Integrierte Planung und Monetarisierung von Umwelteffekten

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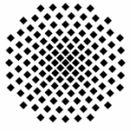
Hannes Krieg

[1] University of Stuttgart, LBP-GaBi

How to…

- …include LCA results in planning and management processes?
- …systematically monetize environmental impacts?
- …reach reduction targets at the lowest cost?



Monetization and Planning

Monetizing: expressing emissions in the environment in monetary values

- Economic quantification of damage caused
- Setting a monetary incentive to reduce impacts [1]

Current approaches for quantification:

- Willingness to pay [2] → subjective
- Environmental damage cost [3] → unclear & widely varying

Monetization and Planning

Excursus: Tragedy of the commons

- Environment is a resource that can be “used” by everybody
- For an individual, it is rational to consume more of it, as it allows to increase the individual profit

→ Overconsumption of resources, as long as they are not limited

Monetization and Planning

Business theory: optimal allocation of scarce resources

- “Environment” is not an unlimited resource
- Use established business methods
- Support allocation of ecological resources

→ Methodology for planning and monetization

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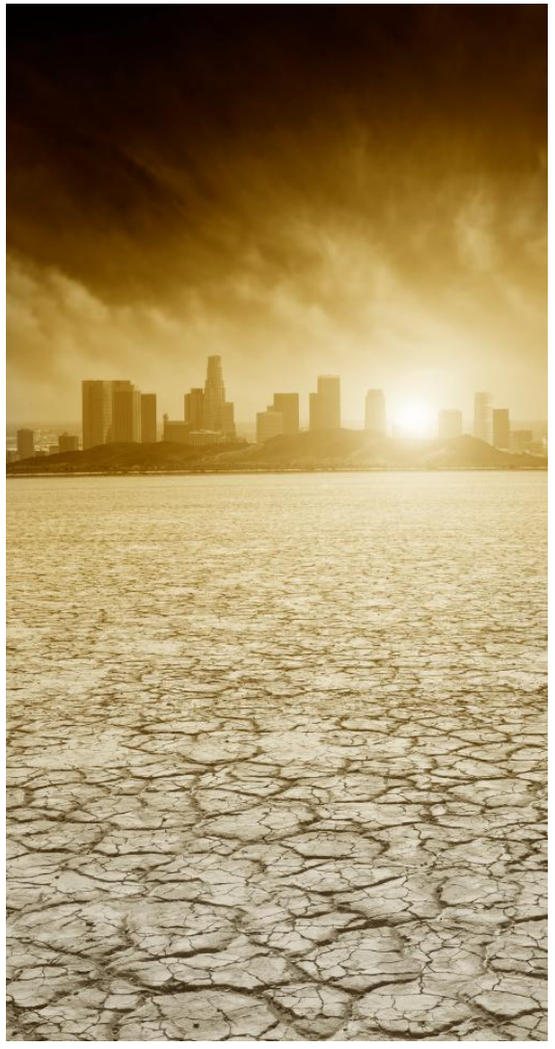
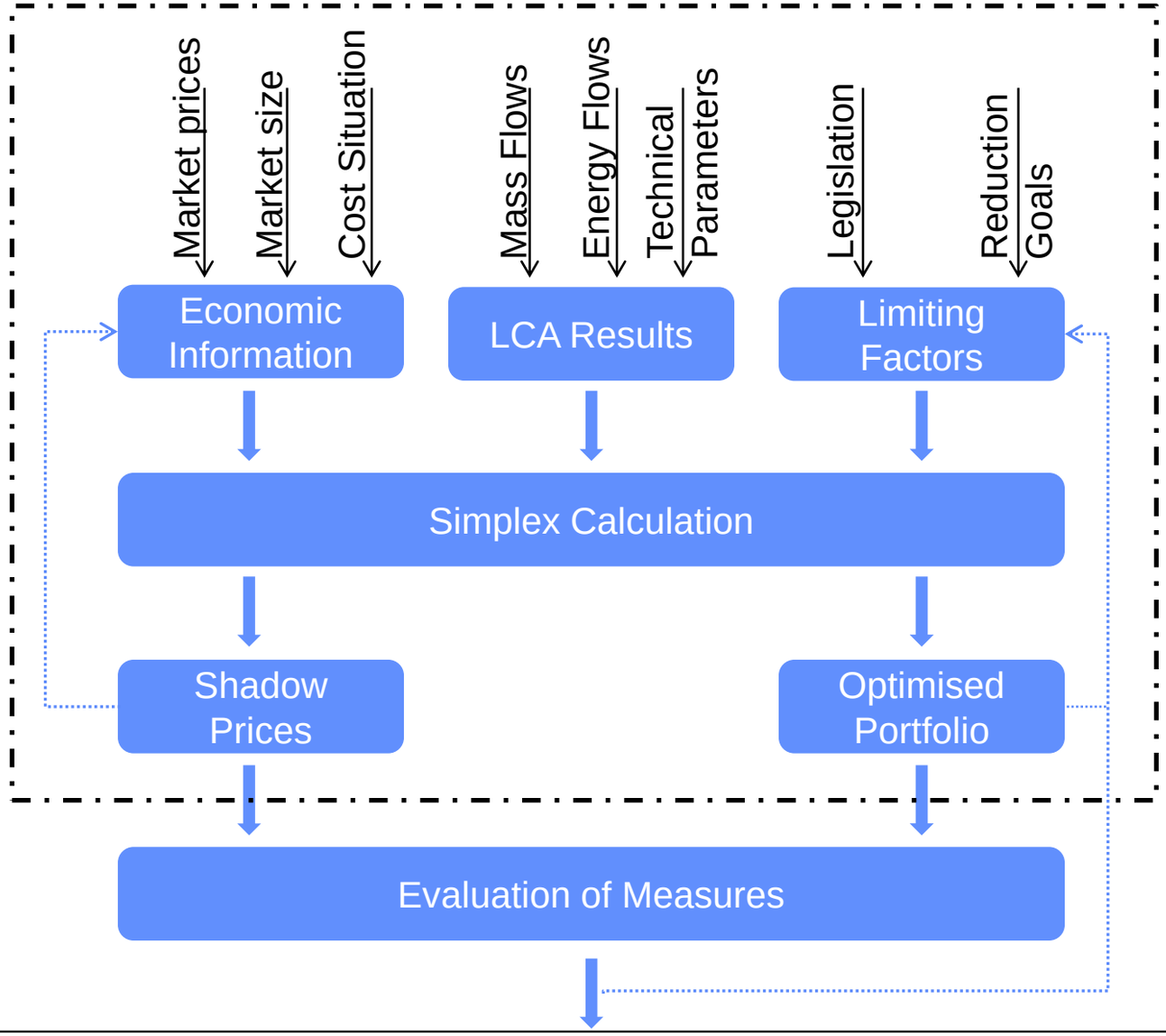


Methodological approach



Case study – logistics service provider

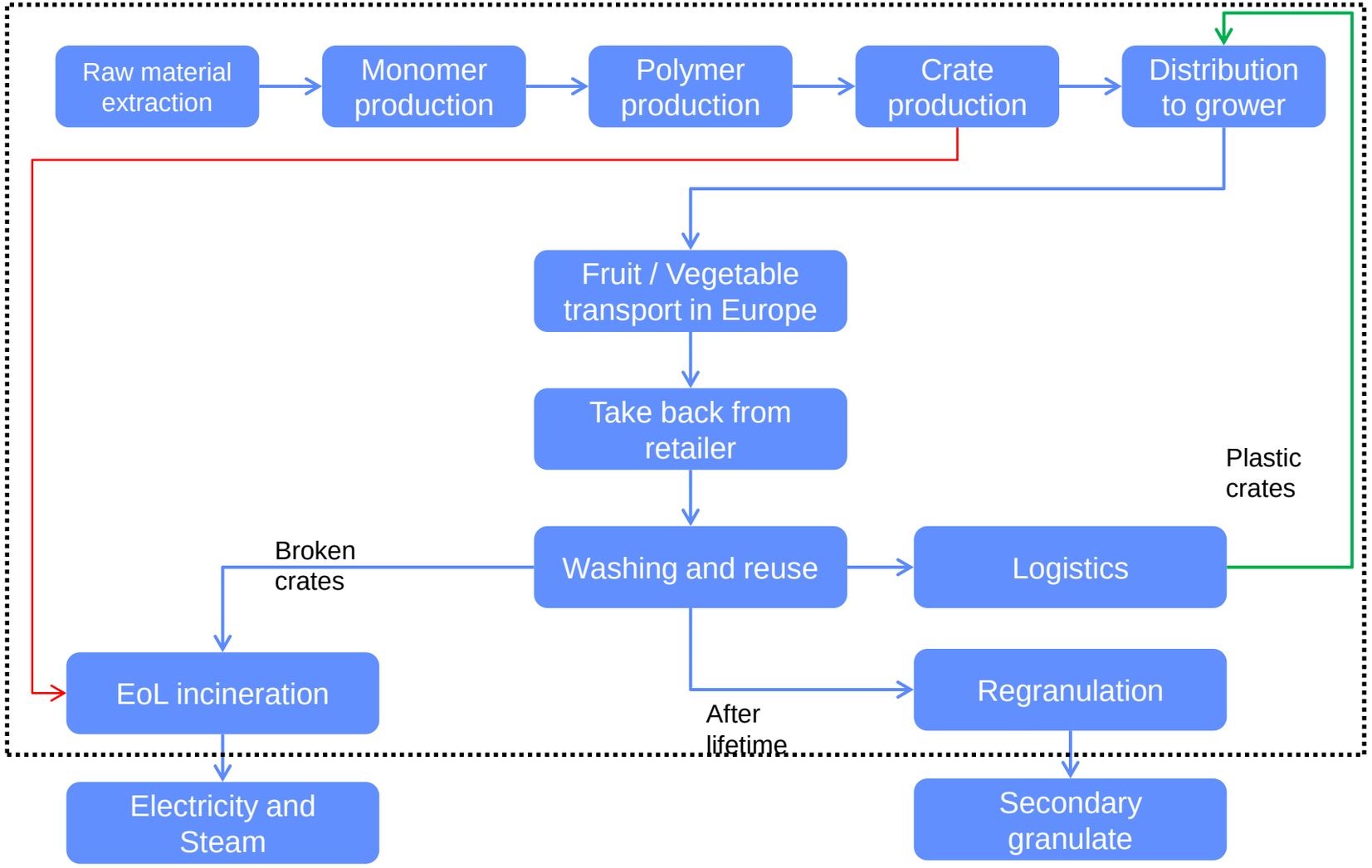
- Rents 2 types of multi-use plastic crates for vegetables [4]
  - Sugar cane based PE (X)
  - Conventional PE (Y)
- Market size: 50,000 t of fruits

→ 3,333,350 crates with a capacity of 15 kg

Status quo: 50 % conventional PE crates, 50 % sugar cane based PE crates

Case study – logistics service provider

Boundaries for the system under study



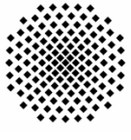
Case study – logistics service provider

Size to be optimized: Contribution to Margin (CtM)

→ Integrates cost and revenue situation

- Product characteristics per circulation of crate

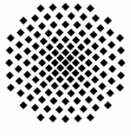
	GWP [kg CO_2-eq.]	AP [kg SO_2-eq.]	CtM [€]
Conventional PE crate	0.33	0.0015	0.50
Bio-based PE crate	0.10	0.0025	0.45
TOTAL	**717,500**	**6,667**	**1,583,341**



Case study – logistics service provider

Goal: Optimize Portfolio while keeping environmental impacts constant

Max	0.50 x + 0.45 y		[CtM]
Subject to	0.33 x + 0.10 y	<= 717,500	[GWP]
	0.0015 x + 0.0025 y	<= 6,667	[AP]
	x + y	<= 3,333,350	[Market]

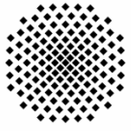


Case study – logistics service provider

1st step: check if current portfolio is an optimal allocation of resources

x	y	S1	S2	S3	RHS
0	1	4.330	0	-0.430	**1,666,675**
0	0	0.004	1	-0.003	**0**
1	0	-4.330	0	1.430	**1,666,675**
0	**0**	**0.220**	**0**	**0.430**	**1,583,341**

→ Number of each crate type and turnover remain the same; basis portfolio is an optimal allocation of resources



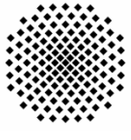
Case study – logistics service provider

2nd step: CO_2-emission shall be reduced by 10 %

→ New constraints are entered in the Simplex tableau

x	y	S1	S2	S3	RHS
0	1	3.69	-147	0	**1,401,737**
1	0	-2.21	488	0	**1,825,637**
0	0	-1.47	-341	1	**105,976**
0	**0**	**0.85**	**146**	**0**	**1,522,405**

Optimized Portfolio with new constraints



Case study – logistics service provider

Results

- GWP reduced by 10 % (71,750 kg of CO_2-eq.)
- CtM reduced by 4 % (60,936 €)
- Reduction cost 0.85 € / kg CO_2-eq.

→ Unsaturated market demand of 106,000 circulations

Case study – logistics service provider

3rd step: Is it possible to saturate the market while also maximising the CtM and reducing the environmental impacts?

→ New Product line is considered

→ Bio-based with sustainable agriculture (no slash-and-burn agriculture, otherwise identical)

→ Higher production costs, therefore lower CtM (0.42 € per circulation)

Case study – logistics service provider

Simplex tableau with new product line

→ Identification of optimal portfolio with new product

X	Y	Z	S1	S2	S3	RHS
0	1	0	3.6	-165.0	0.1	1,407,180
1	0	0	3.6	1.8	-3.9	1,407,180
0	0	1	-7.2	-1.7	4.9	518,990
0	0	0	0.4	41.9	0.3	1,554,797

→ New product line results in an improvement of the portfolio!

Case study – logistics service provider

Results

- Environmental impact reduced (-10% GWP compared to basis scenario, AP constant)
- Total CtM 98,2 % of basis scenario (1,554,797 €)
- Market saturated

→ Reduction of 71t of CO_2-eq. for $ 28,500
(0.40 € / kg CO_2-eq.)

→ -1,8 % of CtM to save 10 % of CO_2-eq.

Applications

- Determine “value” of impacts, e.g. for internal Carbon Tax
- Assess impacts of technical measures on organization performance

→ End of pipe technologies

→ Process & Product innovation

→ Changed cost situation

Applications

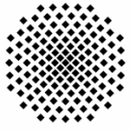
- Determine eco-efficiency of processes with different costs and impacts but same outcome
- Compare Eco-efficiency of different locations with different cost situations and upstream value chains

→ Support decisions on site & location

Conclusions & Outlook

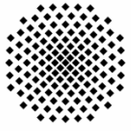
- Validation if portfolio mix is an optimal allocation of scarce resources
- Determination of shadow prices
- Evaluate the introduction of new product variants

→ Reaching environmental target values at minimal cost



Open Points

- General feedback on methodology
- Further application potentials



Contact

Dipl. oec. Hannes Krieg

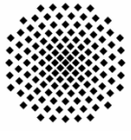
University of Stuttgart
Chair of Building Physics (LBP)
Department Life Cycle Engineering (GaBi)

Hauptstrasse 113
70771 Echterdingen
Germany

Tel. +49(0)711-489999-27
Fax +49(0)711-489999-11

E-Mail hannes.krieg@lbp.uni-stuttgart.de

http://www.LBP-GaBi.de



References

[1] Beckenbach, Hampicke, Schulz: Möglichkeiten und Grenzen der Monetarisierung von Natur und Umwelt (*Possibilities and Limitations of Monetization of Nature and Environment*), Schriftenreihe des IÖW 20/88, Berlin, pp.3-18, 1998.
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[3] German Federal Environment Agency (UBA): Ökonomische Bewertung von Umweltschäden. Methodenkonvention zur Schätzung externer Umweltkosten *(Economic assessment of environmental damages*), 2007.
[4] Albrecht et al: *The Sustainability of Packaging Systems for Fruit and Vegetable Transport in Europe based on Life-Cycle-Analysis – Update 2009*. On behalf of Stiftung Initiative Mehrweg SIM (Foundation of Reusable Systems under German Civil Law). Stuttgart/Michendorf, pp. 17-98, 2009.