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sustainability consulting + software

Approaches to simplify footprint assessment

Andreas Ciroth
GreenDelta GmbH Berlin

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Approaches to simplify footprint assessments

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- **a) footprint assessments**
- **b) why simplification**

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1 Introduction

1 Introduction, footprint assessments

A broad variety of assessment methods are called footprints:

- Ecological Footprint (Wackernagel et al. 1996)
- Carbon Footprint (e.g. Wiedmann and Minx, 2008, ISO 14067)
- Water Footprint (e.g. Hoekstra et al., 2011)
- Product Environmental Footprint, Organisational Environmental Footprint (European Commission, JRC, http://ec.europa.eu/environment/eussd/smgp/product_footprint.htm, 2013)
- Different company-specific footprint assessments
- …
- See e.g. Fang, K., Heijungs, R. and De Snoo, G.R. (2014) Theoretical exploration for the combination of the ecological, energy, carbon, and water footprints: Overview of a footprint family, *Ecological Indicators*, 36: 508-518.

1 Introduction, footprint assessments

→ Methods that try to assess the environmental impacts of products (sometimes also organisations), typically over the life cycle (resource extraction, production, use, disposal)

1 Introduction, why simplification

Footprint assessments are inherently complicated and „difficult“:

- High data demands
- Detailed modeling steps
- Difficult-to-communicate details
- Technically challenging (some; e.g. water footprint requires region-specific information and assessment)

1 Introduction, why simplification

Footprint assessments are inherently complicated

→ It is interesting to look for

- Cost reductions
- Time reductions (also: for use in product design, or for a mass of products, very short study time is mandatory)
- And for ways to make them just easier…

2 The challenge of smart simplification

2 The challenge of smart simplification

Footprint simplification is easy →

Just leave out difficult-to-get data and simplify the modeling.

2 The challenge of smart simplification

Just leave out difficult-to-get data and simplify the modeling.

One example:

Prosuite approach for assessing qualitative social indicators over the life cycle:

"the assessment of the qualitative indicators [over the life cycle] is made by use of expert elicitation"

Prosuite Handbook on a novel methodology for the sustainability impact assessment of new technologies, 2013, p 25, http://prosuite.org/web/guest/the-prosuite-framework

prosuite

2 The challenge of smart simplification

→ Footprint simplification is easy, but gets difficult when you want to maintain a method that is

- credible
- correct and consistent
- able to create new insights

2 The challenge of smart simplification

→ Footprint simplification is easy, but gets difficult when you want to maintain a method that is

- credible
- correct and consistent
- able to create new insights, and
- <u>still valid.</u>

2 The challenge of smart simplification

→ *Smart simplification* makes footprint faster, less complicated, less costly, and preserves at the same time those aspects in the approach that are desirable.
("method efficiency")

3 Simplification options

Simplification options

- Reduce data collection
- Reduce the number of indicators
- Simplify the modeling
- Use efficient software

Simplification options

- Reduce data collection
- Reduce the number of indicators
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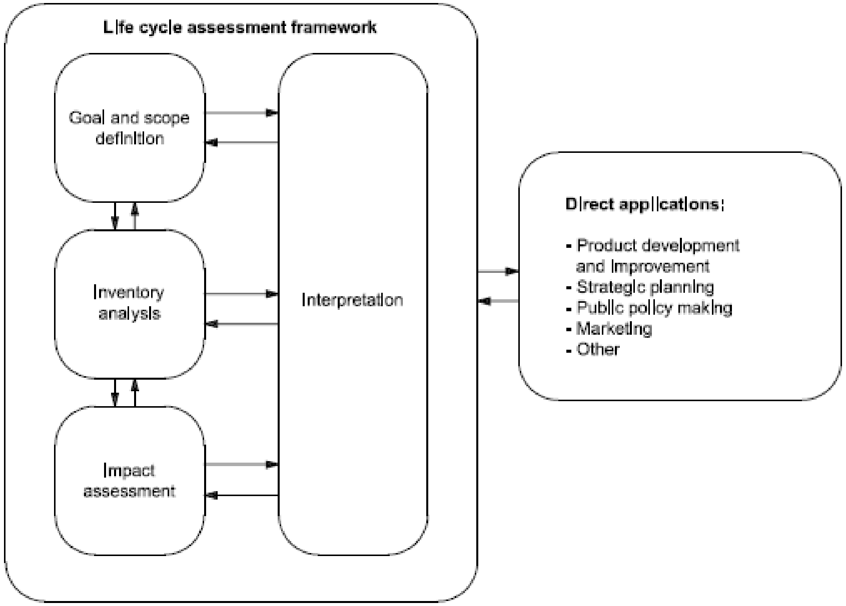
This is all related.



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Simplification options

- Reduce data collection → use generic databases
- Reduce the number of indicators → especially those that require different data, different modeling, different communication
  - Water footprint in addition to carbon footprint
  - Soil organic matter in addition to carbon footprint
  - Risk information in addition to carbon footpint
- Simplify the modeling → linear models instead of nonlinear response models
- Use efficient software → generic software reduces need for training and explanation; specific software may be better suited to the approach and to the company

4 How, and when, simplify?

How, and when, simplify?

- A difficult question.
- For example, Product Environmental Footprint, JRC:
  - Draft method:
    - Described in pilot draft report
    - 14 indicators
    - Some not supported by (all main) generic databases (Soil Organic Matter, e.g.)
    - Default „standard“ approach for all products

→ „one size fits all“ approach, hence inefficencies

→ Benefits due to a unified, generic approach

→ LONG coordination activities

Product Environmental Footprint: Final draft outline

- 6. Environmental Footprint Impact Assessment
  - 6.1 Mandatory Steps: Classification and Characterisation
    - 6.1.1 Classification of Product Environmental Footprint Flows
    - 6.1.2 Characterisation of Environmental Footprint Flows
  - 6.2 Optional Steps: Normalisation and Weighting
    - 6.2.1 Normalisation of Environmental Footprint Impact Assessment Results
    - 6.2.2 Weighting of Environmental Footprint Impact Assessment Results
- 7. Interpretation of Product Environmental Footprint results
  - 7.1 General
  - 7.2 Assessment of the robustness of the Product Environmental Footprint model
  - 7.3 Identification of Hotspots
  - 7.4 Estimation of Uncertainty

Guidelines for simplification

Rule 1: Precisely describe what you want to do

„Goal and scope of the approach"

- → Questions to be answered;
- → Related solutions existing already (i.e., other established approaches, or the approach that you want to simplify)
- → Product types, „other things" that will be investigated
- → Adressees of the answers (B2B, NGOs, policy, …)
- → Who is performing the footprint
- → How is the approach involved in other activities (of yourself, of other parties)
- → Time and effort foreseen per analysis

Guidelines for simplification

Rule 2: Take other existing approaches and solutions as far as possible

„Standing on the shoulders of giants“

- Even applying always 14 indicators and a unified approach can lead to an overall simplification
(→ „economies of scale“).
- Establishing an own method really requires effort and stamina
- Especially critical: Indicator sets, „metrics“, since they require exchange and communciation

Guidelines for simplification

Rule 3: Make it as simple as possible, but don‘t simplify further. Avoid model jargon and model artefacts

This seems obvious, but is often violated.

Simplification rule 3: […] avoid model artefacts

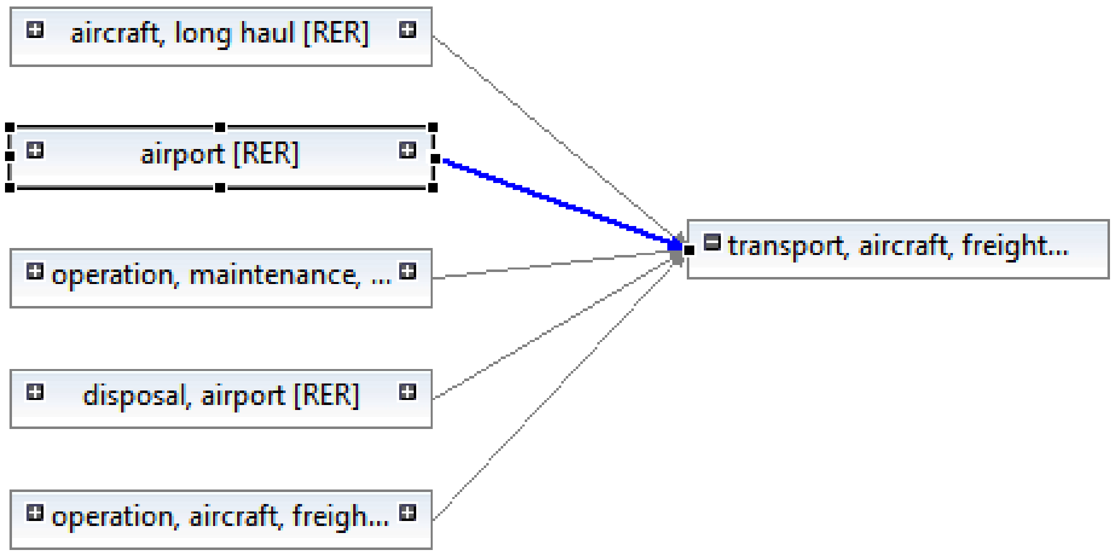
Instructional example, ecoinvent 3:

Idea: Market modeling.

All products are not directly delivered by a production process, but the production process delivers to a market, which in turn delivers to other processes

→ this allows a more flexible connection of processes.

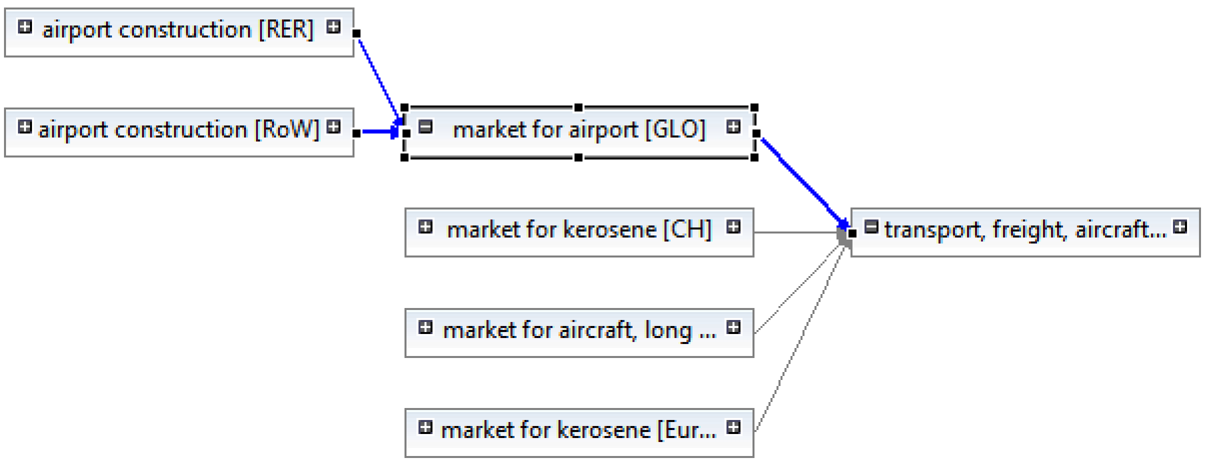
Simplification rule 3: […] avoid model artefacts



Ecoinvent 2.2, airport is used as infrastructure input for airfreight transport

(screenshot from openLCA, www.openlca.org)

Simplification rule 3: […] avoid model artefacts



Ecoinvent 3, airport is used as input into „market for airport", which is used as input for airfreight transport

(screenshot from openLCA, www.openlca.org)

Simplification rule 3: […] avoid model artefacts

Process: market for airport

Inputs

Flow	Category	Flow prop...	Unit	Amount	Uncertainty	Default pr...	Pedigree u...
airport - RER	4210:Constructio...	Number o...	Item(s)	0.2678767...	none	airport co...	
airport - RoW	4210:Constructio...	Number o...	Item(s)	0.7321232...	none	airport co...	

Outputs

Flow	Category	Flow prop...	Unit	Amount	Uncertainty	Avoided pr...	Pedigree u...
airport - GLO	4210:Constructio...	Number o...	Item(s)	1.0	none		

Ecoinvent 3, market for airport, details

(screenshot from openLCA, www.openlca.org)

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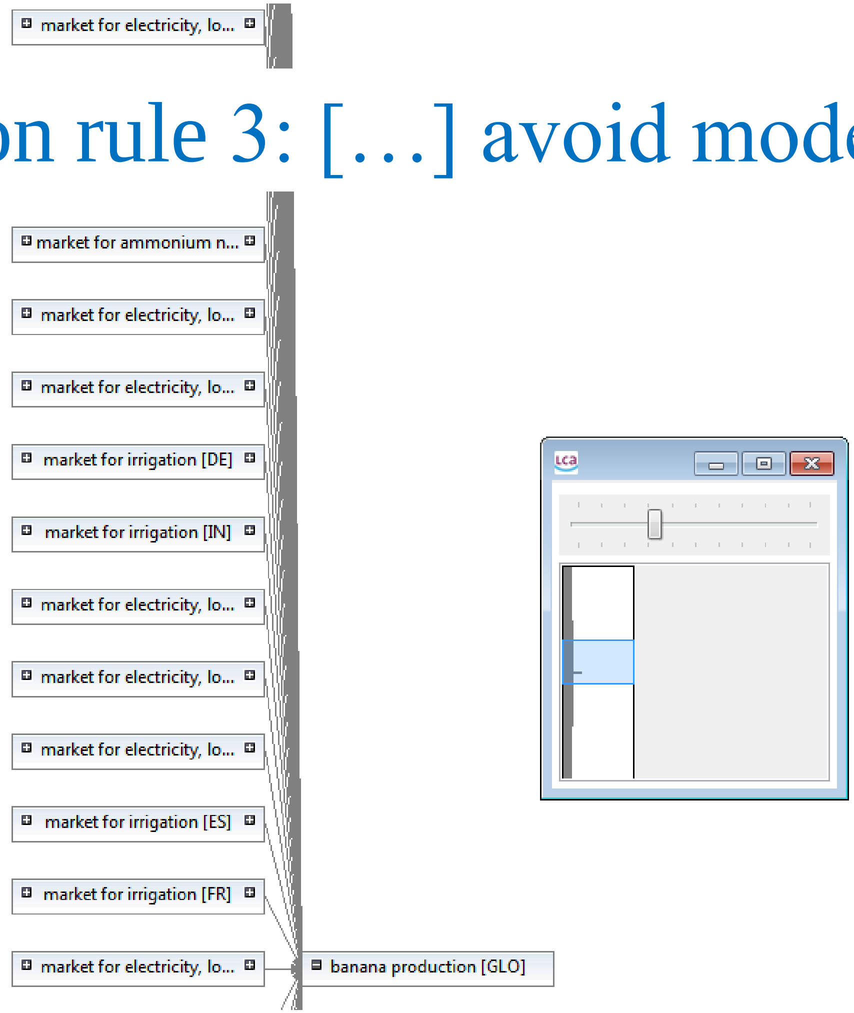
Simplification rule 3: […] avoid model artefacts



Ecoinvent 3, banana production, global → > 100 market inputs, including irrigation market Germany

(screenshot from openLCA, www.openlca.org)

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Simplification rule 3: […] avoid model artefacts

Inputs

Flow	Category	Flow property	Unit	Amount	Uncertainty	Default provider	Pedigree uncertainty
ammonium nitrate, as N - GLO	2012:Manufacture of fertilizers and ...	Mass	kg	0.00682	lognormal: gmean=6.82E-3 gsigma...	market for ammoniu...	
electricity, low voltage - ASCC	3510:Electric power generation, tran...	Energy	kWh	5.20722103663224E-6	lognormal: gmean=5.21E-6 gsigma...	market for electricity, l...	
electricity, low voltage - AT	3510:Electric power generation, tran...	Energy	kWh	4.76097681768024E-5	lognormal: gmean=4.76E-5 gsigma...	market for electricity, l...	
electricity, low voltage - AU	3510:Electric power generation, tran...	Energy	kWh	1.75438080011033E-4	lognormal: gmean=1.75E-4 gsigma...	market for electricity, l...	
electricity, low voltage - BA	3510:Electric power generation, tran...	Energy	kWh	6.61814031165116E-6	lognormal: gmean=6.62E-6 gsigma...	market for electricity, l...	
electricity, low voltage - BE	3510:Electric power generation, tran...	Energy	kWh	6.69070826791834E-5	lognormal: gmean=6.69E-5 gsigma...	market for electricity, l...	
electricity, low voltage - BG	3510:Electric power generation, tran...	Energy	kWh	2.41901145878967E-5	lognormal: gmean=2.42E-5 gsigma...	market for electricity, l...	
electricity, low voltage - BR	3510:Electric power generation, tran...	Energy	kWh	3.35405058997836E-4	lognormal: gmean=3.35E-4 gsigma...	market for electricity, l...	
electricity, low voltage - CA-AB	3510:Electric power generation, tran...	Energy	kWh	2.471072457083E-5	lognormal: gmean=2.47E-5 gsigma...	market for electricity, l...	
electricity, low voltage - CA-BC	3510:Electric power generation, tran...	Energy	kWh	5.45543982648933E-5	lognormal: gmean=5.46E-5 gsigma...	market for electricity, l...	
electricity, low voltage - CA-MB	3510:Electric power generation, tran...	Energy	kWh	3.16343626122342E-5	lognormal: gmean=3.16E-5 gsigma...	market for electricity, l...	
electricity, low voltage - CA-NB	3510:Electric power generation, tran...	Energy	kWh	1.8503109825568E-5	lognormal: gmean=1.85E-5 gsigma...	market for electricity, l...	
electricity, low voltage - CA-NF	3510:Electric power generation, tran...	Energy	kWh	3.72449454768247E-5	lognormal: gmean=3.72E-5 gsigma...	market for electricity, l...	
electricity, low voltage - CA-NS	3510:Electric power generation, tran...	Energy	kWh	2.26812227302949E-5	lognormal: gmean=2.27E-5 gsigma...	market for electricity, l...	
electricity, low voltage - CA-NT	3510:Electric power generation, tran...	Energy	kWh	3.48584144437091E-7	lognormal: gmean=3.49E-7 gsigma...	market for electricity, l...	
electricity, low voltage - CA-NU	3510:Electric power generation, tran...	Energy	kWh	1.45639828112804E-7	lognormal: gmean=1.46E-7 gsigma...	market for electricity, l...	
electricity, low voltage - CA-ON	3510:Electric power generation, tran...	Energy	kWh	1.373180342047E-4	lognormal: gmean=1.37E-4 gsigma...	market for electricity, l...	
electricity, low voltage - CA-PE	3510:Electric power generation, tran...	Energy	kWh	4.31249438044228E-8	lognormal: gmean=4.31E-8 gsigma...	market for electricity, l...	
electricity, low voltage - CA-SK	3510:Electric power generation, tran...	Energy	kWh	9.40680395991667E-6	lognormal: gmean=9.41E-6 gsigma...	market for electricity, l...	
electricity, low voltage - CA-YK	3510:Electric power generation, tran...	Energy	kWh	3.33062365311172E-7	lognormal: gmean=3.33E-7 gsigma...	market for electricity, l...	
electricity, low voltage - CH	3510:Electric power generation, tran...	Energy	kWh	4.54266052185716E-5	lognormal: gmean=4.54E-5 gsigma...	market for electricity, l...	
electricity, low voltage - CL	3510:Electric power generation, tran...	Energy	kWh	4.27934873542696E-5	lognormal: gmean=4.28E-5 gsigma...	market for electricity, l...	
electricity, low voltage - CN	3510:Electric power generation, tran...	Energy	kWh	0.00233614551384779	lognormal: gmean=2.34E-3 gsigma...	market for electricity, l...	
electricity, low voltage - CZ	3510:Electric power generation, tran...	Energy	kWh	4.75068232668793E-5	lognormal: gmean=4.75E-5 gsigma...	market for electricity, l...	
electricity, low voltage - DE	3510:Electric power generation, tran...	Energy	kWh	4.21846757455138E-4	lognormal: gmean=4.22E-4 gsigma...	market for electricity, l...	
electricity, low voltage - DK	3510:Electric power generation, tran...	Energy	kWh	2.68961628139909E-5	lognormal: gmean=2.69E-5 gsigma...	market for electricity, l...	
electricity, low voltage - ES	3510:Electric power generation, tran...	Energy	kWh	2.12059736743727E-4	lognormal: gmean=2.12E-4 gsigma...	market for electricity, l...	
electricity, low voltage - FI	3510:Electric power generation, tran...	Energy	kWh	6.49730911353692E-5	lognormal: gmean=6.50E-5 gsigma...	market for electricity, l...	
electricity, low voltage - FR	3510:Electric power generation, tran...	Energy	kWh	3.62592615760253E-4	lognormal: gmean=3.63E-4 gsigma...	market for electricity, l...	
electricity, low voltage - FRCC	3510:Electric power generation, tran...	Energy	kWh	1.59532899887423E-4	lognormal: gmean=1.60E-4 gsigma...	market for electricity, l...	
electricity, low voltage - GB	3510:Electric power generation, tran...	Energy	kWh	2.75880175199292E-4	lognormal: gmean=2.76E-4 gsigma...	market for electricity, l...	
electricity, low voltage - GR	3510:Electric power generation, tran...	Energy	kWh	4.63135525137179E-5	lognormal: gmean=4.63E-5 gsigma...	market for electricity, l...	
electricity, low voltage - HICC	3510:Electric power generation, tran...	Energy	kWh	8.25166072172749E-6	lognormal: gmean=8.25E-6 gsigma...	market for electricity, l...	
electricity, low voltage - HR	3510:Electric power generation, tran...	Energy	kWh	1.30930308330068E-5	lognormal: gmean=1.31E-5 gsigma...	market for electricity, l...	
electr							
electr							
electr							
electr							
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electr							

Ecoinvent 3, banana production, global → > 100 electricity inputs, also from Germany, Denmark

(screenshot from openLCA, www.openlca.org)

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Guidelines for simplification

Rule 4: Select software tools that fit to your approach. Keep them in shape. Analyse and improve the workflow for creating the footprint

E.g. BASF: Eco-Efficiency Analysis, > 15 years of experience, meanwhile 30 sustainability experts in different teams worldwide;

→ project to move from single-user, stand-alone LCA tool to super-fast web-tool with detailed analysis options, integrated into the companies‘ LDAP system, with detailed user rights management

(developed by GreenDelta, 2011-2013)

Guidelines for simplification

Rule 4: Select software tools that fit to your approach. Keep them in shape. Analyse and improve the workflow for creating the footprint

→ flexible, open, scalable tools are better than locked, single purpose tools

→ And also: standard tools are better than specific tools

Guidelines for simplification

Rule 4: Select software tools that fit to your approach. Keep them in shape. Analyse and improve the workflow for creating the footprint

→ flexible, open, scalable tools are better than locked, single purpose tools

→ And also: standard tools are better than specific tools

→ And further: most standard tools are locked tools that don‘t scale

5 Summary & outlook

5 Summary

Simplifying footprint approaches is often discussed and desired, and yet difficult.

I tried to identify four guiding principles for simplification, which are:

- Precisely describe what you want to do
- Take other existing approaches and solutions as far as possible
- Make it as simple as possible, but don‘t simplify further. Avoid model jargon and model artefacts
- „have an eye“ on software tools and workflow.

5 Outlook

a) Let‘s hope that in future, software tools, databases, and users are more flexible than today, and better able to deal with different application contexts, and adapt the footprint approaches accordingly.

b) Probably, a more unified approach will become predominant, which is more complex than carbon footprint today

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Thank you..

Contact: Dr. Andreas Ciroth
GreenDelta GmbH
Müllerstrasse 135, D-13349 Berlin
ciroth@greendelta.com
www.greendelta.com