Practical guide to impact assessment for organizations

Course material

Ellen Meijer
PRé Consultants, the Netherlands

Practical guide to impact assessment

This guide aims at explaining the basic principles of impact assessment.

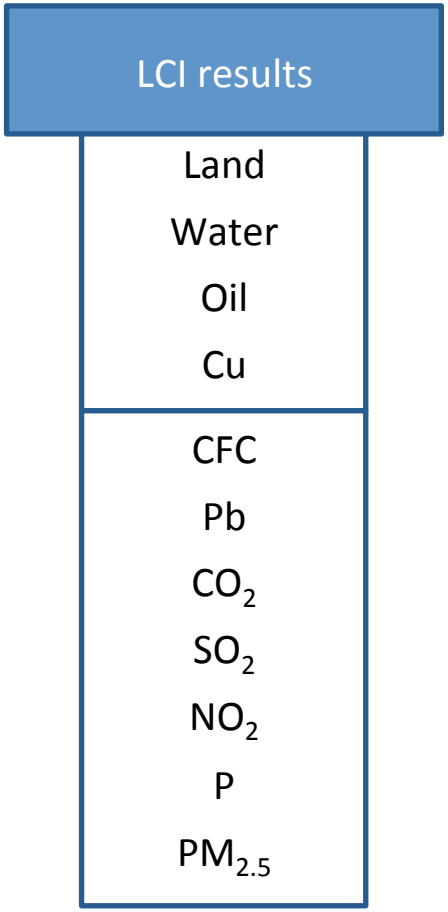
The following topics are covered:

1. Why impact assessment?
2. Steps of impact assessment
3. Impact assessment methods
4. Interpretation
5. LC-IMPACT

Why is impact assessment needed?

- Modeling a life cycle results in a list of elementary flows called **life cycle inventory (LCI)** results.
- Conclusions about impacts cannot be drawn from this long list of inputs from and outputs to nature.

- Life cycle **impact assessment (LCIA)** methods translate LCI results into potential impacts on the environment so conclusions can be drawn.



Multiple impacts

- The earth is a **very complex** system.
- Many anthropogenic activities have the potential to have an effect on human health, the natural environment and resources.
- These effects are captured in a number of impacts, for example:

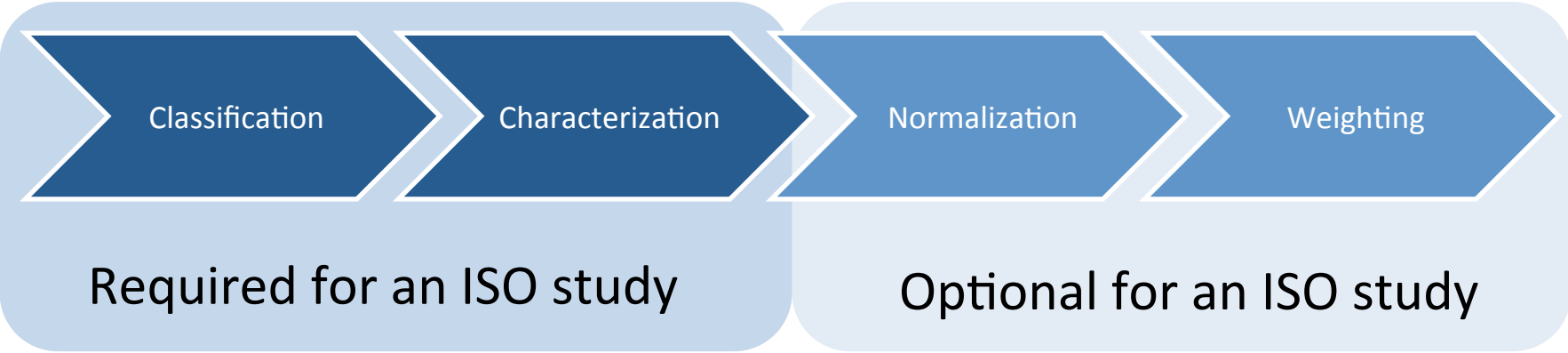
Climate change	*Photochemical oxidant formation*	*Agricultural land occupation*
Ozone depletion	*Particulate matter formation*	*Urban land occupation*
Terrestrial acidification	*Terrestrial ecotoxicity*	*Natural land transformation*
Freshwater eutrophication	*Freshwater ecotoxicity*	*Water scarcity*
Marine eutrophication	*Marine ecotoxicity*	*Mineral scarcity*
Human toxicity	*Ionising radiation*	*Fossil scarcity*

Why multiple impacts should be considered

- **Trade-offs** between impacts can occur, for example:
  - Biofuels vs fossil fuels: biofuels could have a lower impact on fossil resource scarcity compared to fossil fuels but a higher impact on eutrophication.

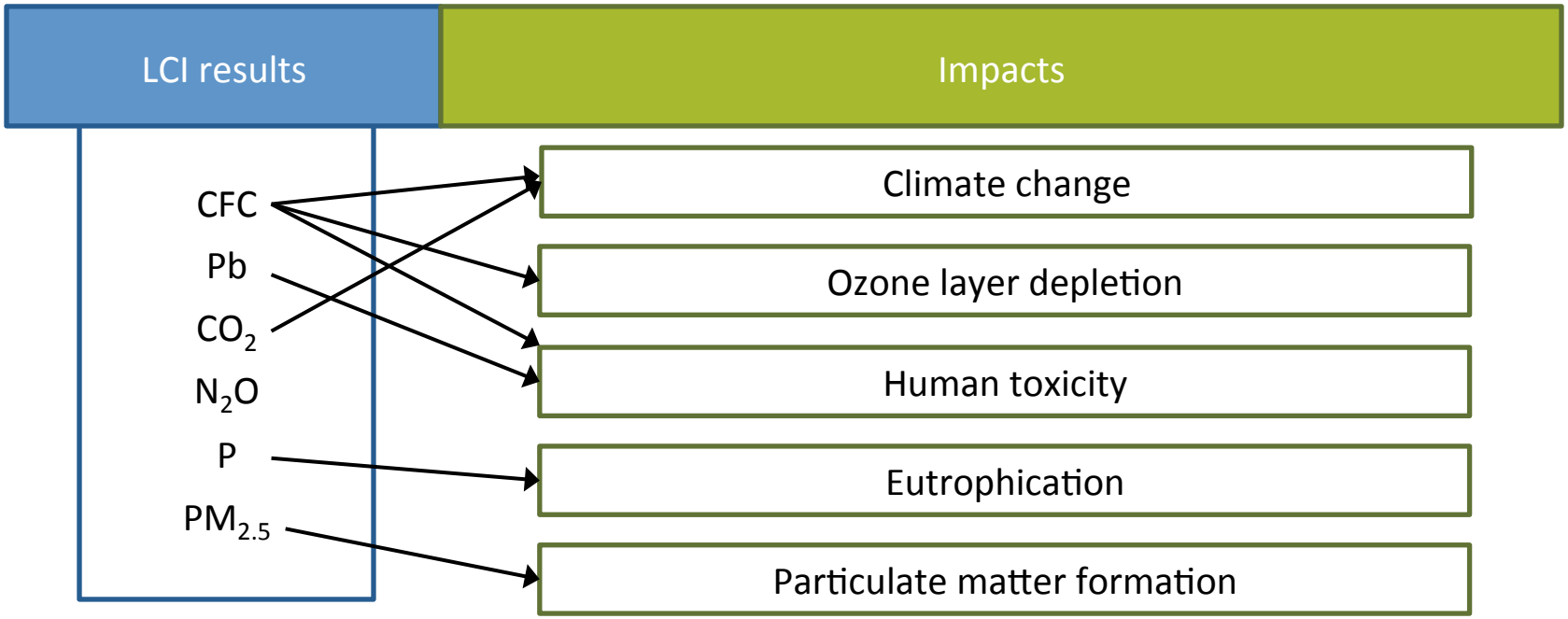
- When looking at only a limited number of impacts badly informed decisions can be made.

Steps of life cycle impact assessment



1. Classification

- LCI results are assigned to environmental themes where they may cause an effect.



2. Characterization

- The **effect** of each substance on an environmental theme is determined.
- Results are summed up into one reference unit per impact, e.g. impact on climate change is expressed in kg CO_2-eq.

LCI results		Climate change		Acidification		Particulate matter	
1 kg	CO_2	x 1	1				
0.01 kg	SO_2			x 1.31	0.0131	x 0.061	0.00061
0.05 kg	N_2O	x 298	1.49	x 0.74	0.037	x 0.0072	0.000036
0.04 kg	$PM_{2.5}$					x 1	0.004
			2.49 kg CO_2-eq.		**0.0168 mol H^+-eq.**		**0.0046 kg $PM_{2.5}$-eq.**

Midpoint versus endpoint

- Impacts can be characterized anywhere along the cause-effect chain

Midpoint

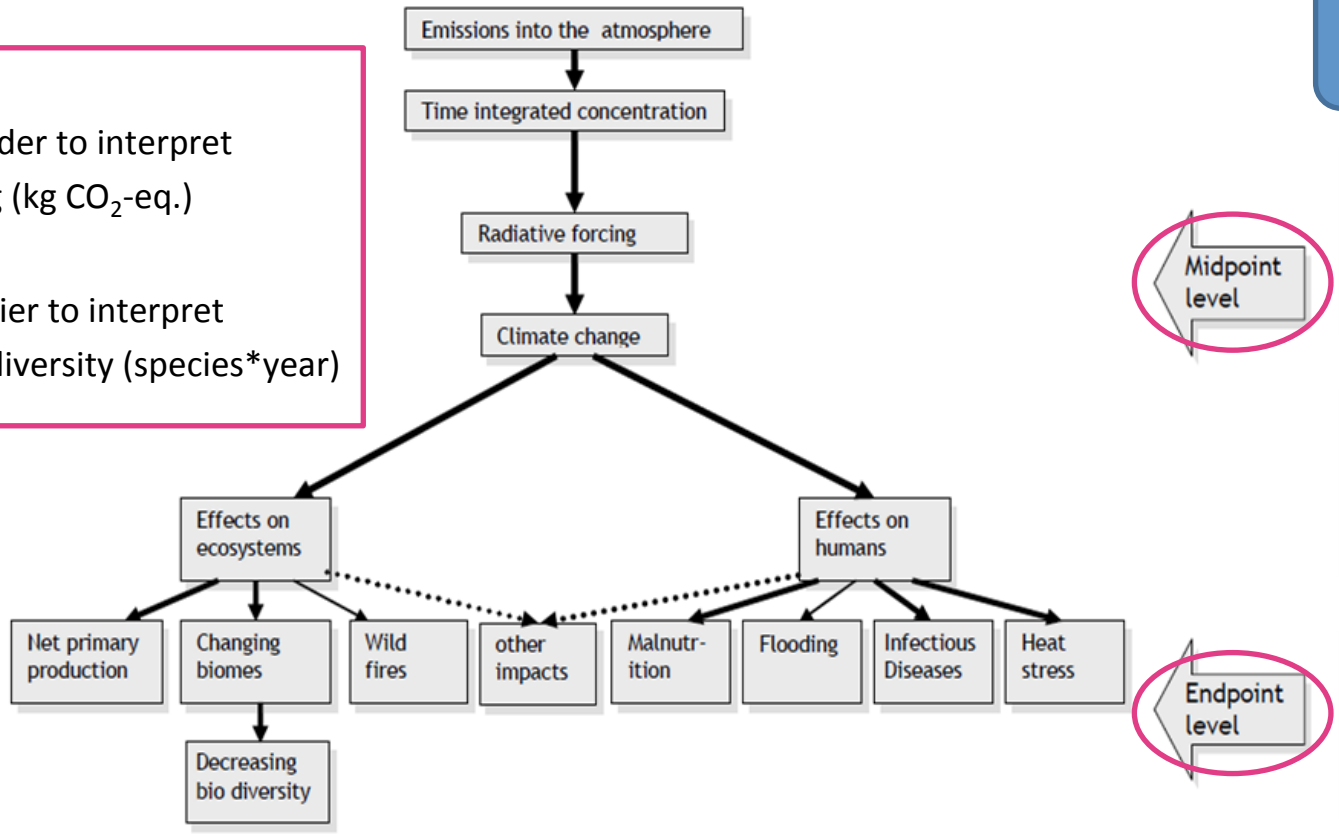
✓ lower uncertainty but harder to interpret

✓ example: radiative forcing (kg CO_2-eq.)

Endpoint

✓ larger uncertainty but easier to interpret

✓ example: decrease in biodiversity (species*year)



3. Normalization

- The characterized results are **compared to a reference**, e.g. average annual impact of a European citizen (person·year).
- All impacts are now expressed in the same unit.

	Climate change		Acidification		Particulate matter	
Characterized results	2.49	kg CO_2-eq.	0.0168	mol H^+-eq.	0.0046	kg $PM_{2.5}$-eq.
Normalization factor	6803	kg CO2-eq / person·yr	49.44	mol H+-eq. / person·yr	2.746	kg PM2.5-eq. / person·yr
Normalized results	0.000366	person·yr	0.00034	person·yr	0.00169	person·yr

4. Weighting

- A **value judgement** is applied to the results stating how important each impact is.
- After weighting the calculated environmental impacts can be aggregated and displayed as a **single score**.

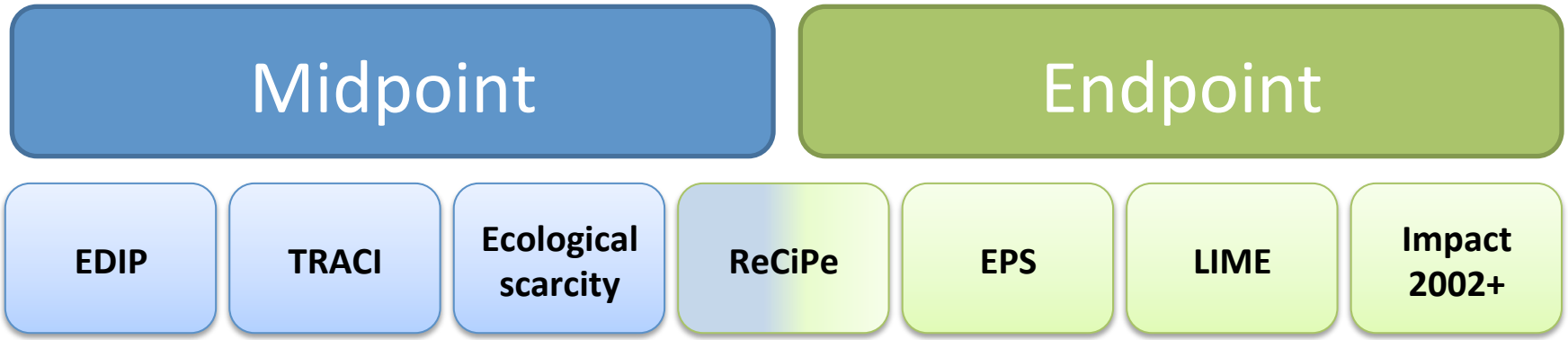
- Weighting is a controversial step since this value judgement may be different per individual/organization.

- Options for determining weighting factors:
  - *Distance to target* (scientific or policy targets)
  - *Monetization* (e.g. willingness to pay)
  - *Panel weighting* (average opinion of a group)

Comprehensive LCIA methods available

- Different LCIA methods are available:
  - At midpoint or endpoint level
  - Using a single impact (IPCC) or multiple impacts (ReCiPe)

- Which method is most relevant to use depends on goal of the study



Interpretation

- When interpreting results:
  - Use sensitivity analysis on assumptions
  - Use uncertainty analysis on data

- After interpretation decisions can be made e.g.:
  - Hotspots identification
  - Determination of KPI's
  - Identification of improvement opportunities
  - Choice of materials/technologies by comparison
  - etc.

LCIA research needs

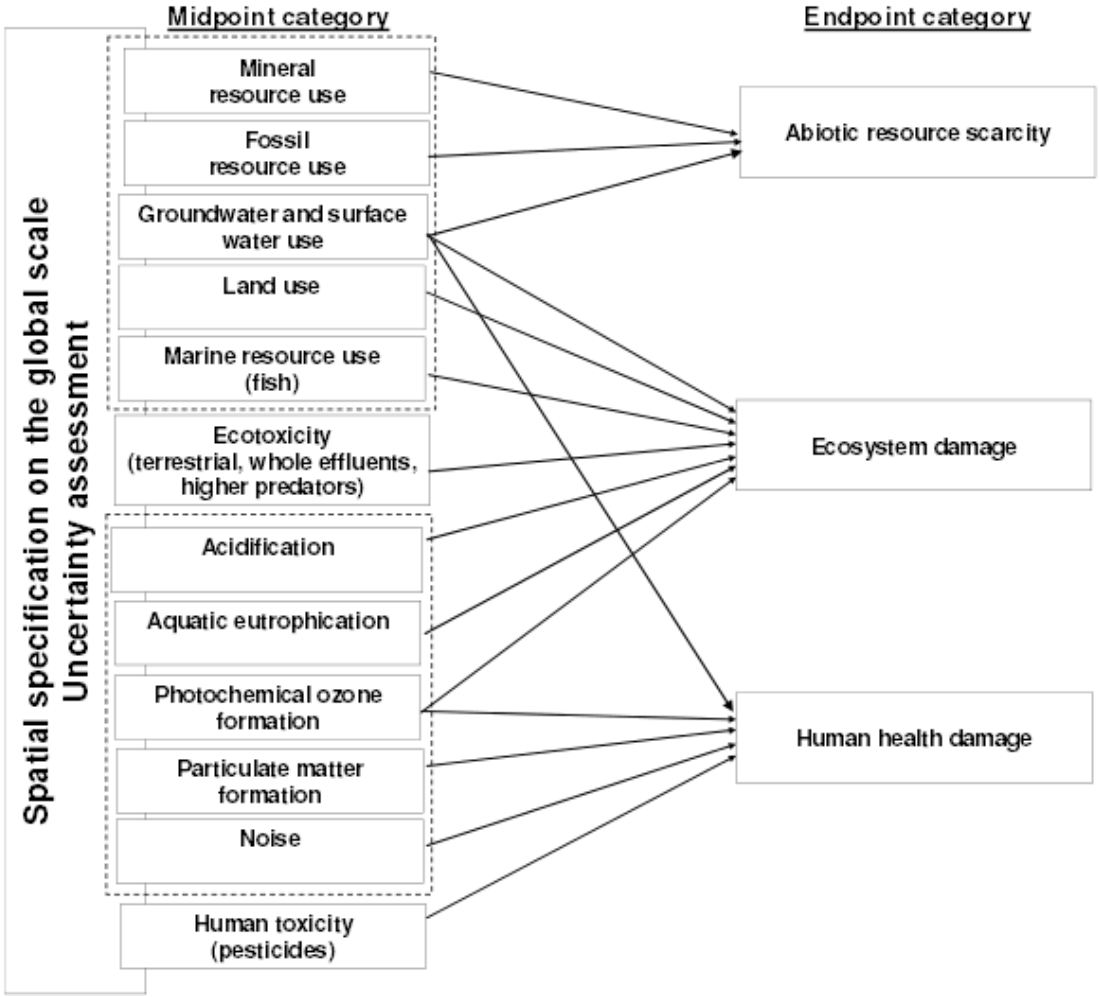
- Several limitations of impact assessment methods exist:
  - Methods are available but need further research, e.g. toxicity impacts of metal emissions
  - No methods are available, e.g. impact of land use on erosion
  - There is no/limited spatial differentiation

LC-IMPACT aims at giving response to some of these research needs

Overview of LC-IMPACT

Consortium

Radboud Universiteit Nijmegen
DTU
DAIMLER
Unilever
ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich
Sik
Raw Materials Group
PRé
European Commission
JOINT RESEARCH CENTRE
International Institute for Applied Systems Analysis
IIASA
Quantis
Sustainability counts
UNIVERSITÄT BAYREUTH
Universiteit Leiden
University of Stuttgart
Germany
GRAPHIC ASSOCIATION DENMARK



Authors:

Ellen Meijer | Technical Analyst meijer@pre-sustainability.com

Marisa Vieira|Senior Technical Consultant vieira@pre-sustainability.com

Rimousky Menkveld | Technical Consultant menkveld@pre-sustainability.com

Anne Gaasbeek | Sustainability Consultant gaasbeek@pre-sustainability.com

Mark Goedkoop|Managing director goedkoop@pre-sustainability.com

Additional information:

Website of PRé Consultants: www.pre-sustainability.com

Website of LC-IMPACT project: www.lc-impact.eu

The research was funded by the European Commission under the 7th framework program on environment; ENV.2009.3.3.2.1: LC-IMPACT - Improved Life Cycle Impact Assessment methods (LCIA) for better sustainability assessment of technologies, grant agreement number 243827.