichloroethane benzene chloroform dichloromethane ethylbenzene hexachlorobenzene toluene xylene	fresh water	some EU_{25+3} countries	EPER	EEA (2006b)	$E_{EU25+3}=E_a/GDP_a*GDP_{EU25+3}$	GDP: WRI (2006)
toxicity	other organics, PAHs, PCBs, other inorganics	fresh water	Canada, Japan, USA	NPRI Canada PRTR Japan TRI USA	EC (2006) NITE (2006) US-EPA (2006)	$E_{EU25+3}=(E_{CA}+E_{JP}+E_{US})/(GDP_{CA}+GDP_{JP}+GDP_{US})*GDP_{EU25+3}$	GDP: WRI (2006)
toxicity	chlorine	fresh water	EU_{25+3}		Euro Chlor (2006)	$E_{EU25+3}=PRODUCTION_{Western\ Europe}*F_{waterdisinfection}$	
toxicity	cyanides	fresh water	some EU_{25+3} countries	EPER	EEA (2006b)	$E_{EU25+3}=E_a/GDP_a*GDP_{EU25+3}$	GDP: WRI (2006)
radiation	radioactive substances	fresh water	United Kingdom	Pollution Inventory	EA (2006)	$E_{EU25+3}=E_{UK}/$ nuclear $capacity_{UK}$*nuclear $capacity_{EU25+3}$	nuclear capacity: ANU (2006)
toxicity	Cd, Cu, Pb, Hg, Zn	marine water	most OSPAR countries		OSPAR (2001)		
toxicity	tributyltin oxide	marine water	Western Europe		Greenpeace (1999)	$E_{EU25+3}= F_{leach}*PRODUCTION_{Western\ Europe}$	fraction leaching:); Van de Plassche & Van der Aa (2004)
eutrophication	N-total	agricultural soil	EU_{25+3}		FAO (2006a&b&c); Bouwman et al. (1997); Bouwman et al. (2002); IFA (2006)		
eutrophication	P-total	agricultural soil	EU_{25+3}		FAO (2006a&b&c)		
toxicity	Cd, Cu, Cr, Pb, Hg, Ni, Zn	agricultural soil	Netherlands		Delahaye et al. (2003); Van Bruggen (2004)	$E_{EU25+3}=C_{hm,fertilizer}*U_{fertiliser,EU25+3}+\sum(C_{hm,manure}*P_{manure,animal\ type}*L_{EU25+3,animal\ type})+E_{hunting,NL}/Surf_{agr,NL}*Surf_{agr,EU25+3}$	crop area: FAO (2006e)
toxicity	insecticides	agricultural	The Netherlands,		CBS (2006); CSL	$E_{EU25+3}=E_{(NL+UK+US)}/$	FAO (2006e)

		soil	UK, USA		(2006); Gianessi & Marcelli (2000)	$AREA_{cropsNL+UK+US)} * AREA_{crops,EU25+3}$	
toxicity	herbicides, fungicides&bactericides and other pesticides	agricultural soil	The Netherlands, UK, USA		CBS (2006); CSL (2006); Gianessi & Marcelli (2000)	$E_{EU25+3} = E_{(NL+UK+US)} / GDP_{(NL+UK+US)} * GDP_{EU25+3}$	GDP: WRI (2006)
toxicity	heavy metals	industrial soil, landfill	Netherlands	National PRTR	Dutch Emission register (2006)	$E_{EU25+3} = E_{NL} / GDP_{NL} * GDP_{EU25+3}$	
toxicity	heavy metals	industrial soil, other soil	Netherlands, Canada	National PRTRs	Dutch Emission register (2006); EC (2006)	$E_{EU25+3} = E_{NL,CA} / GDP_{NL,CA} * GDP_{EU25+3}$	
toxicity	PAHs, PCBs and other organics; inorganics	industrial soil	Canada, Japan, USA	NPRI Canada PRTR Japan TRI US	EC (2006) NITE (2006) US-EPA (2006)	$E_{EU25+3} = (E_{CA} + E_{JP} + E_{US}) / (GDP_{CA} + GDP_{JP} + GDP_{US}) * GDP_{EU25+3}$	GDP: WRI (2006)
agricultural land occupation	land	land use	some EU_{25+3} countries	CLC2000	EEA (2006a)	$ALO_{EU25+3} = \sum AREA_{CORINE\ classes\ 21,\ 22,\ 231,\ 243}$	FAO (2006e)
urban land occupation	land	land use	some EU_{25+3} countries	CLC2000	EEA (2006a)	$ULO_{EU25+3} = \sum AREA_{CORINE\ classes\ 111,\ 112,\ 121,\ 122,\ 131,\ 132,\ 133}$	FAO (2006e)
fossil energy resource depletion	fossil energy resources	in ground	EU_{25+3} countries	energy statistics; country statistics	IEA (2006); USGS (2006)		

Table 2 Emission data: data sources and extrapolation basis (world)

Impact category	Substances	Compartment	Reported data			Estimated data	
			region	**database**	**sources**	**formula**	**add. sources**
global warming	CO_2, CH_4, N_2O	air	most European countries; former Sovjet Union; Australia, Canada, Japan, New Zealand, Japan		UNFCCC (2005)		
global warming, acidification	CH_4, N_2O, CO, NO_x, SO_2	air	Malta		UNECE (2003)		
global warming	CO_2, CH_4, N_2O	air	most remaining countries	EDGAR 32FT2000	NEAA (2006)		
global warming	CO	air	most European countries; former Sovjet Union; North East Atlantic Ocean	WebDab 2005	EMEP (2006)		
global warming	CO	air	remaining countries (remaining oceans not accounted for)	EDGAR 32FT2000	NEAA (2006)		
global warming	HFCs	air	world total		AFEAS (2006)		
global warming	SF_6	air	most countries of the world	EDGAR 32FT2000	NEAA (2006)		
ozone depletion	CFCs, HCFCs	air	group consumption data for most countries of the world; world production of individual substances for limited group of countries		substance group consumption data: UNEP (2002)	$E_{subs}=CONSUMPTION_{group}*PRODUCTION_{subs}/PRODUCTON_{group}$	production of individual CFCs and HCFCs: AFEAS (2006)
ozone depletion	halons	air	group consumption data for most countries of the world; world production of individual substances for		substance group consumption data: UNEP (2002)	$E_{subs}=CONSUMPTION_{group}*PRODUCTION_{subs}/PRODUCTON_{group}$	production of individual halons: Fraser et al. (1999)

			limited group of countries				
ozone depletion; toxicity	$CHCl_3$, CCl_4	air	Canada, Japan, USA	NPRI Canada PRTR Japan TRI USA	EC (2006) NITE (2006) US-EPA (2006)	$E_{world}=(E_{CA}+E_{JP}+E_{US})/(GDP_{CA}+GDP_{JP}+GDP_{US})*GDP_{world}$	GDP: WRI (2006)
acidification; respiratory effects	NO_x, SO_2	air	most European countries; former Sovjet Union; North East Atlantic Ocean	WebDab 2005	EMEP (2006)		
acidification; respiratory effects	NO_x, SO_2	air	remaining countries (remaining oceans not accounted for)	EDGAR 32FT2000	NEAA (2006)		
acidification; respiratory effects	NH_3	air	most countries of the world	.	NEAA (2006); FAO (2006a&b); Bouwman et al. (1997)		
respiratory effects	PM_{10}	air	most European countries; former Sovjet Union; North East Atlantic Ocean	WebDab 2005	EMEP (2006)	$E_{country}=E_{av,\ income\ group}/GDP_{tot,\ income\ group}*GDP_{country}$	GDP: WRI (2006); income group: World Bank (2000)
respiratory effects	NMVOC	air	most European countries; former Sovjet Union; North East Atlantic Ocean	WebDab 2005	EMEP (2006)		
respiratory effects	NMVOC	air	remaining countries (remaining oceans not accounted for)	EDGAR 32FT2000	NEAA (2006)		
toxicity	heavy metals	air	some European countries, Australia, Canada, Japan, USA	Webdab 2005 NPI Australia NPRI Canada PRTR Japan TRI USA	EMEP (2006) AG-DEH (2006); EC (2006); NITE (2006); US-EPA (2006)	$E_{world}=(E_{AU}+E_{CA}+E_{JP}+E_{US})/(GDP_{AU}+GDP_{CA}+GDP_{JP}+GDP_{US})*GDP_{world}-E_{EU25+3}$	GDP: WRI (2006)
toxicity	cyanides 1,2-dichloroethane benzene chloroform dichloromethane tetrachloroethylene trichloroethylen chlorine	air	some European countries, Canada, Japan, USA	EPER NPRI Canada PRTR Japan TRI USA	EEA (2006b) EC (2006) NITE (2006) US-EPA (2006)	$E_{world}=(E_{CA}+E_{JP}+E_{US})/(GDP_{CA}+GDP_{JP}+GDP_{US})*GDP_{world}-E_{EU25+3}$	GDP: WRI (2006)
toxicity	hexachlorobenzene	air	some European	WebDab 2005	EMEP (2006)	$E_{world}=(E_{CA}+E_{JP}+E_{US})/$	GDP:

	benzo(a)pyrene aldrin chlordane lindane pentachlorophenol toxaphene		countries, Canada, Japan, USA	NPRI Canada PRTR Japan TRI USA	EC (2006) NITE (2006) US-EPA (2006)	$(GDP_{CA}+GDP_{JP}+GDP_{US})*GDP_{world}-E_{EU25+3}$	WRI (2006)
ozone depletion; toxicity	other organics, other PAHs, PCBs, other inorganics	air	Canada, Japan, USA	NPRI Canada PRTR Japan TRI USA	EC (2006) NITE (2006) US-EPA (2006)	$E_{world}=(E_{CA}+E_{JP}+E_{US})/$ $(GDP_{CA}+GDP_{JP}+GDP_{US})*GDP_{world}$	GDP: WRI (2006)
toxicity	dioxins and furans	air	some European countries and Cyprus	EMEP (2006): Webdab 2005	EMEP (2006); Pulles et al. (2006)	$E_{world}=E_{countries}/GDP_{countries}*GDP_{world}$	GDP: WRI (2006)
radiation	radioactive substances	air	United Kingdom	Pollution Inventory	EA (2006)	$E_{world}=E_{UK}/$ $\text{nuclear capacity}_{UK}*\text{nuclear capacity}_{world}$	nuclear capacity: ANU (2006)
eutrophication	N-total	fresh water				$E_{world}=365*POPULATION_{world}*$ $(8+11*\sqrt{(GDP_{world}/GDP_{Switzerland})})$	formula: Van Drecht et al. (2003); GDP: WRI (2006)
eutrophication	P-total	fresh water	world total		Smil (2002)		
toxicity	heavy metals	fresh water	Australia, Canada, Japan, USA, EU_{25+3}	Webdab 2005 NPI Australia NPRI Canada PRTR Japan TRI USA	EMEP (2006) AG-DEH (2006); EC (2006); NITE (2006); US-EPA (2006)	$E_{world}=(E_{AU}+E_{CA}+E_{JP}+E_{US})/$ $(GDP_{AU}+GDP_{CA}+GDP_{JP}+GDP_{US})*GDP_{world}-$ E_{EU25+3}	GDP: WRI (2006)
toxicity	chlorine	fresh water	world		Van Santen (1998)	$E_{world}=PRODUCTION_{world}*F_{waterdisinfection}$	Fraction used for water disinfection: Euro Chlor (2006)
toxicity	cyanides	fresh water	some European countries, Canada, Japan, USA	EPER NPRI Canada PRTR Japan TRI USA	EEA (2006b) EC (2006) NITE (2006) US-EPA (2006)	$E_{world}=(E_{CA}+E_{JP}+E_{US})/$ $(GDP_{CA}+GDP_{JP}+GDP_{US})*GDP_{world}-E_{EU25+3}$	GDP: WRI (2006)
toxicity	1,2-dichloroethane benzene chloroform dichloromethane ethylbenzene hexachlorobenzene toluene xylene	fresh water	some European countries, Canada, Japan, USA	EPER NPRI Canada PRTR Japan TRI USA	EEA (2006b) EC (2006) NITE (2006) US-EPA (2006)	$E_{world}=(E_{CA}+E_{JP}+E_{US})/$ $(GDP_{CA}+GDP_{JP}+GDP_{US})*GDP_{world}-E_{EU25+3}$	GDP: WRI (2006)
toxicity	other organics, other PAHs, PCBs, other	fresh water	Canada, Japan, USA	NPRI Canada PRTR Japan	EC (2006) NITE (2006)	$E_{world}=(E_{CA}+E_{JP}+E_{US})/$ $(GDP_{CA}+GDP_{JP}+GDP_{US})*GDP_{world}$	GDP: WRI (2006)

	inorganics			TRI USA	US-EPA (2006)		
radiation	radioactive substances	fresh water	United Kingdom	Pollution Inventory	EA (2006)	$E_{world}=E_{UK}$/nuclear $capacity_{UK}$* nuclear $capacity_{world}$	nuclear capacity: ANU (2006)
toxicity	heavy metals	marine water	OSPAR countries		OSPAR (2001)	$E_{world}=E_{OSPAR}*4$	sea area polluted: UNESCO (2006)
toxicity	tributyltin oxide	marine water	world		Greenpeace (1999)	$E_{world}= F_{leach}*PRODUCTION_{world}$	fraction leaching: Van de Plassche & Van der Aa (2004)
eutrophication	N-total	agricultural soil	most countries of the world		FAO (2006a&b&c); Bouwman et. al. (1997); Bouwman et al. (2002); IFA (2006); NEAA (2006a&b)		
eutrophication	P-total	agricultural soil	world		Smil (2002)		
toxicity	heavy metals	agricultural soil	The Netherlands		Delahaye et al. (2003); Van Bruggen (2004)	$E_{world}=C_{hm,fertilizer}*U_{fertiliser,world}$ $+C_{hm,manure}*P_{manure,animal\ type}*L_{world,animal\ type}$ $+E_{hunting,NL}/Surf_{agr,NL}*Surf_{agr,world}$	
toxicity	aldrin, DDT, dieldrin, cyhexatin	agricultural soil	world		UNEP/FAO (1995)	$E_{world}= PRODUCTION_{world}$	
toxicity	other insecticides	agricultural soil	The Netherlands, UK, USA		CBS (2006); CSL (2006); Gianessi & Marcelli (2000)	$E_{world}=E_{(NL+UK+US)}/$ $AREA_{crops,NL+UK+US)}*AREA_{crops,world}$	crop area: FAO (2006e)
toxicity	herbicides, fungicides&bactericides and other pesticides	agricultural soil	The Netherlands, UK, USA		CBS (2006); CSL (2006); Gianessi & Marcelli (2000)	$E_{world}=E_{(NL+UK+US)}/GDP_{(NL+UK+US)}*GDP_{world}$	GDP: WRI (2006)
toxicity	heavy metals	industrial soil, landfill	Netherlands	National PRTR	Dutch Emission register (2006)	$E_{world}=E_{NL}/GDP_{NL}*GDP_{EU25+3}$	
toxicity	heavy metals	industrial soil, other soil	Netherlands, Canada	National PRTRs	Dutch Emission register (2006); EC (2006)	$E_{world}=E_{NL,CA} / GDP_{NL,CA} * GDP_{EU25+3}$	
toxicity; ozone depletion	PAHs, PCBs, other organics, inorganics	industrial soil	Canada, Japan, USA	NPRI Canada PRTR Japan TRI USA	EC (2006) NITE (2006) US-EPA (2006)	$E_{world}=(E_{CA}+E_{JP}+E_{US})/(GDP_{CA}+GDP_{JP}+GDP_{US})*$ GDP_{world}	GDP: WRI (2006)
agricultural land occupation	land	land use	world		WRI (2000)		
urban land occupation	land	land use	world		WRI (2000)		

fossil energy resource depletion	fossil energy resources	in ground	world	energy statistics; country statistics	IEA (2006); USGS (2006)		

Parameters and units:

AREA = surface area (km^2)

C = concentration (kg/kg)

E = emission (kg)

F = fraction (-)

GDP = gross domestic product (US dollars)

L = livestock (head)

P = excretion (kg/head)

U = usage (kg)

Parameter underscores:

a = for countries for which intervention data is available

agr = agricultural

animal type = per animal type

AU = Australia

av = average

CA = Canada

crops = used for crop breeding

group = substance group

hm = heavy metals

hunting = caused by hunting

JP = Japan

leach = leaching

na = for countries for which intervention data is not available

NL = The Netherlands

OSPAR = OSPAR regions (OSPAR, 2001)

subs = substance

tot = total

U = usage

UK = United Kingdom

US = United States

waterdisinfection = for which water is disinfected

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