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Integration of Carbon-Emissions into Corporate Decisions – A Reflection of Theory and Practice

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Agenda

1. Motivation
2. Concept
3. Case Study of Textile Chain
4. Conclusion and outlook

Motivation

Background and problem

- Instruments for assessment and improvement of company's emission performance
- Assessment of emission-intensity by stakeholders:
  Ratios, e.g. emission-intensity are highly aggregated
- Improvement of emission-intensity:
  Isolation or inadequate treatment of carbon emissions

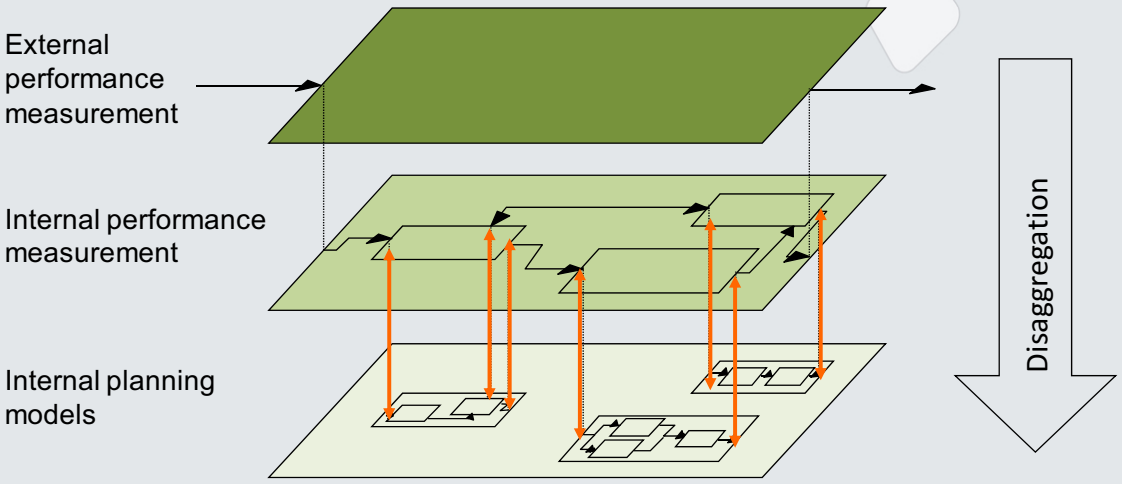
→Gap between assessment and improvement of eco-intensity

Objective

- Developing a concept for the implementation of eco-intensity into corporate decision-making processes

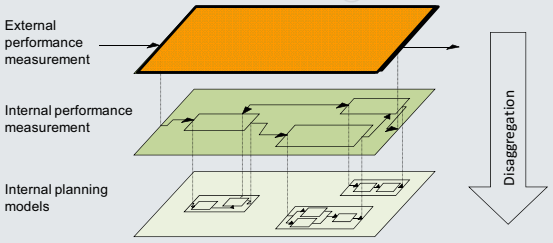
Concept

Hierarchical concept for integration of emission-intensity indicators into corporate decision-making processes



External performance measurement

- Goal: Comparison of companies by the ratio of emission-intensity
- Ex-post Analyses
- External data
- Aggregated indicator



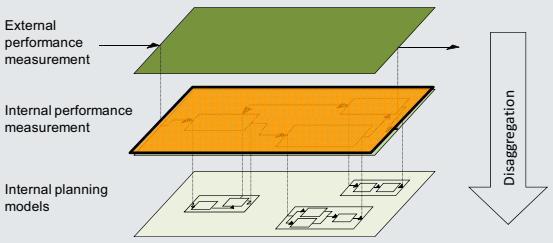
Internal performance measurement

- Goal: Comparison of organizational units or suppliers
  → Where is an improvement potential?
  → How big is this improvement potential?
- Internal data
- Ex-post Analyses
- Additional information

→Disaggregation,Portfolio

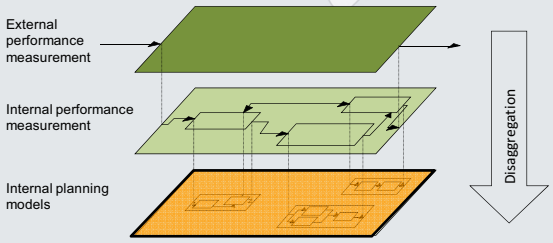
→Multicriteria problem

- Methods:
  - Multi-Attribute Decision Making (MADM)
  - Multi-Objective Decision Making (MODM)
  - Efficiency analysis (e.g. Data Envelopment Analysis)



Internal planning models

- Goal: Improvement of the position in the portfolio by emission reduction measures
- Internal data
- Ex-ante Analyses
- Analyses of processes
- Multicriteria problem



- Integration of ecological aspects into planning models:
  - Monetization
  - Weighting
  - Constraints/Limits
  - Calculation of trade-offs

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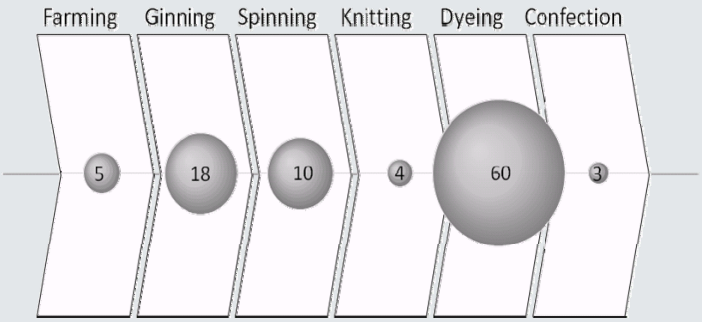
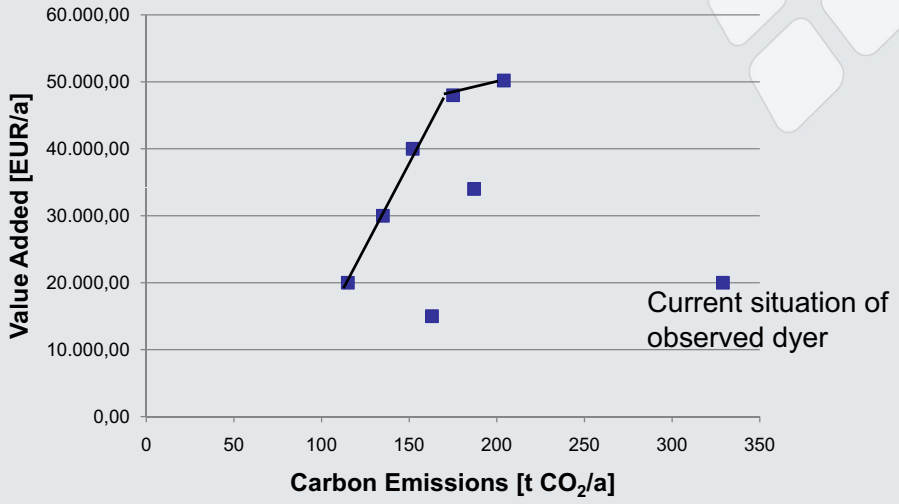
Background

- Improvement of carbon efficiency in textile chain
- Huge energy amount for dyeing process
- Comparison of dyeing-sites



Relative energy demand [%] along the textile chain [Systain Consulting GmbH (2007)]

Internal performance measurement



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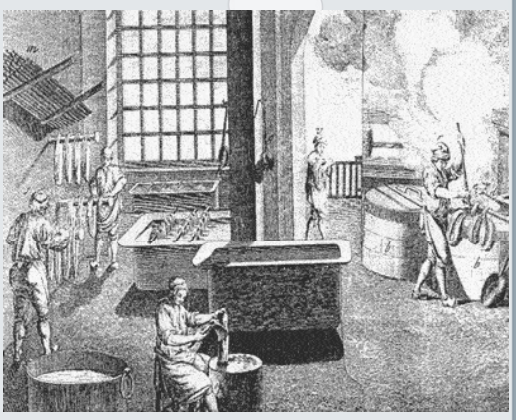
Case Study

Current situation

- Energy demand for heating: 1.3 mil. kWh/a → 329 t CO_2/a
- Annual cost for heating: 68.200 EUR/a
- Fossil fuel used: Diesel



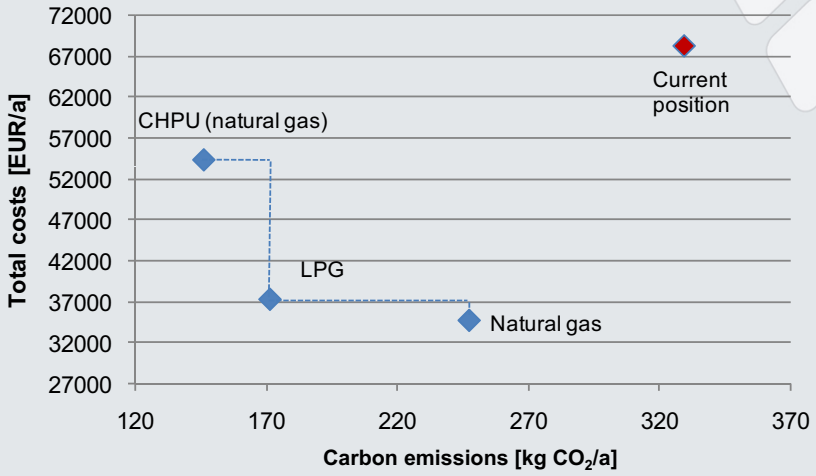
Substitution options

- Natural gas
- LPG
- Combined Heat and Power Unit (CHPU): Natural gas, diesel
  → Credits necessary to obtain same utility

→ Multicriteria problem: Minimization of costs and carbon emissions

Case Study 1

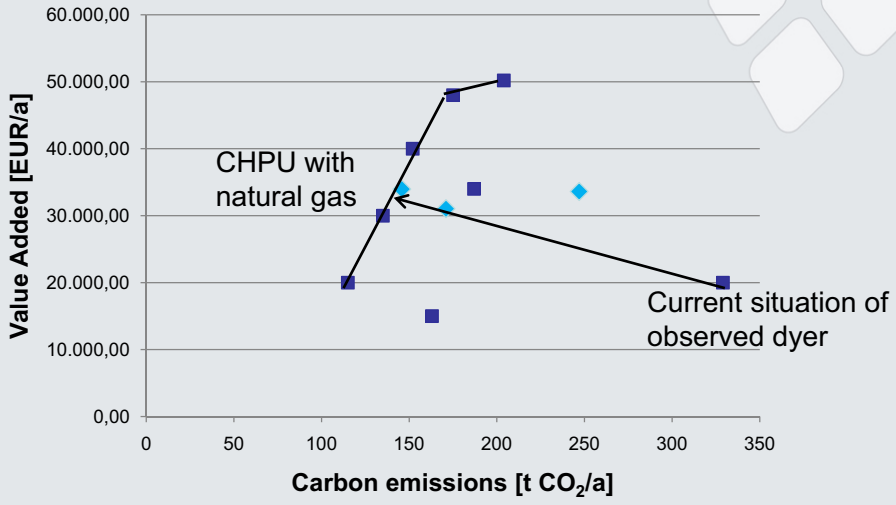
Trade-offs between carbon emission and annual costs



Efficient improvement measures

Case Study

Connection of the levels



Sites

Efficient improvement measures

Conclusion

- Economic performance and carbon emissions need to be considered on different decision-making levels
- Hierarchical concept
  - Level of external performance measurement
  - Level of internal performance measurement
  - Level of internal planning models
  - Connection of these levels

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Thank you for your attention!

Questions?

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Planning model for energy consumption

$$\min C = \sum_{i=1}^{n} \left(x_i * c_i + \left(D_i + I_i + O_i \right) * y_i \right)$$

$$\min E = \sum_{i=1}^{n} e_i * x_i$$

s.t.

$$\sum_{i=1}^{n} h_i * x_i \geq T$$

$$x_i \leq M * y_i \quad \forall i$$

$$y_i \leq x_i \quad \forall i$$

$$x_i \geq 0 \quad \forall i$$

$$y_i \in \{0;1\} \quad \forall i$$

Decision variable: Use of input [kg/a or l/a]:	x_i
Binary decision variable:	y_i
Variable costs for fuel i [€/l or €/kg]:	c_i
Emission factor of fuel i [kg CO_2/l or kg CO_2/m³]:	e_i
Heat value of fuel i [kWh/l or kWh/m³]:	h_i
Total energy demand [kWh/a]:	T
Depreciation of the investment with use of fuel i [€/a]:	D_i
Operational fixed costs of the investment with use of fuel i [€/a]:	O_i
Interests of the investment with use of fuel i [€/a]:	I_i
Very big number:	M

Parameters for calculation

(Values for gas are given per m³)

Fuel	D_i [EUR/a]	I_i [EUR/a]	O_i [EUR/a]	c_i [EUR/l]	e_i [kg CO_2/l]	h_i [kWh/l]
Diesel	0	0	2.304	0,55	2,650	10,80
LPG	6.117	4.588	2.304	0,19	1,631	12,70
Natural gas	2.778	2.084	1.878	0,23	2.041	11,06
CHPHU (diesel)	17.907	13.430	18.802	0,50	1,292	10,80
CHPU (natural gas)	11,587	8,690	12,166	0,18	1,204	11,06

- Credits for CHPU are already included