

Index

- abiotic
  - factor, 33
  - resource, 25
  - transformation, 76
- acceptable risk, 132, 133
- acenaphthene, 127, 128
- acetaldehyde, 135
- acetyl coenzyme A, 110
- acetylcholine, 112
- acid rain, 1, 45
- acidification, 45
  - ocean, 48
  - soil, 47–48
- acidifying substances, 45
- active transport, 97
- adenosine diphosphate, 109
- adenosine triphosphate, 109
- advection, 73
- agonist, 113
- AHP. *See* analytic hierarchy process
- albedo, 20, 55
- allergen, 114
- allergic reaction, 114
- allocation
  - 50/50, 155
  - by partitioning, 152
  - by quality, 155
  - by system expansion, 152
  - closed-loop approximation, 155
  - cut-off, 153
  - disposal loading, 155
  - economic, 153
  - extraction loading, 154
  - for open-loop recycling, 153
  - in ISO14044, 152
  - physiochemical, 152
- Alzheimer’s disease, 115
- analytic hierarchy process, 203, 216
- analytical solution, 82, 87, 89
- aniline, 99
- Annex XIV, under REACH, 178
- Annex XVII, under REACH, 179
- antagonist, 116
- antagonistic effect, 192
- Anthropocene period, 19, 39, 58
- antibody, 114
- antigen, 113
- applied scientist, 1
- appropriate technology, 14
- areas of protection in LCIA, 160
- arsenic, 62
- asbestos, 106
- Asian brown cloud, 52
- atmosphere, 20, 67
- ATP. *See* adenosine triphosphate
- attributinal LCA, 146, 155
- authorisation, under REACH, 178
- B cell, 114
- backcasting, 200
- Baltic Sea, 49
- Basel Convention, 176
- BAT. *See* Best Available Technology
- BATNEEC. *See* Best Available Techniques Not Entailing Excessive Costs
- belief system, 219
- benzo(a)pyrene, 114
- benzoic acid, 99
- Best Available Technology, 14
- Best Practicable Environmental Option, 14
- beta-Poisson function, 131
- bile, 107
- bile duct, 107
- bioaccumulation, 59, 60, 68, 70
- bioavailability, 68, 75
- biobased economy, 7–8
- biocapacity, 39
- bioconcentration, 60, 68
- biodiversity, 24, 34, 39, 40
- biogeochemical cycles, 28
- biological membrane, 95
- biomagnification, 60, 68
- biorefinery, 7
- biosafety levels, 137
- biosphere, 27–28, 67
- biotic transformation, 75
- biotransformation, 75, 103
- bioturbation, 75, 76
- blood, 100, 108
- blood-brain barrier, 103
- bottom-up control, 32
- Bowman’s capsule, 108
- BPEO. *See* Best Practicable Environmental Option
- brainstorming, 200
  - negative, 200
  - with SWOT, 200
- Brownian motion, 95
- Brundtland Commission, 2

- BSL. *See* biosafety levels  
burden of disease indicators, 131
- cadmium, 61, 116  
cancer, 116  
Candidate List, under REACH, 179  
carbon cycle, 29  
carbon dioxide, 56, 110  
carbon dioxide equivalents, 158  
carbon footprint, 159  
carbon monoxide, 111  
carcinogen, 115, 128, 130  
carcinogenic, mutagenic, toxic to reproduction, 178  
catalyst, 53  
cell, 27  
CFC, 53, 73 *See* chlorofluorocarbon  
characterisation factors, 159  
characterisation in LCA, 158  
chemical, 65  
chemical exposure, 132  
Chemical Safety Report, 178  
chlorofluorocarbon, 53, 173  
choice problem, 199  
cholic acid, 107  
chromated copper arsenate, 125  
cilia, 106  
circular economy, 6–7  
circularity, 6  
Citizens Against Drinking Sewage, 218  
citric acid cycle, 109  
classification, 158  
classification in LCA, 158  
Clean Air Act  
    Californian exemption, 184  
    United States, 183  
Clean Water Act, United States, 183  
climate change, 24, 30, 38, 40  
climate change denial, 39  
closed-loop recycling, 7  
CLRTAP. *See* Convention on Long-Range Transboundary Air Pollution  
CMR. *See* carcinogenic, mutagenic, toxic to reproduction  
Cochabamba water wars, 217  
Code of Federal Regulations, of the United States, 182, 192  
comparative LCA, 143  
compensation in MCA, 215  
completeness check in LCA, 162  
complex systems, 4  
concordance principle in ELECTRE, 210  
Congress of the United States, 181  
conjugation, 104  
consequential LCA, 146, 155  
consistency check in LCA, 162  
consumer, 31  
contact allergy, 114  
contribution analysis in LCA, 162  
convection, 22, 73  
Convention on Long-Range Transboundary Air Pollution, 170, 172  
coral bleaching, 160  
corporate social responsibility, 16  
Corporate Social Responsibility Report, 194  
Council of the European Union, 177  
cradle-to-cradle framework, 7  
critical review in LCA, 148  
cultural theory, 220  
cut offs, in LCA, 145  
cyanide, 111
- DALY. *See* Disability Adjusted Life Years  
DDT. *See* dichlorodiphenyltrichloroethane  
de Saint-Exupéry, Antoine, 92  
decision-maker, 199  
decisions, EU, 177  
decomposer, 31  
dematerialisation, 11  
denitrification, 30  
deoxyribonucleic acid, 114, 116  
description problem, 199  
diabetes, 115  
dichlorodiphenyltrichloroethane, 59, 113, 116, 171  
diffuse emissions, 44  
diffusion, 73, 95  
    facilitated, 96  
digestive tract, 99  
dioxin, 63, 67  
directives  
    EU, 177, 194  
    Swedish, 188  
dirty dozen, 62, 171  
Disability Affected Life Years, 131, 160  
discordance principle in ELECTRE, 210  
dispersion, 73, 80  
    coefficient, 80  
    model, 80  
DNA. *See* deoxyribonucleic acid  
Dobson units, 53  
dopamine, 112  
dose, 94  
dose-response relationship, 126  
dossier evaluation, under REACH, 178  
down-cycling, 7  
down-going curve, 81, 90  
DPSIR framework, 11  
durable water repellent, 171  
dust inhalation, 129  
duty ethics, 224
- Earth's crust, 25  
Ebro River, Spain, 181  
EChA. *See* European Chemicals Agency  
eco-efficiency, 10  
Ecoindicator 99 method, 221  
ecological footprint, 39, 166, 190  
ecological rucksack, 166

- ecological succession, 48
- economic modelling, 157
- ecosystem, 27, 31
- ecosystem services, 35, 38
- ED50, 127
- EEIOA, 151 *See* environmentally extended IOA
- effect
  - acute, 109
  - chronic, 109
  - local, 95
  - systemic, 95
- EIA. *See* environmental impact assessment
- EIS. *See* environmental impact statement
- El Niño, 24
- ELECTRE method for MCA, 209
- EMS. *See* environmental management system
- endocrine disruptor, 116
- endocytosis, 97, 106
- endpoint indicator in LCIA, 159
- energy loss, 32
- energy pyramid, 32
- enforcement mechanism, 175
- engineer, 1
- engineering
  - chemical, 3
  - civil, 3
  - mechanical, 3
- enterohepatic circulation, 107
- Environmental Code, Swedish, 187
- environmental impact assessment, xi, 185, 190, 191, 193
- environmental impact statement, 190, 193
- environmental management system, xi, 16, 190, 195, 196
- Environmental Objectives Council, Swedish, 189
- Environmental Protection Agency
  - Swedish, 189
  - US, 182, 183, 185
- environmental systems analysis, 140, 169
- environmentally extended IOA, 167, 151
- epidermis, 97
- epigenetic, 116
- ESA. *See* environmental systems analysis
- ethical dilemma
  - axe problem, 224
  - definition of, 223
  - lifeboat problem, 223
  - management of, 224–225
  - trolley problem, 223
- Euro 6 vehicle emissions regulation, 180
- European Chemicals Agency, 178
- European Commission, 177
- European Compliance label, 180
- European Council, 177
- European Parliament, 177
- European Union, 170, 176, 177
- eutrophication, 48, 139
- evolution, 115
- excitotoxin, 113
- excretion, 105, 106
- executive agreement, 176
- exocytosis, 97, 112
- exponential function, 131
- exposure assessment, in risk assessment, 128
- exposure averaging time, 130
- exposure limit, 134
- exposure pathway, 128
- exposure route, 124
- extended producer responsibility, 15
- extinction, 27
- Factor X concept, 10
- fatty tissue, 102
- Federal Register, United States, 182
- federation of states, 181
- filtration, 96
- flame retardant, 171
- flowchart, in LCA, 144
- food chain, 31
- food web, 31
- fossil fuel, 25, 30
- four principles for sustainability, 8
- Framework Convention on Climate Change, 173, 175, 176
- Frank R. Lautenberg Chemical Safety for the 21st Century Act, 184
- Freundlich
  - equation, 69, 83
  - isotherm, 70
- functional diversity, 34
- functional unit, in LCA, 143
- författningar*, 187
- gall, 107
- genetic diversity, 34
- geoengineering, 59
- geothermal energy, 26
- global concordance degree in ELECTRE, 211
- global distillation, 22, 63
- global hectares, 166
- Global Reporting Initiative, 195
- Globally Harmonised System, 134
- glomerulus, 108
- gloves, 98
- glucose, 109
- glutamate, 112
- glycine, 104
- goal statement, in LCA, 143
- Gold Coast Waterfuture, 219
- Gothenburg Protocol, 172
- grasshopper effect, 22, 63
- Green Climate Fund, 175, 176
- green engineering, 12
- greenhouse effect
  - enhanced, 55
  - natural, 20
- greenhouse gas, 20, 29, 30, 53, 54, 55, 56
- greenhouse gas life cycle assessment, 159

- guide words. *See* HAZOP
- gun laws, 133
- H. See* Henry’s law
- Haber-Bosch process, 30
- habitat loss, 41
- haemoglobin, 111
- Haiti, 176
- halocline, 25
- hazard, 124
- hazard analysis and critical control points, 119, 120
- HAZard and OPerability study, 119
- hazard assessment
  - in risk assessment, 124
  - under REACH, 178
- hazard pictogram, 134
- hazard quotient, 130
- hazardous event, 121
- hazardous waste, 141, 176
- HAZOP. *See* HAZard and OPerability study
- HCFC. *See* hydrochlorofluorocarbon
- Henry’s law, 69, 84
- heterogeneous catalytic ozone depletion, 54
- HFC. *See* hydrofluorocarbon
- homeostasis, 36
- House of Representatives of the United States, 181, 186
- HQ. *See* hazard quotient
- human needs, 2, 9
- human well-being, 35
- hydrochlorofluorocarbon, 173
- hydrofluorocarbon, 173
- hydrological cycle, 28
- hydrolysis, 76, 104
- hydrosphere, 22–25, 66
- hydroxyl radical, 159
- issue identification, in risk assessment, 124
- immune system, 113
- importance coefficient, 214
- improvement analysis in LCA, 162
- IMUP equation, 10
- in silico* testing, 126
- in vitro* testing, 125
- in vivo* testing, 125
- independent peer-review, 143
- indicator selection in LCA, 147
- indicators, 12, 200
  - endpoint, in LCIA, 159
  - midpoint, in LCIA, 159
  - reversing in MCA, 203
  - Swedish environmental objectives, 190
- indifference threshold in ELECTRE, 211
- indirect potable recycling, 218
- industrial symbiosis, 6
- initiation, of cancer, 116
- input-output analysis, 167
  - in LCI, 151
  - interdisciplinary, 4
- Intergovernmental Panel on Climate Change, 159
- intermedia transport, 68
- intermediate technology, 14
- interpretation in LCA, 162
- intertidal zone, 24
- intramedia transport, 72
- invasive species, 42
- IOA. *See* input-output analysis
- IRIS database, 127
- ISO standard
  - ISO 14001, 190, 196
  - ISO 14025, 142
  - ISO 14040, 142, 148
  - ISO 14044, 142, 148, 152, 158
  - ISO 14048, 142
  - ISO 22000, 120
  - ISO 31000, 118
  - ISO 31010, 118
- judicial system
  - Sweden, 188
  - United States, 185
- kidneys, 108
- $K_{oc}$ . *See* soil organic carbon sorption coefficient
- $K_{ow}$ . *See* octanol-water partition coefficient
- Krebs cycle, 109
- $K_s$ . *See* solubility constant
- K-strategist, 32
- Kyoto Protocol, 159, 175
- La Niña, 24
- landscape diversity, 34
- lateral thinking, 200
- law
  - international environmental, 170
  - Swedish environmental, 187
  - US environmental, 182
- Law
  - Henry’s, 84
- law of thermodynamics
  - first, 8
  - Second, 8
- LCC. *See* life cycle costing
- LCI. *See* life cycle inventory
- LCIA. *See* life cycle impact assessment
- LCSA. *See* life cycle sustainability assessment
- LD50, 127
- lead, 113, 116
  - tetraethyl, 61
- learning circle, 196
- legislature
  - bicameral, 181
  - unicameral, 186, 187
- levels of containment, 136
- life cycle assessment, xi, 190
- life cycle costing, 163
- life cycle impact assessment, xi, 146, 159, 221

- life cycle inventory, 149, 151, 156
- life cycle perspective, 5, 139
- life cycle sustainability assessment, 164
- life cycle thinking, 140
- liming, 45, 46
- limiting element, 27
- lithosphere, 25–27, 67
- littoral zone, 24
- liver, 106
- Living Planet Index, 39
- Love Canal, 183
- lungs, 100
- macrophage, 106
- material flow analysis, xi, 164
- material flux analysis, 164
- Material Intensity Per Service, 165
- MAUT. *See* multi-attribute utility theory
- MCA, 222 *See* multicriteria analysis
- MCDA. *See* multicriteria decision aiding
- mercury, 116
  - alkylmercury, 60
- metabolism, 103
- metadata in LCA, 150
- methane, 56
- methanol, 102
- methylmercury, 103, 107
- MFA. *See* material flow analysis
- midpoint indicators in LCIA, 159
- Miljöbalken, 187
- MIPS. *See* Material Intensity Per Service
- model, 78
  - box, 78
  - compartment, 78
  - Mackay, 78
  - plume, 79, 193
- monoculture, 41
- Montreal Protocol, 173
- mortality, 133
- mucous membrane, 101
- mucous, 106
- multi-attribute utility theory, 202, 203, 214, 215, 216
- multicriteria analysis, xi
- multicriteria analysis, 161, 198
- multicriteria decision aiding, 198
- multidisciplinary, 4
- multiple barrier risk management, 137
- mutation, 115
- myelin sheath, 111, 113
- narrative approaches, 4
- National Environmental Policy Act, United States, 182
- natural capital, 34
- nephron, 108
- nerve cell, 111
- nested dependencies model, 2
- net present value, 163
- neuron, 111
- neurotoxin, 113
- nickel, 114
- nicotine, 113
- NIMBY. *See* not in my backyard
- not in my backyard, 222
- nitrate, 116
- nitric acid, 30
- nitrite, 111, 115
- nitrogen cycle, 30
- nitrogen fixation, 30
- nitrosamine, 115
- nitrous oxide, 56
- N-nitrosodimethylamine, 115
- no observable adverse effect level, 127, 130
- NOAEL. *See* no observable adverse effect level
- non-carcinogen, 128
- non-renewable resource, 25
- normalisation in LCIA, 161
- NPV. *See* net present value
- numerical solution, 83, 86, 89, 90
- nutrients
  - biological, 7
  - technical, 7
- Occam’s razor, 78
- ocean acidification, 30
- oceanic circulation, 22
- oceanic zones, 24
- octanol-water partition coefficient, 60, 69, 71, 72
- one vote, one value, 199
- open-source appropriate technology, 14
- organophosphate, 113
- oxidation, 76, 104
- oxidative phosphorylation, 110
- ozone, 22, 51
  - depletion, 52, 53
  - hole, 22, 54, 74
  - layer, 22, 52, 53
- pairwise comparison in MCA, 206
- pancreas, 99
- Paracelsus, 94
- Paris Agreement, 175
- particle size, 101
- particulate matter, 51
- PAS2050, 142
- passive products, in LCA, 145
- pathogen exposure, 132
- PBT. *See* persistent, bioaccumulative and toxic
- PCB. *See* polychlorinated biphenyl compound
- PDCA. *See* Plan-Do-Check-Act cycle
- PER. *See* public environmental report
- persistent chemical, 170
- persistent organic pollutant, 62, 170, 171, 176
- persistent toxic pollutant, 1
- persistent, bioaccumulative and toxic, 178

- personal protective gear, 122, 136
- pesticide, 171
- PET. *See* polyethylene terephthalate
- phagocytosis, 106
- phagosome, 106
- phospholipid molecules, 95
- photochemical oxidants, 51
- photolysis, 76
- photosynthesis, 20, 30, 31, 56
- phthalate, 116
- placental barrier, 103
- Plan-Do-Check-Act cycle, 136, 195
- planetary boundaries, 12, 39, 215
- point emission, 44, 139
- poison, 94
- pollutant, 44
  - effects
    - global, 44
    - local, 44
    - primary, 44
    - regional, 44
    - secondary, 44
  - emerging, 64
  - persistent, 59
  - persistent organic. *See* persistent organic pollutant
- polluter pays principle, 15
  - in Swedish law, 187
- pollution, 44, 66
  - organic, 49
- polychlorinated biphenyl compound, 63, 105, 116
- polyethylene terephthalate, 139, 153
- POP. *See* persistent organic pollutant
- population dynamics, 33
- portal vein, 107
- positivism, 168, 5, 15
- pragmatic design, 200
- precautionary principle, 14
  - in Swedish law, 187
- preference flow in PROMETHEE, 209
- preference functions in PROMETHEE, 206
- Preference Ranking Organisation Method for Enriched Evaluation, 206, 216
- preference threshold in ELECTRE, 211
- president of the United States, 176, 181, 186
- prime minister of Sweden, 186
- process analysis in LCI, 150
- producer, 31
- PROMETHEE. *See* Preference Ranking Organisation Method for Enriched Evaluation
- promotion, of cancer, 116
- propinquity factor, 222
- Protocol
  - Gothenburg, 172
  - Kyoto, 175
  - Montreal, 173
- public environmental report, 194
- QALY. *See* Quality Adjusted Life Years
- QRA. *See* risk assessment, quantitative Quality Adjusted Life Years, 131
- radiative forcing, 158, 160
- rank reversal, 214, 216
- ranking problem, 199, 209
- ratification, 170
- REACH. *See* Registration, Evaluation, and Authorisation of Chemicals
- reaction
  - first-order, 77
  - second-order, 77
- recipe method in LCIA, 160, 161
- Redfield ratio, 27
- reduction, 76, 104
- reductionism, 15
- reference dose, 127, 130
- regime shift, 34
- Registration, Evaluation, and Authorisation of Chemicals, 14, 170, 177, 178, 179, 184
- regulations
  - EU, 177, 186
  - Swedish, 188
  - United States, 182
- residence time, 86, 87
- resilience, 33
- resource
  - flow-type, 35
  - fund-type, 35
  - non-renewable, 35
  - renewable, 35
  - stock-type, 35
- respiration, 30, 56
- respiratory system, 106
- restriction, 179
- Restriction of Hazardous Substances Directive, 179
- reunification of Germany, 141
- RfD. *See* reference dose
- Riksdag, 186, 187, 188
- risk, 94
- risk assessment, 118
  - microbial, 127, 131
  - qualitative, 119
  - quantitative, xi, 122
  - semi-quantitative, 121
- risk management, 136
- risk perception, 132
- River Basin Management Plan, 180, 186
- risk characterisation, in risk assessment, 129
- r-strategist, 32
- scaling in MCA
  - fraction of root of sum of squares, 203
  - fraction of sum of scores, 203
  - min-max, 203
  - zero-max, 202

- sciatic nerve, 111
- scope creep, 191
- scope of an LCA, 143
- scopes, 157
- screening of alternatives, 201
- Senate of the United States, 171, 176, 181
- sensitivity analysis, 162
- serotonin, 112
- Shewhart cycle, 195
- Sierra Club, 185
- sigmoidal curve, 128
- silicosis, 106
- SIN list, 14
- sink, 53
- SLCA. *See* social life cycle assessment
- slope factor, 128
- small intestine, 99
- smog, 50
- social constructivism, 137
- social life cycle assessment, 164
- soil, 26
- soil organic carbon sorption coefficient, 69
- solubility, 69
- solubility constant, 69
- sorting problem, 199, 209
- Southern Oscillation, 24
- species
  - extant, 27
  - extinct, 27
- species diversity, 34
- species extinction, 34
- spiders and snakes, 132
- systematic inventive thinking, 200
- stakeholder, 199, 200, 201, 215, 216
- stand-alone LCA, 143
- State of the Environment Report, 194
- statutes, Swedish, 187
- steady state, 80, 85
- Stockholm Convention, 171
- stomach, 99
- stratosphere, 20
- stratum corneum, 98
- straw man in MCA, 203
- stressor, 125
- strong sustainability, 215
- structural contribution methods, 72
- structure-activity relationships, 70
- subchronic experiment, 127
- substance evaluation, under REACH, 178
- substances of very high concern, 14, 178
- substitution principle, 14
  - in Swedish law, 187
- Superfund Act, United States, 183
- Supreme Court, United States, 185
- sustainability, 2
- sustainable development, 1
- sustainable development goals, 2
- Sustainable Development Mechanism, 175
- Sweden, 170, 186
- SVHC. *See* substances of very high concern
- synapse, 112
- synergistic negative effect, 192
- synthesizing criterion in MCA, 202
- synthesizing preference relational system in MCA, 202, 206
- system boundaries
  - geographic, 146
  - in LCA, 144
  - natural, 146
  - technical, 145
  - temporal, 146
- system conditions for sustainability, 8
- systems analysis, 4, 15
- systems perspective, 5
- T cell, 114
- technosphere, 65
- temperature inversion, 22, 50
- The Natural Step, 9
- thermocline, 25
- thermodynamics, second law of, 19
- threshold limit value, 135
- tin, 61
- tobacco, 116
- tobacco smoke, 133
- tolerance range, 34
- toluene, 104
- Toowoomba water crisis, 218
- top-down control, 32
- Toxic Substances Control Act, United States, 184
- toxicant, 94, 95
  - distribution, 102
- toxicodynamics, 94
- toxicokinetics, 94
- toxicology, 94
- trade-off weight, 214
- transboundary transport, 45
- transdisciplinary, 4
- transmaterialisation, 11
- transport accident, 133
- treaty, 171, 176
- triage nurse, 138
- tropopause, 20
- troposphere, 20
- truncation error, 167
- tubulus, 108
- tumour, 116
- UF. *See* uncertainty factor, in risk assessment
- ultraviolet radiation, 173
- uncertainty analysis, 162
- uncertainty factor, in risk assessment, 127, 128
- UNFCCC. *See* Framework Convention on Climate Change
- unitary state, 186
- United Nations, 171

- United States of America,170
- unsteady state, 81
- up-going curve, 82, 87, 89, 91
- urine, 108
- USEPA. *See* Environmental Protection Agency, United States
- USEtox model, 78, 84, 160
- value chains, 5
- waste hierarchy, 13
- water cycle, 28
- Water Framework Directive, 180, 186
- weak sustainability, 215
- weighting in MCA, 214
- verbal preference scale in MCA, 204
- Verhulst model, 33
- very persistent and very bioaccumulative, 178
- vesicle, 97, 106, 112
- veto threshold in ELECTRE, 211
- wicked
  - problem, 4, 16, 140
  - system, 168
- World Health Organization, 132, 171
- worldview, 2, 219
  - environmental stewardship, 220
  - environmental wisdom, 220
  - planetary management, 219
- vPvB. *See* very persistent and very bioaccumulative
- weighting in LCIA, 161