

LCIA METHODOLOGY	Eco-indicator 99	EDIP97	EDIP2003	EPS 2000d	(Dutch) LCA Handbook	IMPACT 2002(+)	LIME	(SWISS) ECOSCARCITY	JEPIX	TRACI	ADDITIONAL METHOD
Method description	Damage approach, including Normalization and default weightingsets	Midpoint method with normalization	Midpoint method with normalization	Category indicators at damage level + weighting as WTP to avoid damage	Midpoint method with normalization	Midpoint+damage including normalization	Midpoint+Damage assessment+Weighting; practitioner can choose the step of LCIA based on the aim of	Weighting method, based on environmental policy goals, to be used for midpoint categories and selected	Weighting method, based on distance-to-target of environmental policy. Providing regionalized weighting factors	Midpoint method with normalization	
Website Access Point	www.pre.nl/eco-indicator99/	http://ipl.dtu.dk/~mic/Projects.htm#EDIP97	http://ipl.dtu.dk/~mic/Projects.htm#EDIP2003	http://eps.esa.chalmers.se/	http://www.leidenuniv.nl/cml/sap/pacts/lca2/lca2.html	http://www.epfl.ch/impact/	http://www.jemai.or.jp/caforum/index.cfm	http://www.umwelt.schweiz.ch/buwal/eng/fachgebiete/produkte/umsetzung/sekobalanz/n/index.html	www.jepix.org	http://epa.gov/ORD/NRMRL/std/sab/iam_traci.htm	
Reference	Goedkoop et al.(1999), check for updates at website (version April 2000)	Wenzel et al. (1997), Hauschild and Wenzel (1998)	Hauschild and Potting (2004), Potting and Hauschild (2004)	Steen (1999) and Steen(1999)	Guinée, J.B. (Ed.), M. Gorrée, R. Heijungs, G. Huppes, R. Kleijn, A. de Koning, L. van Oers, A. Wegener Sleeswijk, S.Suh, H.A. Udo de Haes, J.A. de Bruijn, R. van Duin and M.A.J. Huijbregts. 2002. Handbook on Life Cycle Assessment: Operational Guide to the ISO Standards. Kluwer Academic Publishers. Dordrecht	Jolliet et al.(2003)	METI, NEDO, AIST (2003) written in Japanese Itsubo (2003) in IJLCA	Brand G., Braunschweig A., Scheidegger A., Schwank O.: Weighting in Ecobalances with the Ecoscarcity Method - Ecofactors 1997, BUWAL Series 297, 1998. German print available at the above web-address; english PDF available at docu@buwal.admin.ch or for download at http://www.e2mc.com/BUWAL297%20english.pdf	In JAPANESE: Miyazaki, N., Siegenthaler, C., Kumagai, S., Shinozuka, E., Nagayama, A. (2003): JEPIX – The Japan Environmental Policy Priorities Index, Japan Science and Technology Inc./Sustainable Management Forum Japan, Tokyo./ in ENGLISH Miyazaki, N., Siegenthaler, C., Schoenbaum, T., Azuma, K. (2004): Japan Environmental Policy Priorities Index (JEPIX), 21st Century COE Monograph Series 7, Social Science Research Institute of	Bare J.C. et al.(2003) (available on JIE website)	
Key Contacts	Mark Goedkoop email: goedkoop@pre.nl	Michael Hauschild email: mic@ipl.dtu.dk	Michael Hauschild email: mic@ipl.dtu.dk	Bengt Steen email: Bengt.steen@esa.chalmers.se	Jeroen Guinée email: Guinée@cml.leidenuniv.nl	Olivier Jolliet email: olivier.jolliet@epfl.ch	Norihiro Itsubo email: itsubo-n@aist.go.jp	Arthur Braunschweig email:abraunschweig@e2mc.com	Claude Siegenthaler email: claude@i.hosei.ac.jp	Jane Bare email: Bare.jane@epamail.epa.gov	
Comments	Three versions are published (Nierarchis, Individualist, Egalitarian. Below Hierarchist is described.	Update available as EDIP2003 with site-dependent characterization for most non-global impact categories	Site-dependent characterization for European countries for most non-global impact categories	Factors and description downloadable on site	Factors and updates downloadable on site	Factors and description downloadable on site	All of the list (midpoint, damage assessment, weighting) are downloadable on site Based on Japanese environmental conditions for most non-global impact categories	Update for 2004 Swiss values in progress. The "Swiss ecopoints" are based on the Swiss environmental policy; the method may be applied to other regions' environmental policy goals as well.	Technical report and weighting factors as well as raw data used for calculation are freely available for endusers on site. Revision and update in progress under the Centre of Excellence program of the Japanese government.	Factors and updates downloadable on site	

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MIDPOINT CATEGORIES											
Releases											
Climate change	(38) (DALYs/kg emission) M&D Damage model based on CO ₂ , CH ₄ and N ₂ representing substances with a lifetime of 100, 20 and 500 years. GWP equivalence factors for substances with similar lifetimes used to extend range of substances	(76 + factors for organics) kg CO ₂ -eq./kg emitted M (GWP 100 as default, GWP 20 and GWP 500 as options – includes factors for all organic substances of petrochemical origin	(76 + factors for organics) kg CO ₂ -eq./kg emitted M (GWP 100 as default, GWP 20 and GWP 500 as options – includes factors for all organic substances of petrochemical origin	(# factors) (units)	(42) kg CO ₂ -eq./kg emitted M (GWP 100 as baseline; GWP 20, GWP 500, upper limit of net GWP and lower limit of net GWP as alternatives	(38) kg CO ₂ eq M (GWP 500) - kept as a separate damage category	(76) M: kg CO ₂ eq./kg emitted, D DALYs/kg emitted, JY/kg emitted M&D M: GWP 100 as default, GWP20 and GWP500 as options from IPCC2001. D: Damage model relate to human health and social assets were developed. Scope of Human health; thermal/cold stress, infectious diseases, disasters, inanition/starvation Scope of social assets; crops, land loss, energy consumption	(27) CO ₂ -eq / kg emission	(42) CO ₂ -eq / kg emission weighting EIP/kg emission EIP=Environmental Impact Points	(24) CO ₂ -e / kg emission M (GWP 100) Global warming index based on 100 year average of 450 and 550 ppm time horizon and IPCC Second Assessment Report (IPCC 1996; direct climate forcing; with methane including indirect effects). GWP for additional emissions can be deducted from CFC-11	(*)
	Stratospheric ozone depletion	(23) (DALYs/kg emission) M&D Damage model for CFCs, and ODP factors used to extrapolate to other substances	(19) kg CFC-11-eq./kg emitted M (ODP, infinite)	(19) kg CFC-11-eq./kg emitted M (ODP infinite)	(*) (units)	(22) kg CFC-11-eq./kg emitted M (ODP infinite as baseline; ODP 5, 10, 15, 20, 25, 30 and 40 as alternatives)	(22) kg CFC-11 equ into air M&D (ODP infinite)	(*) M: kg CFC-11eq./kg emitted, D: DALYs/kg emitted, NPP/kg emitted, JY/kg emitted M: ODP infinite from WMO1998 as default, ODP listed in Montreal protocol as alternative D: Damage model relate to human health, social assets and primary production were developed. Scope of human health; cataract, skin cancer Scope of social assets; crops, forestry Scope of primary production; ocean plankton, terrestrial plant	(26) CFC-11-eq / kg emission	(35) CFC-11-eq / kg emission weighting EIP/kg emission	(89) CFC-11-e / kg emission M (ODP infinite)

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Accidents					(XX) (units) M (Unweighted aggregation of victims)	(XX) (units) M&D Cases and DALY from statistics can be added to other human health impacts					
Photo oxidant formation	(50) (DALYs/kg emission) M Eco-indicator 99 name: Respiratory organic, POCP values used to calculate Ozone formation. Ozone treated as respiratory inorganic impact category (see above)	(82 individual substances and 13 VOC mixtures) kg ethylene-eq./kg emitted M (POCP, high or low background concentration of NO _x) Regression expressions for calculation of missing characterisation factors based on k _{OH}	(All NMVOCs, and CH ₄ , NO _x and CO) m2 ecosystem*ppm*hours/g emitted; pers*ppm*hours/g emitted M (but close to damage - exposure above threshold times duration) Separate site-dependent modelling of exposure of vegetation and of human beings in two separate sub categories		(126) kg ethylene-eq./kg emitted; kg formed ozone/kg emitted M (High NOx POCP as baseline; MIR, MOIR, EBIR and low NOx POCP as alternatives)	(130) kg ethylene equ into air M&D (POCP) M: Box model considering Japanese climate conditions are developed originally. Ozone formation is calculated for each region of Japan (7 regions). E: Damage model relate to human health, social assets	(686) M: kg ethylene-eq./kg emitted, D: DALYs/kg emitted, NPP/kg emitted, JY/kg emitted M&D	*NM-VOC* & NOx g NM-VOC Emission maxima for NM-VOC and NOx according to the national Air Hygiene goals	(124) plus regionalized for 47 prefectures (124*47) kg ethylene-eq./kg emitted, weighting EIP/kg	(529) g - NOx-e / m / kg emission M A combination of individual substances and VOC mixtures (VOC and NOx influence as mixtures, spatial emission and release at US national and county level)	(*)
Noise	(0) (DALYs/Pa*2.s) Applied experimentally in link with Mueller Wenk 2003, but not included in methodology report		- pers*sec Noise from traffic in Potting and Hauschild (2004)		(*) (Pa*2.s) (Unweighted aggregation of sound in Pa ² .s)	- (units) (Compatible with Mueller-Wenk, 2003)	- under development (will be published in 2006)	- (An earlier version of the Swiss Eco-points included a provisional noise assessment)	(6) EIP/km Weighting factors based on road-noise-kilometer distance-to-target using annual Japanese traffic		
Acidification	(3) (PDF/m3/yr) Acidification and Eutrophication are combined. Direct link between emissions and damage. ONLY airborne emissions: Fate using Dutch SMART model. Effect, using Dutch MOVE model. Calculates PDF/m3/yr directly using Ellenberg curves. Waterborne emissions not included!	(12) kg SO2-eq. /kg emitted M (AP based on SO ₂)	(12) m2 unprotected ecosystem/g emitted; M (but close to damage - area of ecosystem exposed above critical load)		(4) kg SO2-eq. in Switzerland/kg emitted; kg SO2-eq./kg emitted M (Average AP expressed in SO ₂ equivalents based on RAINS model as baseline; generic H ⁺ release based AP and RAINS based region (site) dependent AP as alternatives)	(10) kg SO2 equ into air M for aquatic, M&D for terrestrial (AP based on SO ₂)	(6) M: kg SO2-eq./kg emitted, D: NPP/kg emitted, JY/kg emitted M&D M: Deposition rate of acidifying substances with transportation and transformation are calculated. Grid model considering Japanese climate conditions was applied. D: Damage model relate to social assets and primary production were developed. Scope of social assets; fishery, and forestry Scope of primary production, terrestrial plant	H+ moles-e / kg emission AP based on SO ₂ for HF, HCl; NH ₃ & NO _x are covered based on more stringent goals	(7) EIP/km Weighting factors based on road-noise-kilometer distance-to-target using annual Japanese traffic	(7) H+ moles-e / kg emission M Based on Advanced Statistical Trajectory Regional Air Pollution (ASTRAP) model (Shannon 1991, 1992, 1996) originally developed to support the U.S. National Acid Precipitation Assessment Program. (AP based on H+)	(*)

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Eutrophication	(3) (DALYs/ke emission) See acidification	(12) kg NO ₃ ⁻ -eq./kg emitted; kg N eq/kg emitted; kg P-eq/kg emitted M (N and P equivalents, aggregation possible based on Redfield factor (NO ₃ ⁻ equivalents))	(12) m2 unprotected ecosystem/g emitted; M Separate modeling of aquatic eutrophication (exposure factor to be combined with the EDIP97 site-generic characterization factor) and terrestrial eutrophication (area of ecosystem exposed above critical load).		(12) kg PO ₄ ³⁻ -eq./kg emitted; kg NOx-eq. in Switzerland/kg emitted M (Average EP expressed in PO ₄ equivalents based on the Redfield ratio as baseline; average European EP based on RAINS model and RAINS based region (site) dependent EP as alternatives)	(10) kg PO43- equ into water M for aquatic M&D for terrestrial (P equivalent based on Redfield factor, by default P-limited only)	(14) M: kg PO ₄ ³⁻ -eq./kg emitted; D: JY/kg emitted M&D M: Based on Redfield ratio. Regarding the substance emitted to air, fate model was taken into account. D: The impact on fishery was assessed with the change of Dissolved oxygen concentration. The change of DO concentration was simulated considering hydrodynamic transportation and biochemical transformation.	(4) g N and g P P: annual emission limit into swiss lakes; N: annual emission limits into sweet water (in view of receiving sea basins)	(3) plus regionalized for inland sea areas, designated bays and lakes (20*3) kg N (lakes, bays), kg P (lakes, bays), kg COD (lakes, bays), BOD kg (rivers) Weighting factors based on distance-to-target for annual emissions of N, P and COD for designated bays and lakes (Law of Special Water Quality Control Measures for Lakes and Ponds, 2001) scaled for lakes using exceeding concentration levels. For BOD in rivers, a virtual BOD annual flow is calculated based on concentration and annual flow of water for 109 rivers.	(18) N-e / kg emission M Regionalized atmospheric transport and deposition models with hydrologic modeling of run-off to fresh- and salt- water environments to derive aquatic eutrophication factors for airborne sources in each of the 48 continental U.S. states. (N and P equivalents, aggregation possible based on Redfield factor (N equivalents are used))	(*)
	Ecotoxicity (Fate, exposure and effect should at least be considered)	(200) (PDF/m3/yr)/kg emission Fate calculated with EUUSES, using a closed Europe setting (low wind speed, low water runoff). For metals some corrections are made in the air compartment. PAF method used to determine Potentially Affected fraction assuming effect addition and assuming background PAF. Conversion from PAF to PDF using conversion factor 10. Correction for pesticides the impact on agricultural soil is set to zero, as this effect is also covered in land use	(192) m3 water/g emitted to air, water or soil; m3 soil/g emitted to air, water or soil M Partial fate including transfer between compartments, photochemical oxidation and biodegradation. Effect based on PNEC	(192) m3 water/g emitted to air, water or soil; m3 soil/g emitted to air, water or soil M Exposure factors for emissions to water and soil to be used together with site-generic EDIP97 characterisation factors for ecotoxicity in these compartments to represent the extent to which the emission leads to human exposure. Mainly for sensitivity analysis		(892) kg 1,4-DCB-eq. emitted to fresh water, sea water or industrial soil/kg emitted M Integrated multi-media fate, exposure and effect modelling based on USES-LCA model of Huijbregts (infinite Toxicity Potentials (TPs) for global scale as baseline; global scale TPs for 20, 100 and 500 years time horizon and continental scale TPs for infinite time horizon as alternatives; separate TPs for fresh water aquatic ecotoxicity, marine aquatic ecotoxicity, fresh water sediment ecotoxicity, marine sediment ecotoxicity and terrestrial ecotoxicity).	(393) aquatic ecotox. (393) terrestrial ecotox kg triethylene glycol equ into water / soil M&D AMI method: Assessment of mean impacts based on HC50 (geometric mean of EC50), Affected & Disappeared fraction of species	(81) aquatic ecotox. (81) terrestrial ecotox M: kg benzene-eq. emitted to water/kg emitted; D: EINES/kg emitted M&D M: Multi-media fate model with Japanese parameters was used. Effect is based on PNEC. D: The change of the extinction risk due to the change of intrinsic rate of natural growth was assessed. The relationship between intrinsic rate of natural growth and the concentration of chemicals in water was derived from statistically fitting experimental data.	(42) g Various - no single "eco tox" category. Annual maxima for emission (e.g. acids to air, heavy metals to air, water and top soil, oxygen-consuming carbon to surface waters, pesticides to ground water), based on the various considerations in defining legal concentration or flow limits into air, water and top soil.	Ecotoxicity was not considered in this version, but is under examination for the coming update. 2,4-D-e / kg emission M Integrated multi-media fate, exposure and effect modeling based on CaITOX (ETPs) and Huijbregts Terrestrial Toxicity factors based on PNEC. 2,4-D is used as reference substance.	(*)

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Resource use											
Land use & habitat losses	(15) Based on Köllner 1999, but with some changes. Köllner collected data for species richness in Swiss lowlands per land use type. Uses the Species area relationship; also to include regional aspect. Regional impact. Both occupation and conversion, but conversion uses simple default restoration time of 30 years. Problem. Species data for agricultural area's probably too low, as Edges of croplands are not fully included	-	-	-	m2.yr Unweighted aggregation of land competition	(15) m2 organic arable crop Adoption of Ecoindicator 99 method	(85) M: (occupation) m2.yr, (transformation) m2, D: (transformation) EINES/m2, dry-kg/m2, (occupation) dry-kg/m2/yr M: Land transformation and land occupation were separated as sub-categories. D: Damages on ecosystem (biodiversity and primary production) of land use (inc. transformation and occupation) were developed. Regarding the impact on the biodiversity, the relationship between the decrease of the population of vascular plant and risk of extinction were estimated based on the knowledge of conservation biology and RDB (Red Data Book). Regarding the loss of NPP, the changes of NPP through 10 years were measured for every grid in Japan. The representative damage factor for each type of land use was obtained based on these calculated results.	(4) volume and weight of controlled waste deposition (use of scarce space fit for specific waste depositions) (1 for all)	(2) waste generated kg, waste landfilled kg Landfilling capacity is considered based on distance-to-target of annual waste landfilled (OECD, 2002 / Ministry of Environment, 2003) and target flow 2010 (OECD, 2002). Waste generated is characterized by the rate of waste generated to waste landfilled.	-	-
Energy extractions	(9) (units) Fossil fuels: surplus energy concept further developed for fossil.	(xx) Weighting based on supply horizon	-	-	(98) (Primary energy carriers and minerals assessed together. ADP based on ultimate reserves and extraction rates as baseline; economic reserves and extraction rates, ultimate or economic reserve only, and exergy content as alternatives)	(9) MJ total Cumulative non renewable primary energy demand	(4) M: MJ total, D: JY/kg EINES/kg, dry-kg/kg M: Total energy consumption was adopted. D: The socio-economic impact and the impact to ecosystem are taken into account. Regarding the socio-economic impact, user cost was obtained from the viewpoint of equity between generations. The impact to ecosystem was estimated with relation to the area of land transformation in resource extraction. Damage model relate to social assets, biodiversity and primary production were developed. Scope of social assets; increase of user cost Scope of biodiversity; terrestrial species Scope of primary production; terrestrial plant	input of energy (= consumption of exergy), expressed as energy content of consumed energy carriers (fossile, nuclear, hydro, etc.) see below	-	(6) Fossil Fuel Index based on Ecoindicator '99	(7)

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Damage Assessment Categories											
Human health											
Human health	(1) (DALYs) Human Health includes mortality and morbidity			(169) (years) Includes as damages subcategories, (158) YOLL-years of lost life, (161) severe morbidity, (1) severe nuisance and (7) nuisance		(4) midpoint categories brought together (DALYs) Human Health includes mortality and morbidity	(893) DALYs include mortality and disability: Global warming (75), Ozone layer depletion (96), Air pollution (4), Photochemical oxidant creation (685), Human toxicity (33) are included.		(*)	(1) DALYs/tonne emissions (Criteria) Exposure to elevated particulate matter less than 2.5µm measured in DALYs (regionalized to U.S. census)	(*)
Biotic and Abiotic natural environment											
Biotic natural environment	(1) (PDF/m2/yr)/kg emission Ecosystem Quality			(160) Unitless NEX, normalized extinction of species, dimensionless		(4) midpoint categories brought together PDF-m2-year Ecosystem Quality	(152) EINES (Expected Increase in Number of Extinct Species) defined as 'Biodiversity'; The impact caused by Land use (4), Ecotoxicity (87), Resource consumption (abiotic and biotic 26) and waste (35) are measured.				
Abiotic natural environment	-					kg CO2 equ Climate change kept as separate damage on life support system					

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Abiotic and biotic natural resources											
Abiotic natural resources	-			(81) kg / kg reserves (1) Fossil oil, (1) fossil coal, (1) fossil natural gas and (78?) element reserves	(98) (units) Primary energy carriers and minerals assessed together. ADP based on ultimate reserves and extraction rates as baseline; economic reserves and extraction rates, ultimate or economic reserve only, and exergy content as alternatives		(22) Loss of economic value (Japanese Yen) defined as an element of 'Social assets', mineral resources and fossil fuels are taken into account.	(3) MJ (1) Fossil oil, (1) fossil coal, (1) fossil natural gas	-	Not considered in this version, but under consideration for the coming update as new legislation on resource conservation and efficiency have been introduced in Japan.	
	(1) MJ / MJ surplus Resources (MJ surplus energy)			(2) kg Drinking water and Irrigation water, (characterization factor of 1, as the flow mostly is determined directly in the LCI. The same is relevant for the 81 abiotic resources).		(2) midpoint categories brought together MJ primary non ren. energy Natural resources					
				(7) mole H+ equivalents Base cat-ion capacity of soil							
Biotic natural resources	-			-112 kg / kg reserves (112) crop production, (112) wood production, (9) fish & meat production		Biotic natural resources as a proxy	(1003) NPP (Net Primary Productivity) (dry kg) defined as 'Primary production' Loss of the net primary production (kg) is adopted as a damage indicator. The impact caused by global warming (75), ozonlayer depletion (96), acidification (5), photochemical oxidant creation (685), land use (81), resource consumption (abiotic and biotic)26, and waste (35) are taken into account.		-	Not considered in this version, but under consideration for the coming update as new legislation on resource conservation and efficiency have been introduced in Japan.	
Abiotic and biotic man-made environment											
Abiotic man-made environment				Recreational and cultural values							
Biotic man-made environment				also see biotic natural resources above + defined adhoc categories		Biotic natural resources as a proxy	(771) Loss of economic value (Japanese Yen) is adopted defined as an element of 'Social assets', the damage on crops, fishery and forestry were taken into account. Global warming (75), Acidification (5), Eutrophication (6), Photochemical oxidant creation (685) are included.				