

OPERATIONS RESEARCH AND LCA COMBINED FOR REGIONAL WASTE AND RESOURCE MANAGEMENT

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Outline

- Background of project
- Problem statement
- Methodological/modelling approach
- Methodological challenges
- Outlook

Background

- Dissertation of M.E. Bösch → LCA₄AFR tools
- Alternative treatment options often compared LCA₄AFR to identify 'best' solution
- Possible to apply mathematical optimization techniques to support decision making instead?
- Overall goal of project: To guide policy makers and practitioners towards waste management with improved environmental performance

General LCA₄AFR Tool Structure

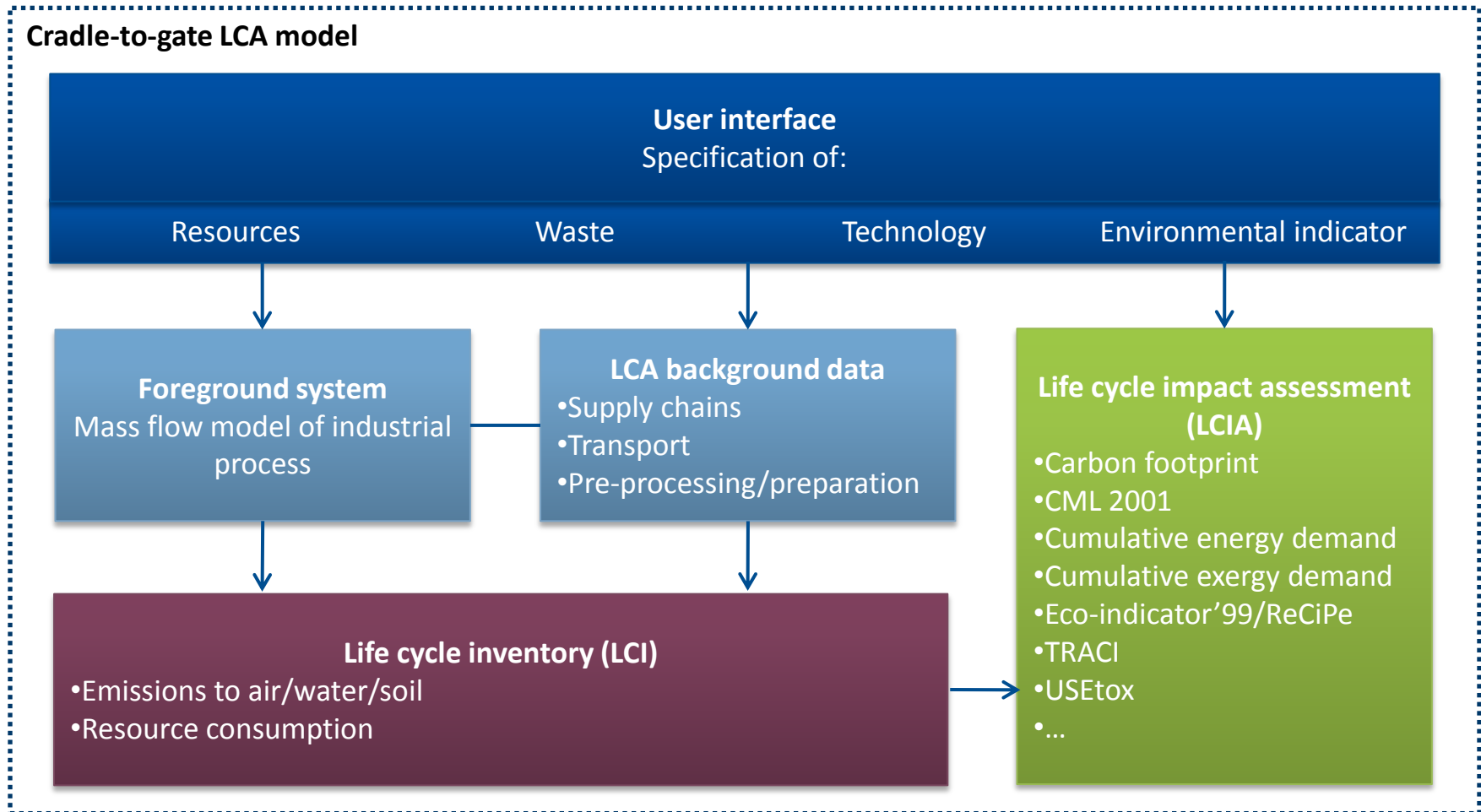
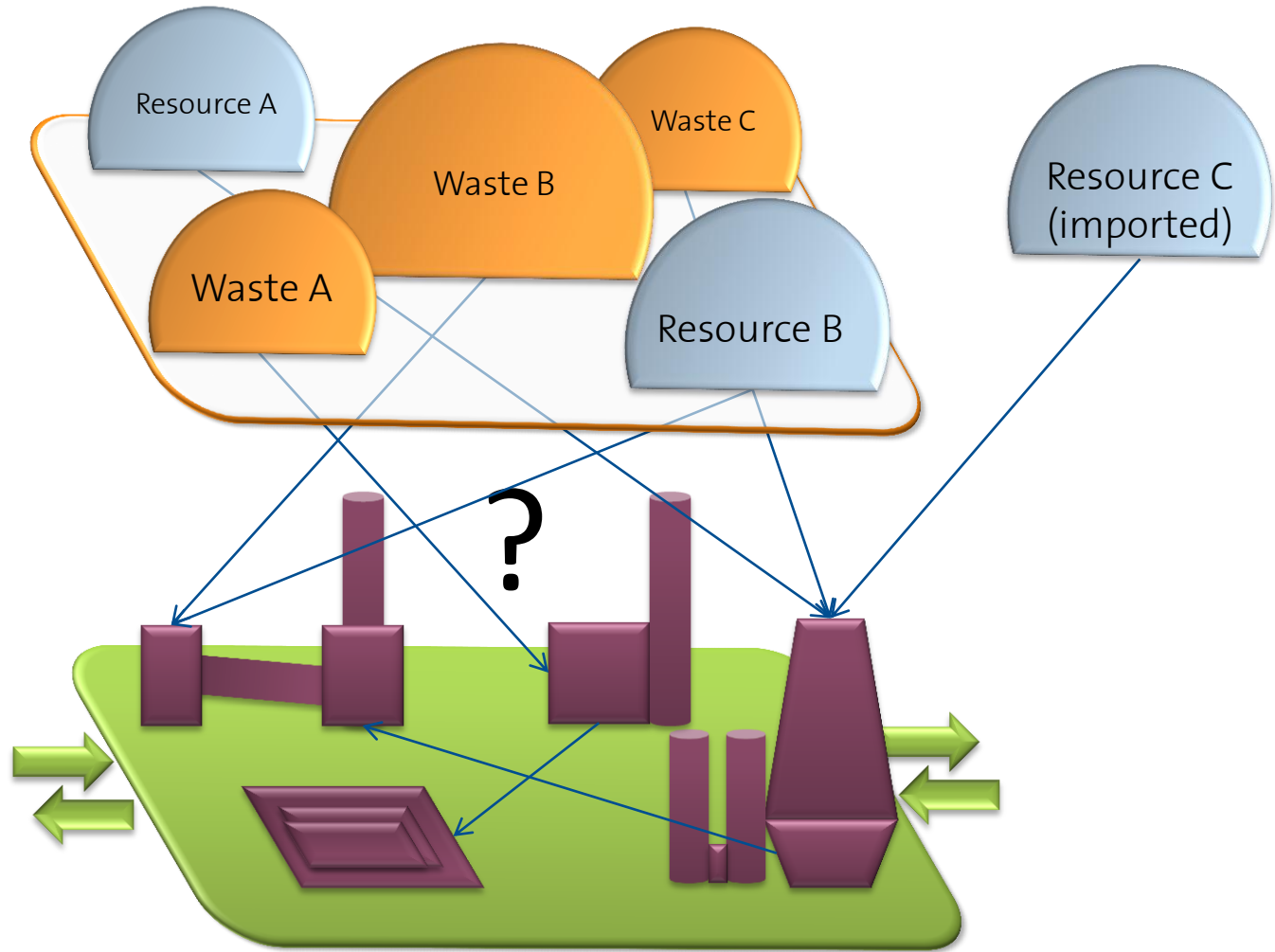


Figure adopted from Boesch *et al.* (2009)

Problem Statement



Environmental Assessment as Objective

Objective value (to be minimized) Characterisation factors LCI direct emissions: calculated by MF models LCI database (ecoinvent)

Objective function (environmental impact)

$$\min Z^S(n) = \sum_{j \in J} \left(\sum_{e \in E} CF(e, n) \cdot \sum_{\hat{j} \in \hat{J}} \left(EM_{TOT}^S(e, \hat{j}) + \sum_{i \in I} B_I(e, i) X^S(i, \hat{j}) - \sum_{r \in R} B_R(e, r) \cdot REC^S(\hat{j}, r) \right) \right),$$

$\forall n \in N$

LCIA methods

Life cycle inventory (LCI)

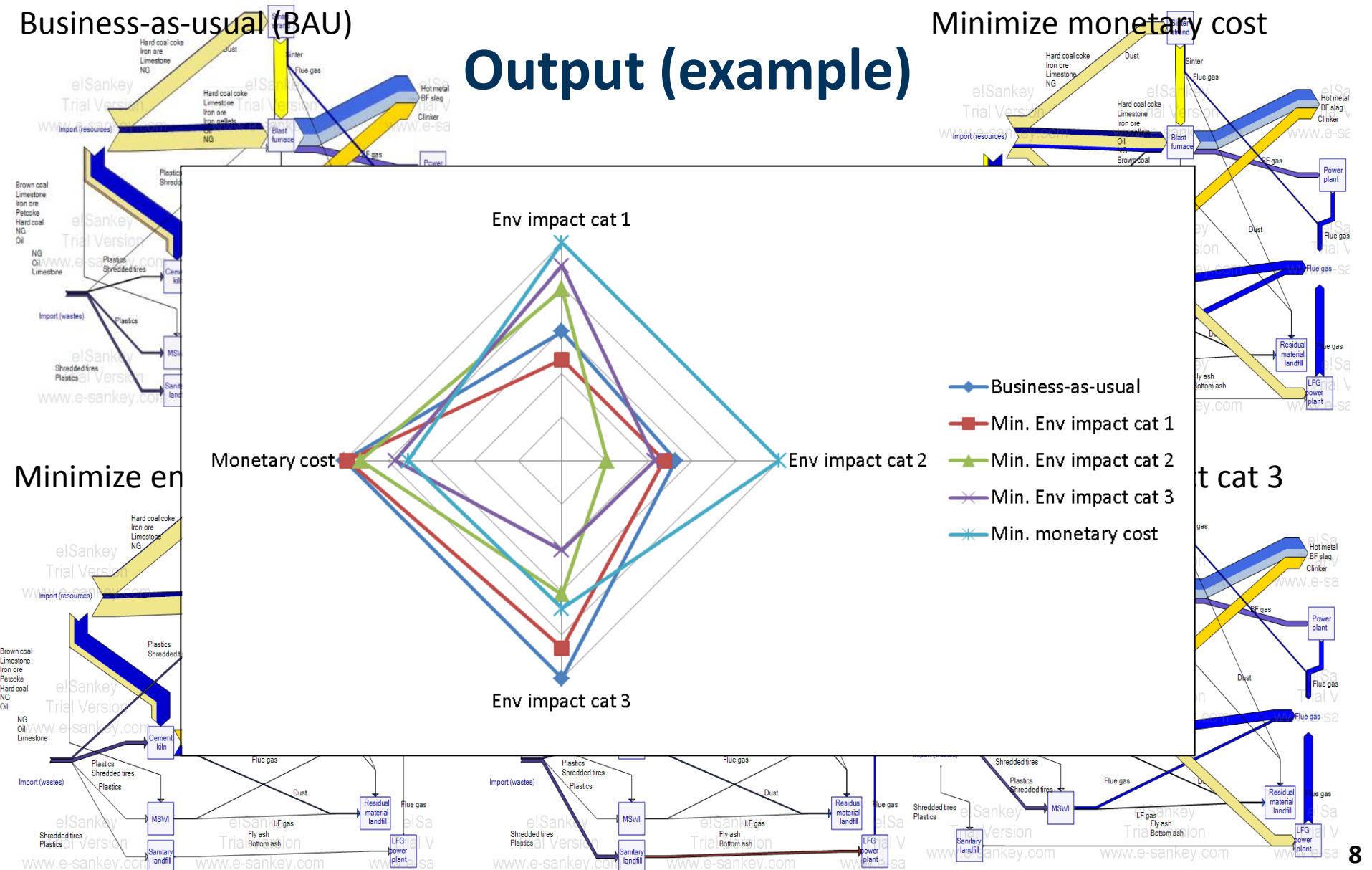
DECISION VARIABLE

Variable outputs calculated by MF models

Business-as-usual (BAU)

Minimize monetary cost

Output (example)



Methodological Challenges

- Process reference flow and functionality
 - Dedicated waste treatments
 - Co-processing activities
- Variable outputs (by-products)
 - System expansion/avoided burden
 - (Allocation – both physical and economic possible)
- Multi-objective optimization
 - Multiple environmental impact categories
 - Impact on environment vs. monetary cost

Methodological Challenges (cont'd)

- Business-as-usual vs. optimal solution
- Integration of uncertainties
 - Comparative analysis
 - Stochastic model

Outlook

Possible extensions and foreseen activities

- Further process models
- Planning problem → design problem
- Stochastic model for integration of uncertainty
- Practical application in case study to support regional waste management in developing country

Thank you!



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