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Copernicus Institute of Sustainable Development

Environmental sustainability indicators for biobased products

Focus on early-stage assessment

Martijn Broeren (m.l.m.broeren@uu.nl), Li Shen
- Copernicus Institute, Utrecht University, Netherlands
Susanne Waaijers, Michiel Zijp, Evelyn Heugens
- National Institute for Public Health and the Environment, Netherlands

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Early-stage sustainability assessment for biobased products

- New products/substances
  - Optimise for sustainability during development
  - Avoid creating new problems

Many assessment methods exist…

1. Climate change (CC)
2. Ozone depletion (OD)
3. Terrestrial acidification (TA)
4. Freshwater eutrophication (FE)
5. Marine eutrophication (ME)
6. Human toxicity (HT)
7. Photochemical oxidant formation (POF)
8. Particulate matter formation (PMF)
9. Terrestrial ecotoxicity (TET)
10. Freshwater ecotoxicity (FET)
11. Marine ecotoxicity (MET)
12. Ionising radiation (IR)
13. Agricultural land occupation (ALO)
14. Urban land occupation (ULO)
15. Natural land transformation (NLT)
16. Water depletion (WD)
17. Mineral resource depletion (MRD)
18. Fossil fuel depletion (FD)

ILCD handbook
International Reference Life Cycle Data System

EPD VERIFIED

ISO 14040
Approved Life Cycle Assessment

Product Environmental Footprint

PAS 2050:2011

International Organization for Standardization
ISO
14044:2006

GRI Empowering Sustainable Decisions

EU Ecolabel

NORDIC ECOLABEL
5023 0001

OK biobased

Water Footprint

ECO FRIENDLY 100% PRODUCT

USDA CERTIFIED BIOBASED PRODUCT

ECO FRIENDLY

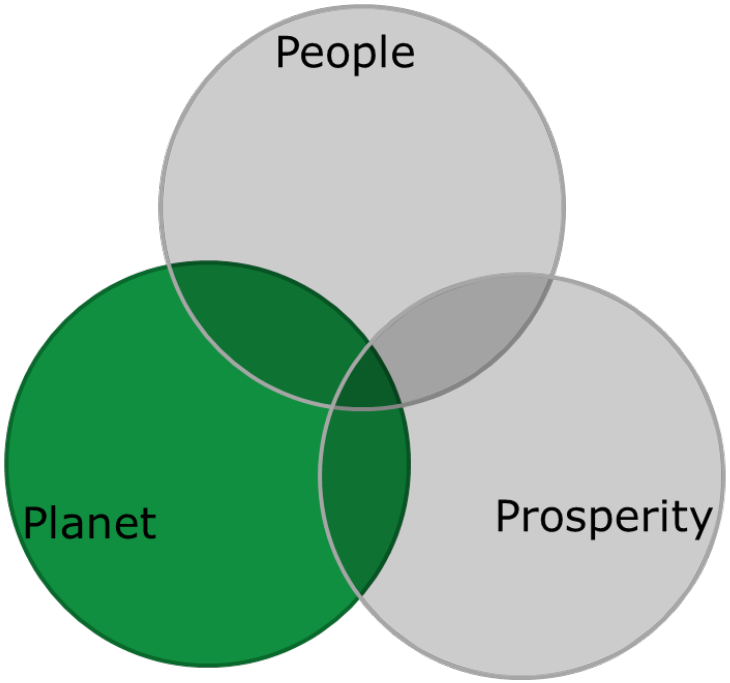
Ref: ReCiPe LCIA

This study

Goal: identify methods/indicators suitable for early-stage environmental sustainability assessment of biobased products

Today:

- Inventory of methods
- Lessons learned from published LCAs

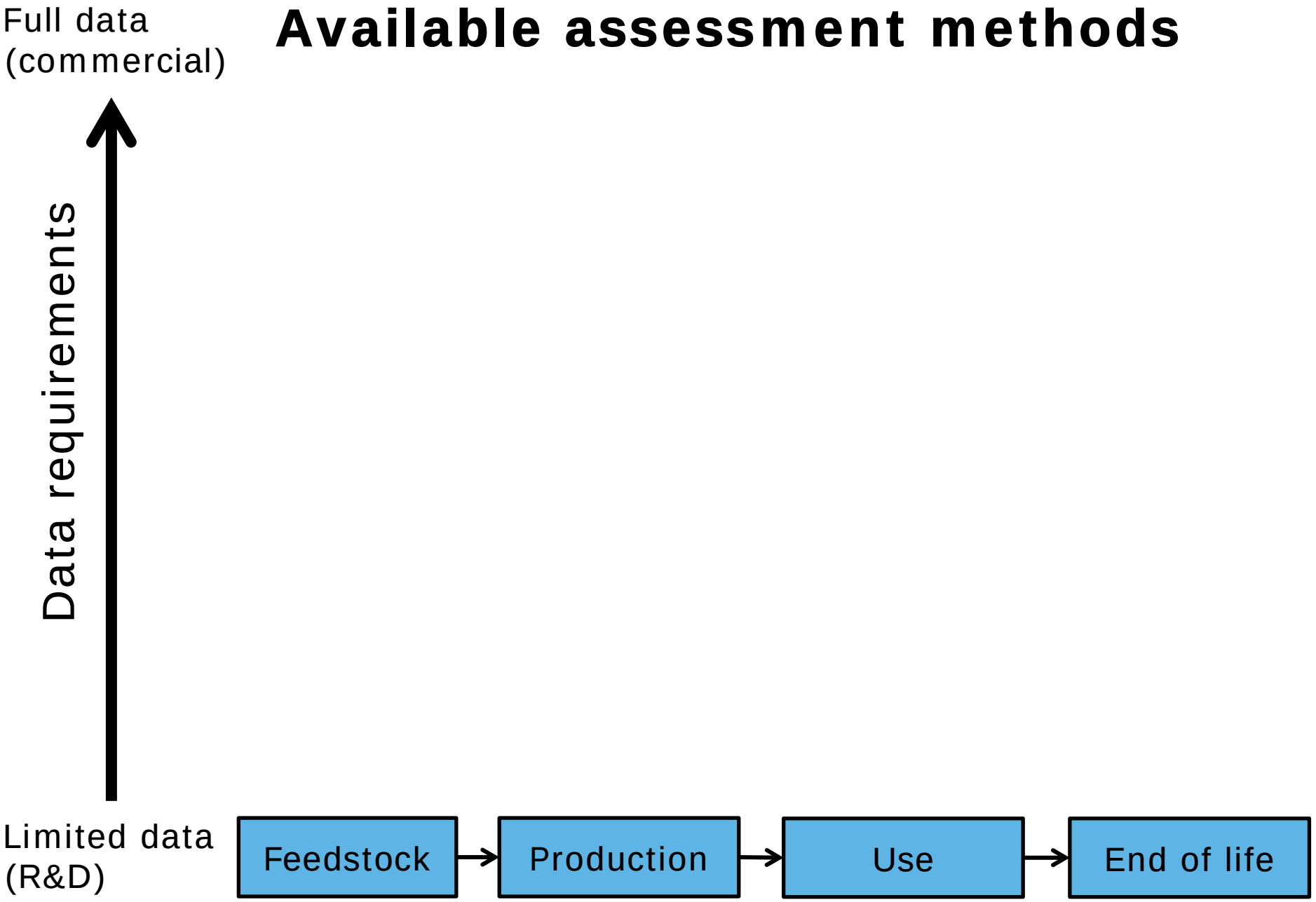


Methods inventory

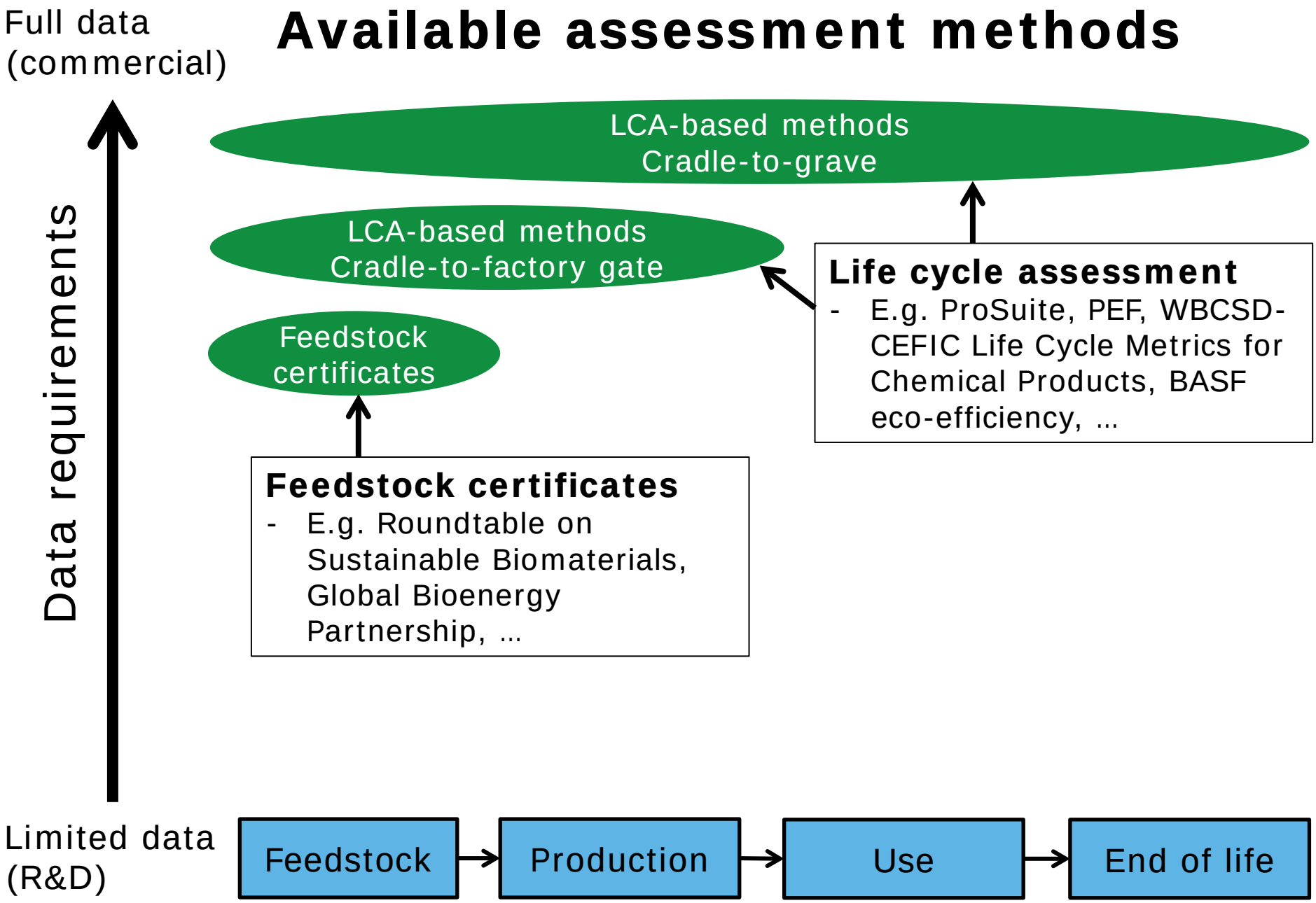
- Reviewed >35 assessment methods, >120 indicators/metrics
  - Applicable to biobased products
  - Publicly available

- Categorisation based on e.g.:
  - Object
  - Scope
  - Life cycle coverage

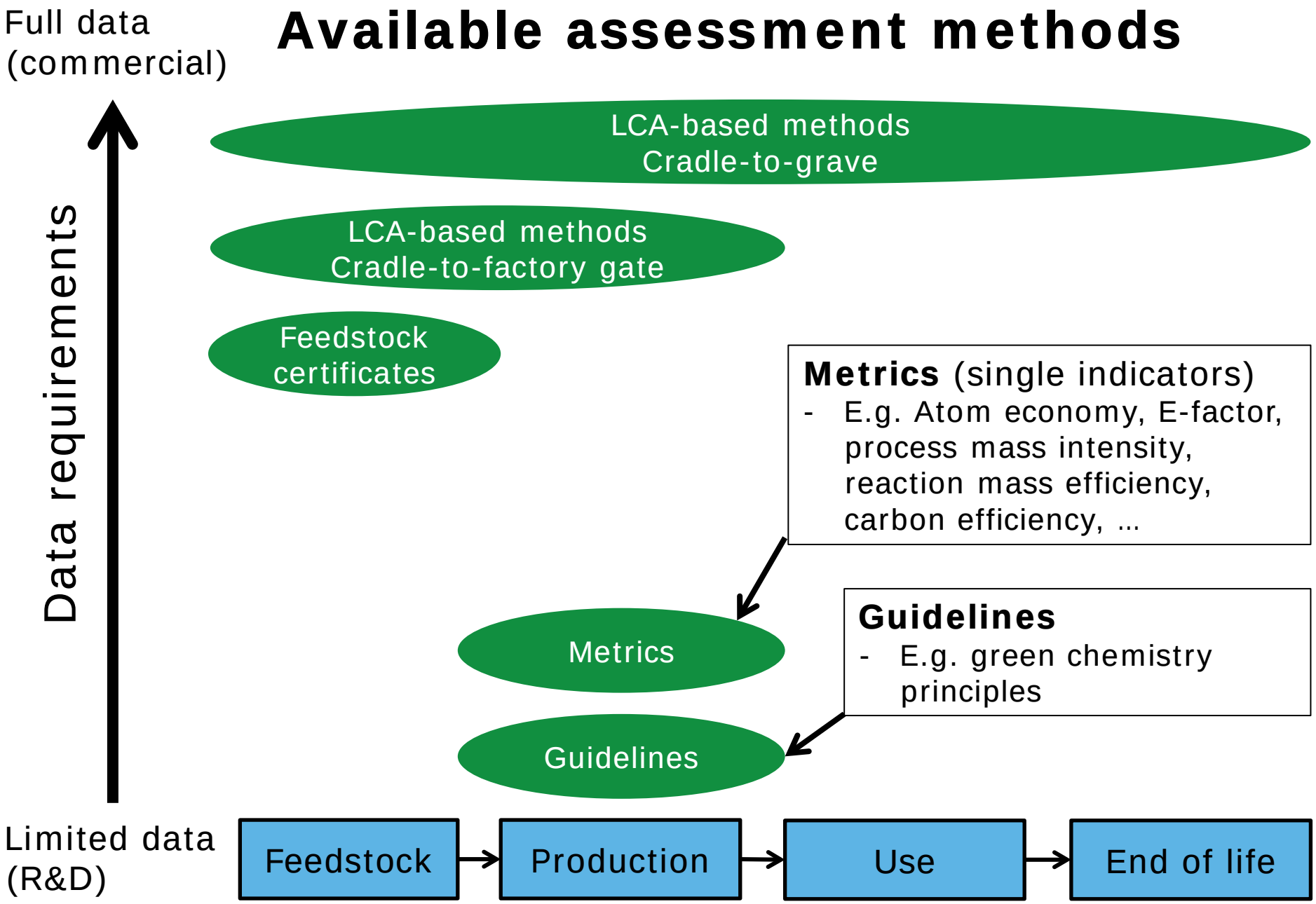
Available assessment methods



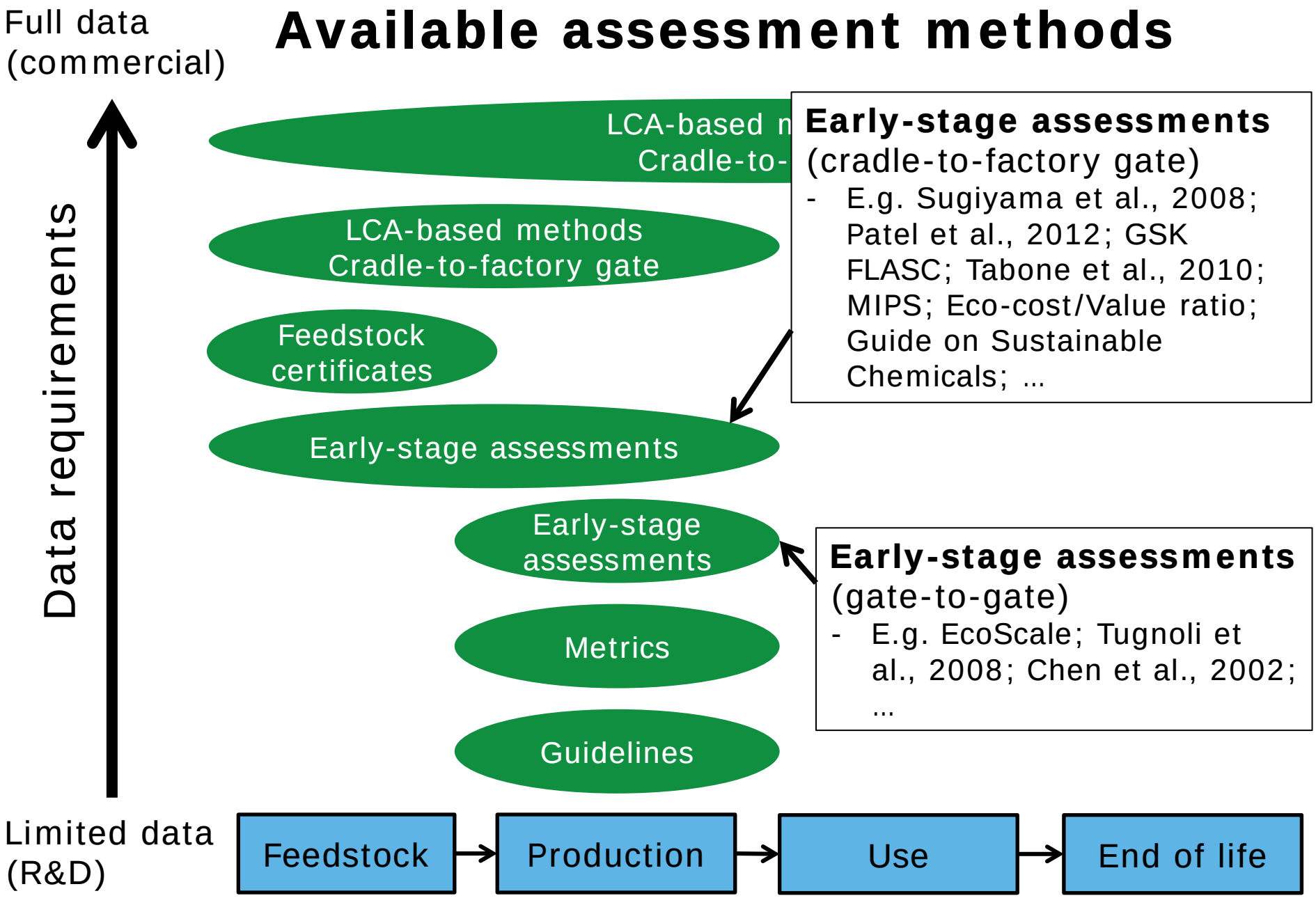
Available assessment methods



Available assessment methods



Available assessment methods



Indicator examples

Metrics

Material efficiency indicators

E-factor

Process mass intensity

Effective mass yield

Carbon efficiency

Atom efficiency

Early-stage assessments

LCA midpoints (gate-to-gate)

OR

"Early-stage indicators"

Feedstock distance

Share of renewable resources

Biodegradability

Solid waste disposed

Net mass of materials used

- Much attention for energy and mass
- Limited attention for land/water use
- Health & safety assessed based on existing data (e.g. toxicity info)

LCA-based methods

Midpoints

Climate change

Ozone depletion

Photochem. oxidant formation

Particulate matter

Radiation

Acidification

Eutrophication

Eco-toxicity

Human health/toxicity

Resources

Land

Water

Abiotic depletion

Fossil depletion

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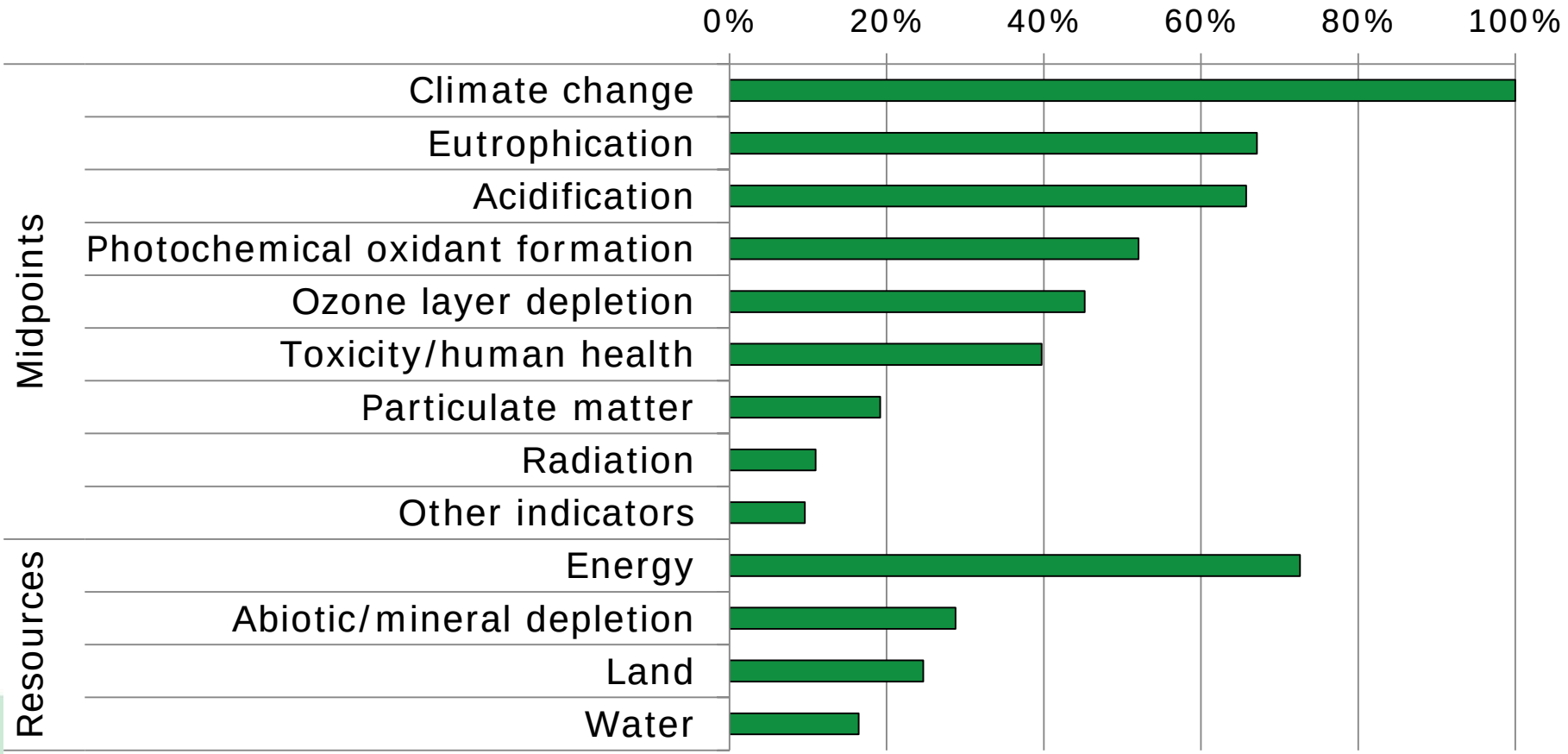
Impacts reported by published LCAs

Biobased products (nonfuel)

Prevalence of environmental impact indicators in biobased product LCAs (n=72)



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Conclusions from published LCAs

Weiss et al., 2012

- Meta-analysis of 44 LCA studies comparing biobased and conventional materials (not fuels)
- Results:

Lower	Climate change	-3	±1	t CO_2eq./t
	Non-renewable energy use	-55	±34	GJ/t
Higher	Ozone depletion	+1.9	±1.8	kg N_2Oeq./t
	Eutrophication	+5	±7	kg PO_4eq./t
Inconclusive	Acidification	-2	±20	kg SO_2eq./t
	Photochem. ozone formation	-0.3	±2.4	kg C_2H_4eq./t

- Confirms importance of feedstock production impacts for (current) biobased products

Weiss et al., 2012. A Review of the Environmental Impacts of Biobased Materials, Journal of Industrial Ecology 16, S169-S181

Preliminary conclusions

- Published LCAs: feedstock production impacts important, but not always studied

- Reviewed early-stage assessment methods
  - Focus on energy and material efficiency, not on land/water
  - Environmental health & safety based on existing data
  - Gate-to-gate methods do not capture upstream impacts; link up with feedstock assessments?
  - Early-stage indicators are rarely validated

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Outlook

- Identify indicators for early-stage assessment
  - Capturing critical impacts
  - Low data requirements
  - Non-energy related impacts
- Validate with case studies

Part of broader, ongoing **SafeBBE** project

- More information in poster **4AV.2.28**
- This research was carried out as part of RIVM Strategic Programme (SPR). With this programme RIVM is contributing to the development of expertise and innovative research projects, to prepare RIVM for questions that may arise in future.

National Institute for Public Health and the Environment
Ministry of Health, Welfare and Sport