TECHNISCHE UNIVERSITÄT DRESDEN

Faculty of Business and Economics, Chair of Business Administration, esp. Environmental Management and Accounting

Life Cycle Assessment (LCA) of Small and Central Wastewater Treatment Plants

Team: Josephine Müller
Rebecca Schubert
Martin Woite

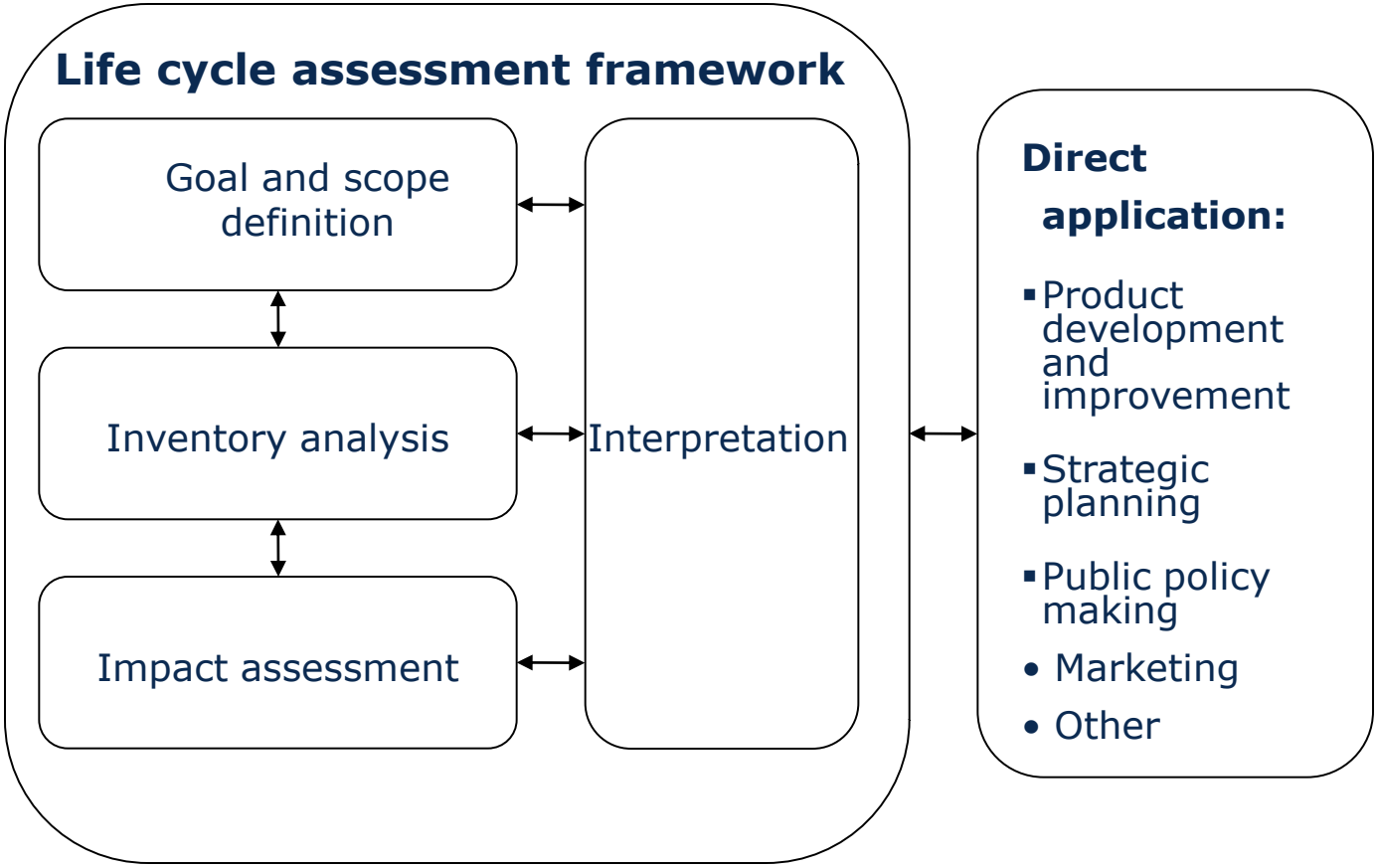
Prof. Dr. Edeltraud Guenther
Martin Nowack

Berlin, 26 February 2010

Agenda

1. Basics of life cycle assessment (LCA)
2. Review of LCA studies
3. LCA of a central wastewater system
4. LCA of a decentral wastewater treatment systems
5. Summary

Basics of life cycle assessment

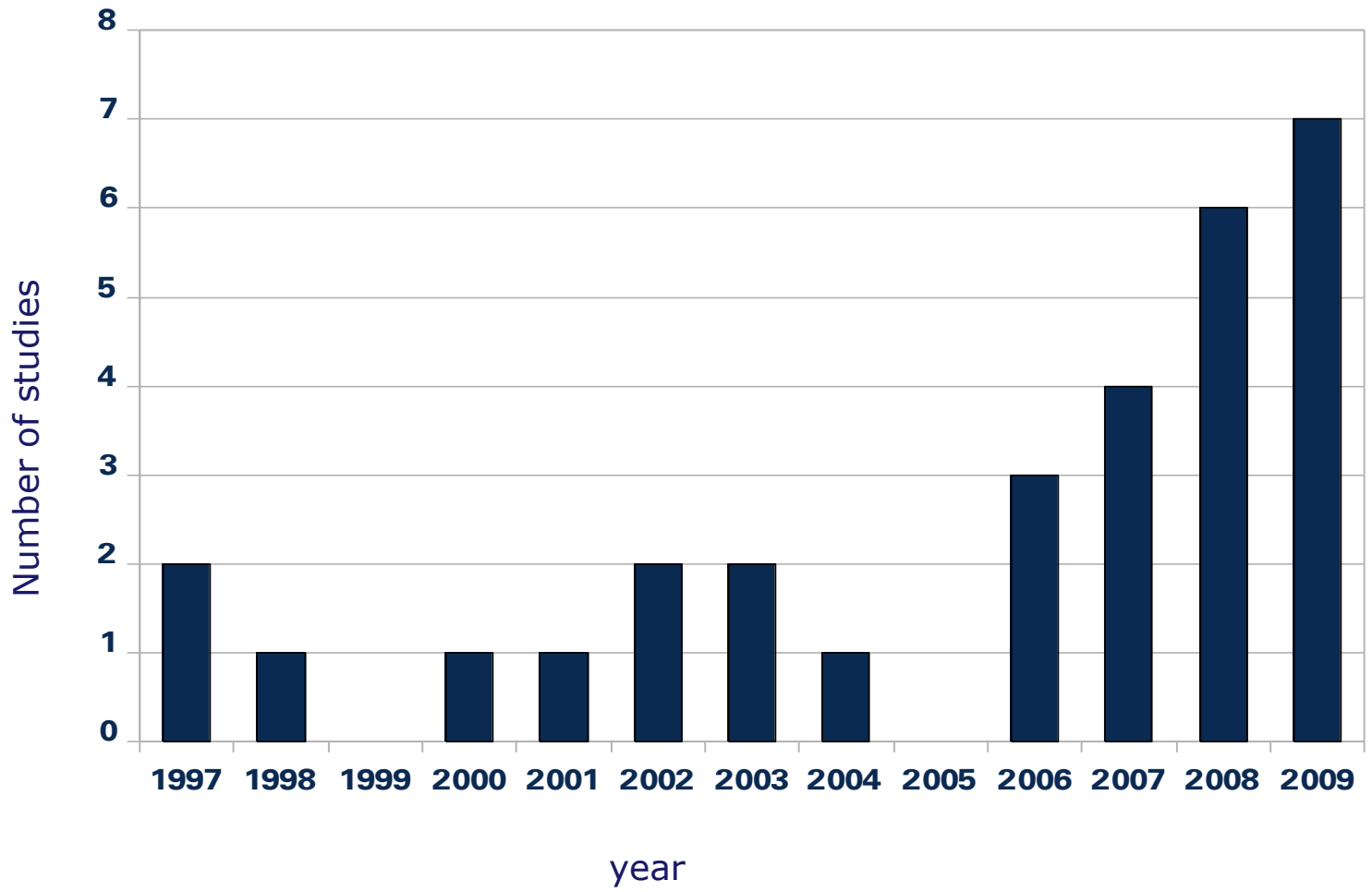


(Based on: DIN EN ISO 14040 (2006), p. 16

Agenda

1. Basics of life cycle assessment (LCA)
2. Review of LCA studies
3. LCA of a central wastewater system
4. LCA of a decentral wastewater treatment systems
5. Summary

Review of LCA studies



Agenda

1. Basics of life cycle assessment (LCA)
2. Review of LCA studies
3. LCA of a central wastewater system
4. LCA of a decentral wastewater treatment systems
5. Summary

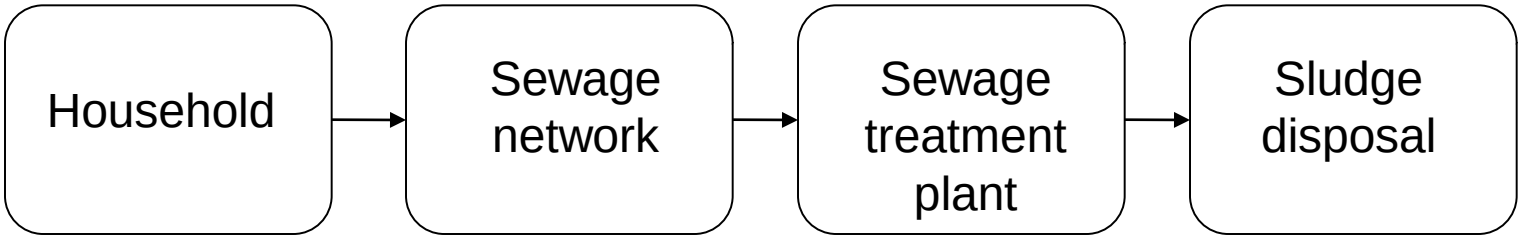
Research question:

What are the ecological aspects of decentral and central wastewater treatment systems (wwts)?

Modelling of a central wastewater treatment system

Data:

- EcoInvent report 2000 of swiss EcoInvent Centre
- Functionel unit: 4 pe per year



Model EcoInvent Report 2000

Comparison of the sizes of sewage treatment plants:

	unit	Size range				
		1	2	3	4	5
capacity	pe/a	over 100.000	50.000-100.000	10.000-50.000	2.000-10.000	30-2000
number of plants	number	40	45	192	262	428
total capacity	pe/a	9.329.000	3.201.000	4.774.000	1.394.000	345.000
average capacity per plant	pe/a	233.225	71.133	24.865	5.321	806
lenght of channel	km	583	242	109,4	30,3	6,13

Average capacity of sewage treatment plant with corresponding network(Based on: DOKA, G. (2007), p. 2, 10

Goal and scope definition

All Scenarios based on EcoInvent Report 2000

Central wwts (base case):

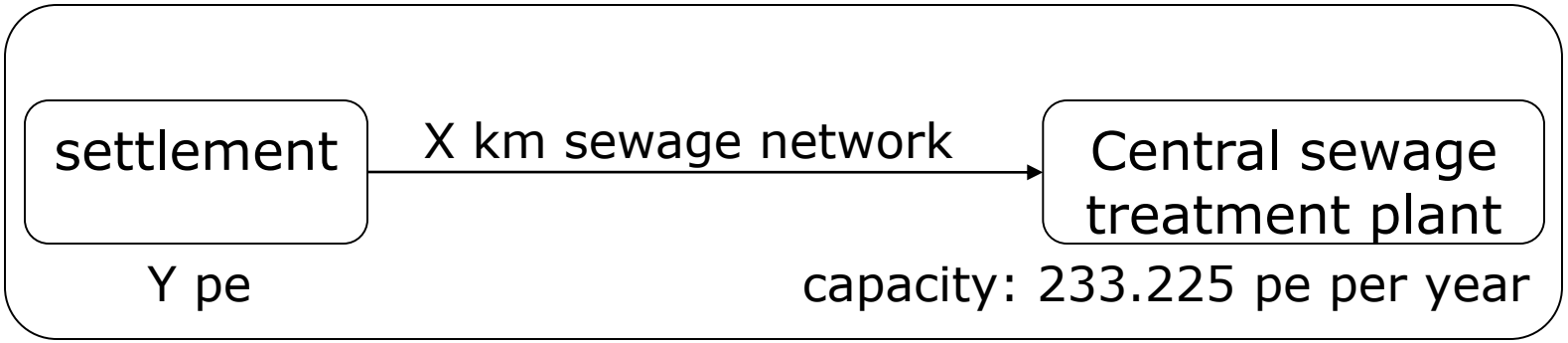
- Central wastewater treatment plant class 1 (capacity: 233.225 pe per year)
- Sewage network class 1 (length: 583km)
- 73 pump station (capacity: ever 644.000 m³ per year)

Analysis of the connection of a new settlement

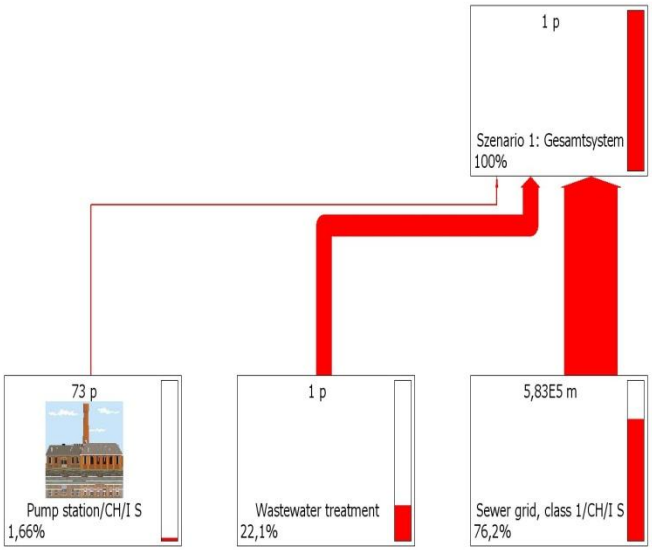
- Analysis of the connection of wwts size 4 and 5 to central wwts
- comparison of a decentral solution and a connection to the central system

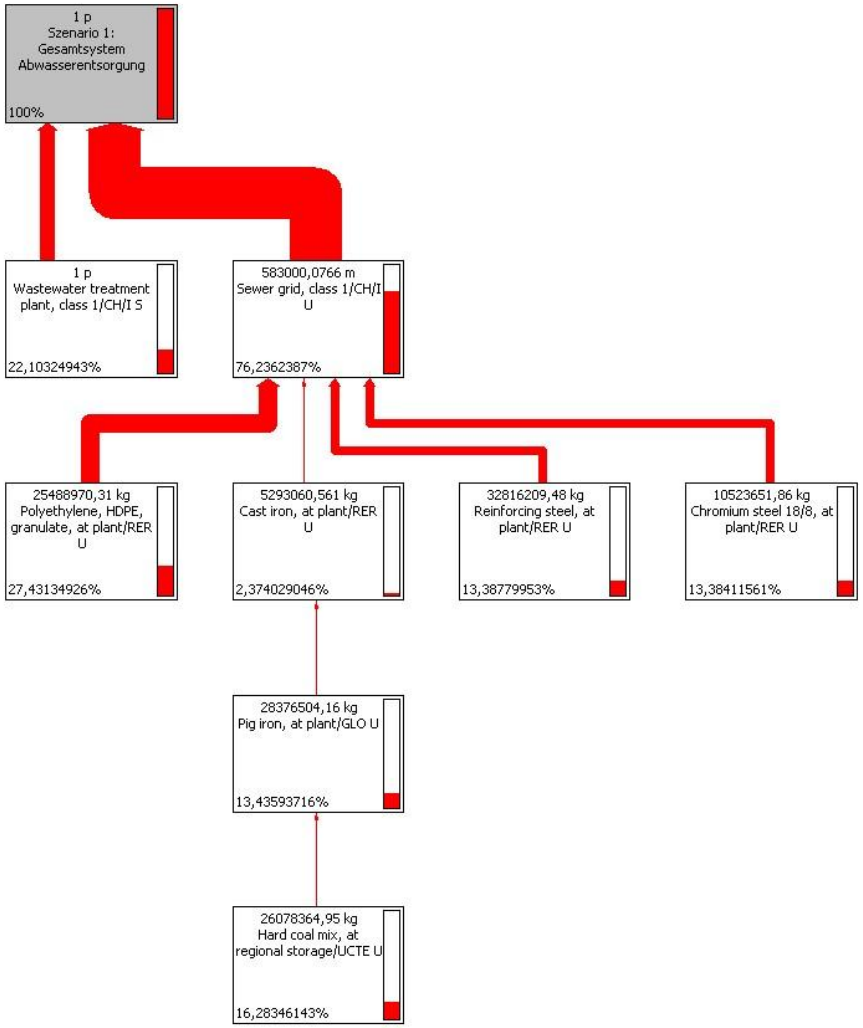
  → x km network

  →Variation of distance until the ecological performance of both situations equal



Impact assessment and interpretation





Abiotic depletion (Source: SimaPro.)

Result

Result:

ecological performance of both situations equal for

- size 4 (2.000 – 10.000) at 15km
- size 5 (30 – 2.000 pe) at 4km

- Ecological efficiency rises with rising size of plant
- Canal system has an important impact
- Pump station has a low impact
- Size of settlement and distance from the existing sewage treatment plant are decisive

Agenda

1. Basics of life cycle assessment (LCA)
2. Review of LCA studies
3. LCA of a central wastewater system
4. LCA of a decentral wastewater treatment systems
5. Summary

Research question:

What are the decisive environmental aspects of small sewage treatment plants during the production, operation and disposal phase?

Goal and scope definition

Data, data research und data quality:

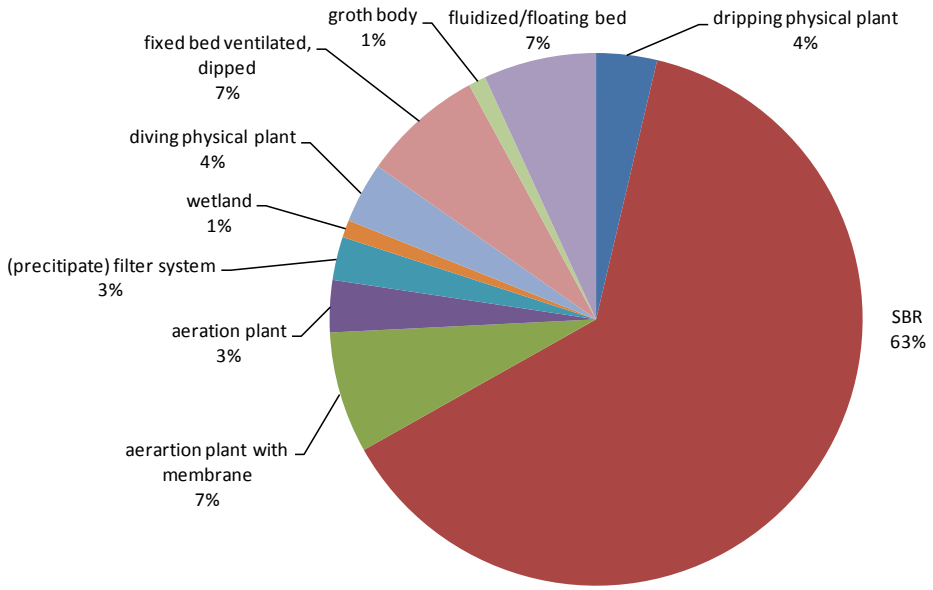
- Literature research in technical databases
- Conduction of a survey
- Technical datasheets of small sewage treatment plants

Funcionel unit:

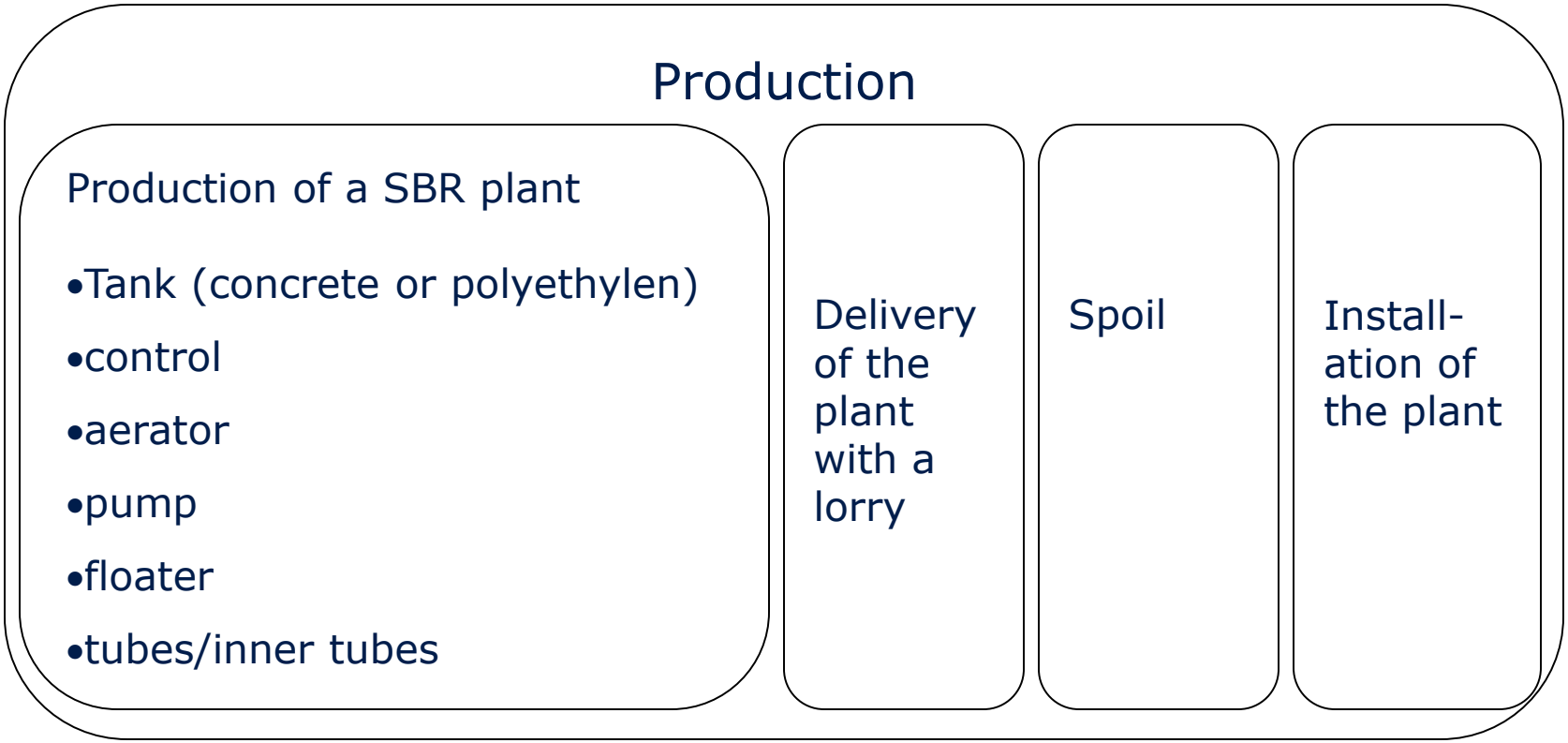
- 4 ep

Product system:

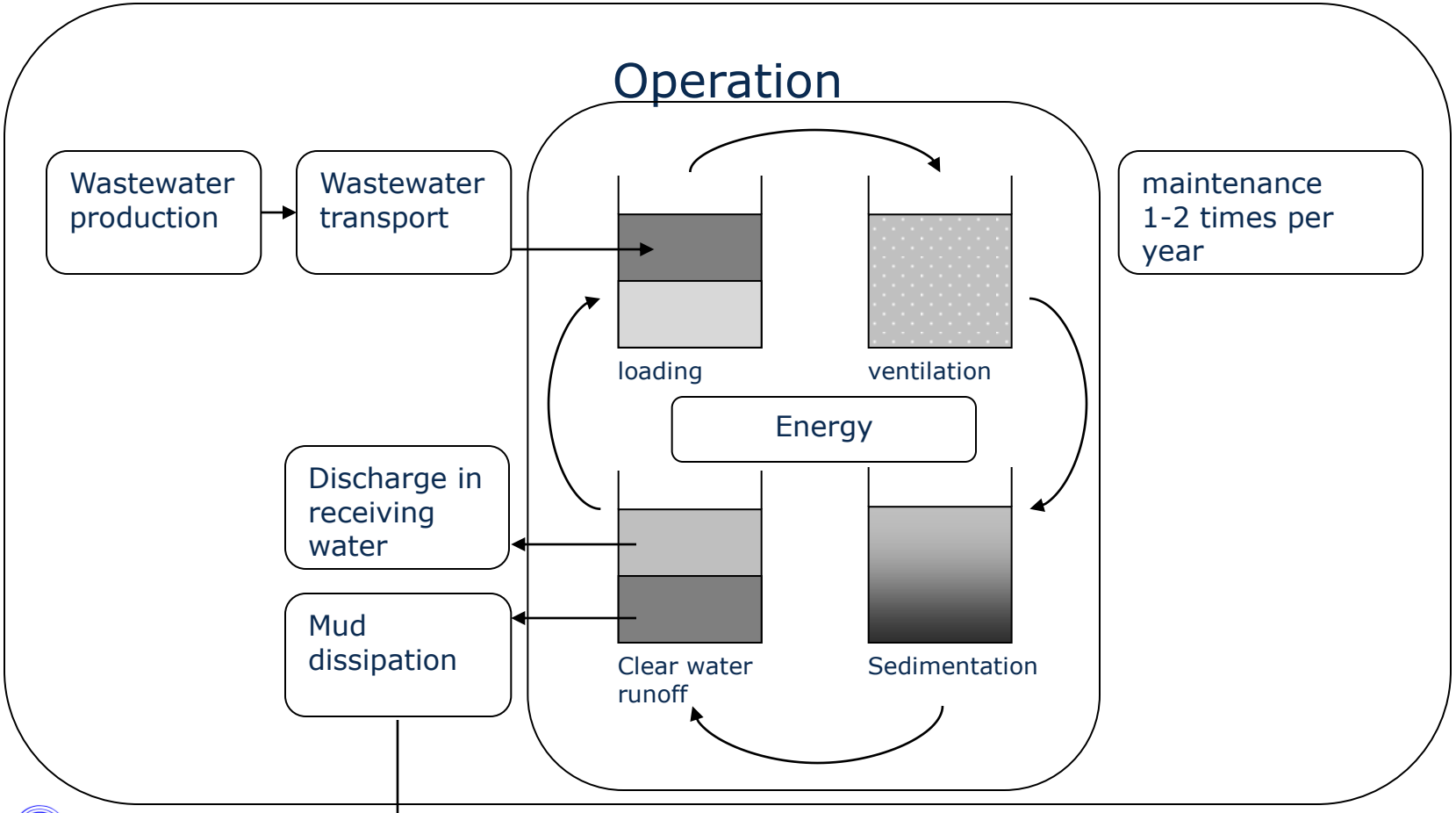
- Creation with the help of the answered questionnaires
- Small sewage treatment plant for an exemplary SBR-plant



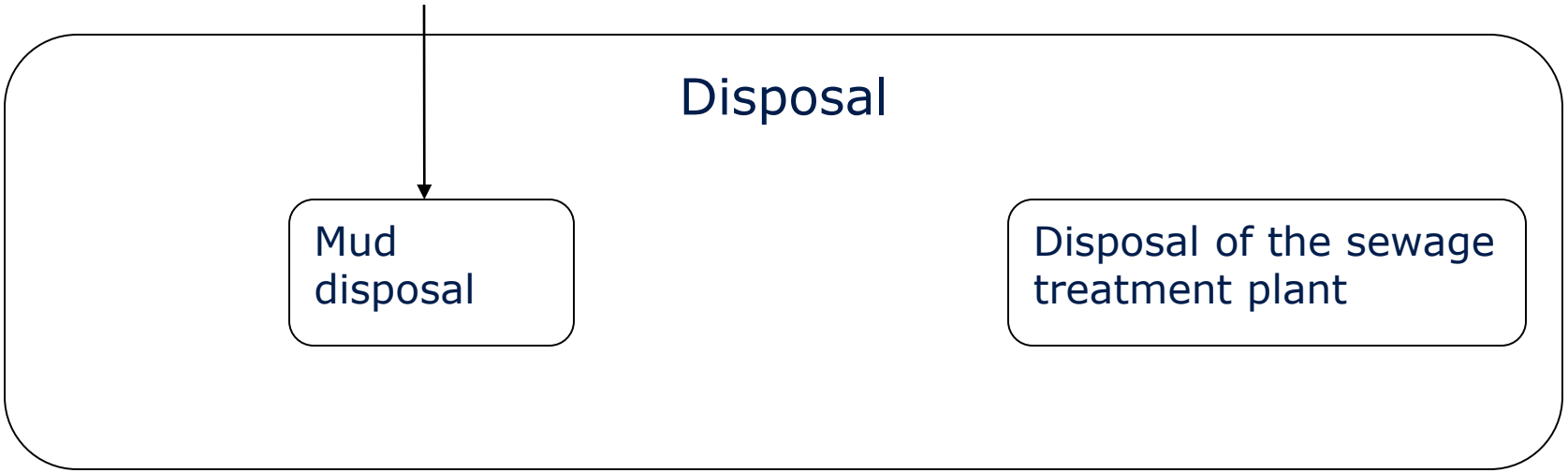
Life cycle of a small sewage treatment plant I



Life cycle of a small sewage treatment plant II



Life cycle of a small sewage treatment plant III



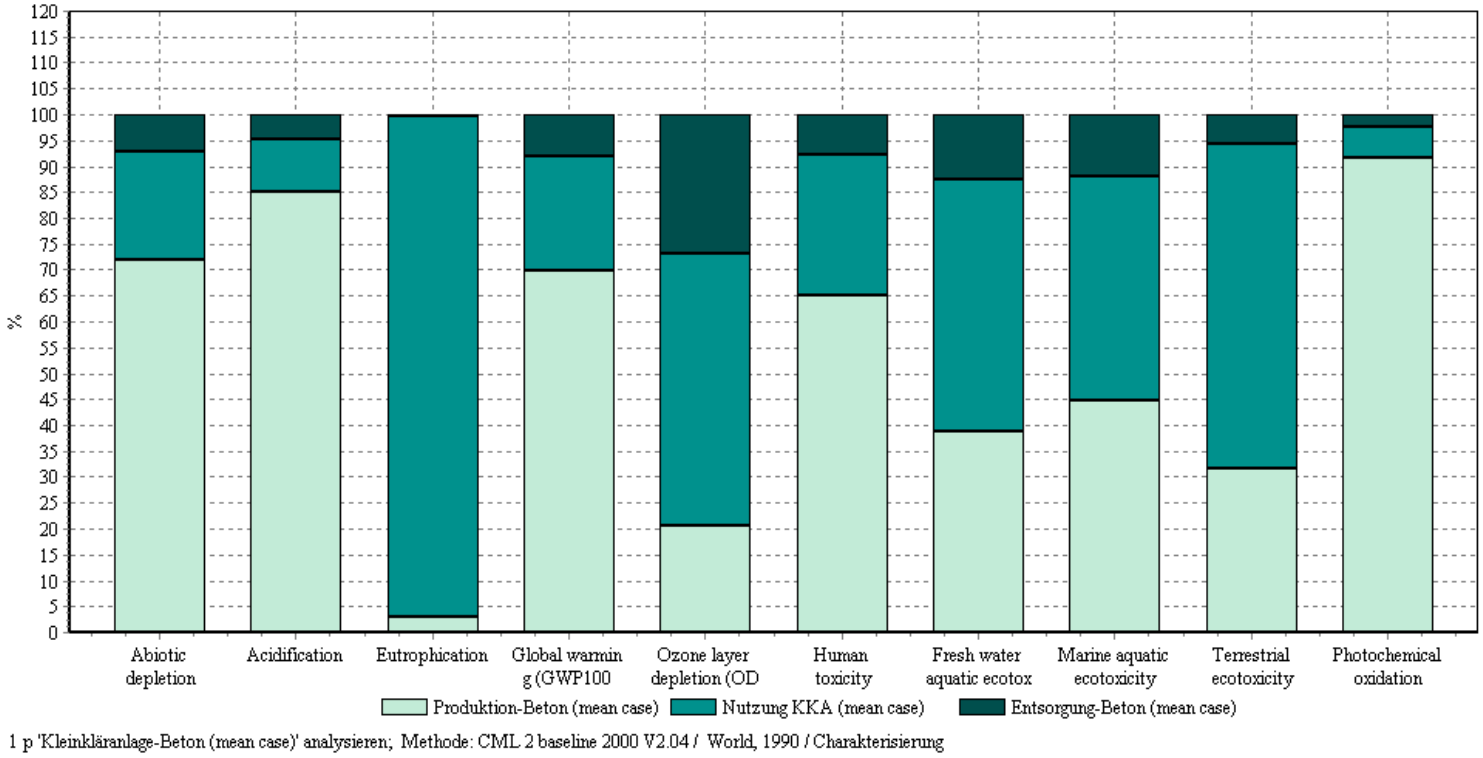
Production phase:

Tank-concrete	Data					worst case	best case	mean case
amount (kg)	5142	4583	5420	6260	6000	**6260**	**4583**	**5481**
service life (years)	30		30-50			30	50	35
Number for 40 years (unit)						**1,3**	**0,8**	**1,1**

Tab. 2: Data – Tank-concrete (Own representation.)

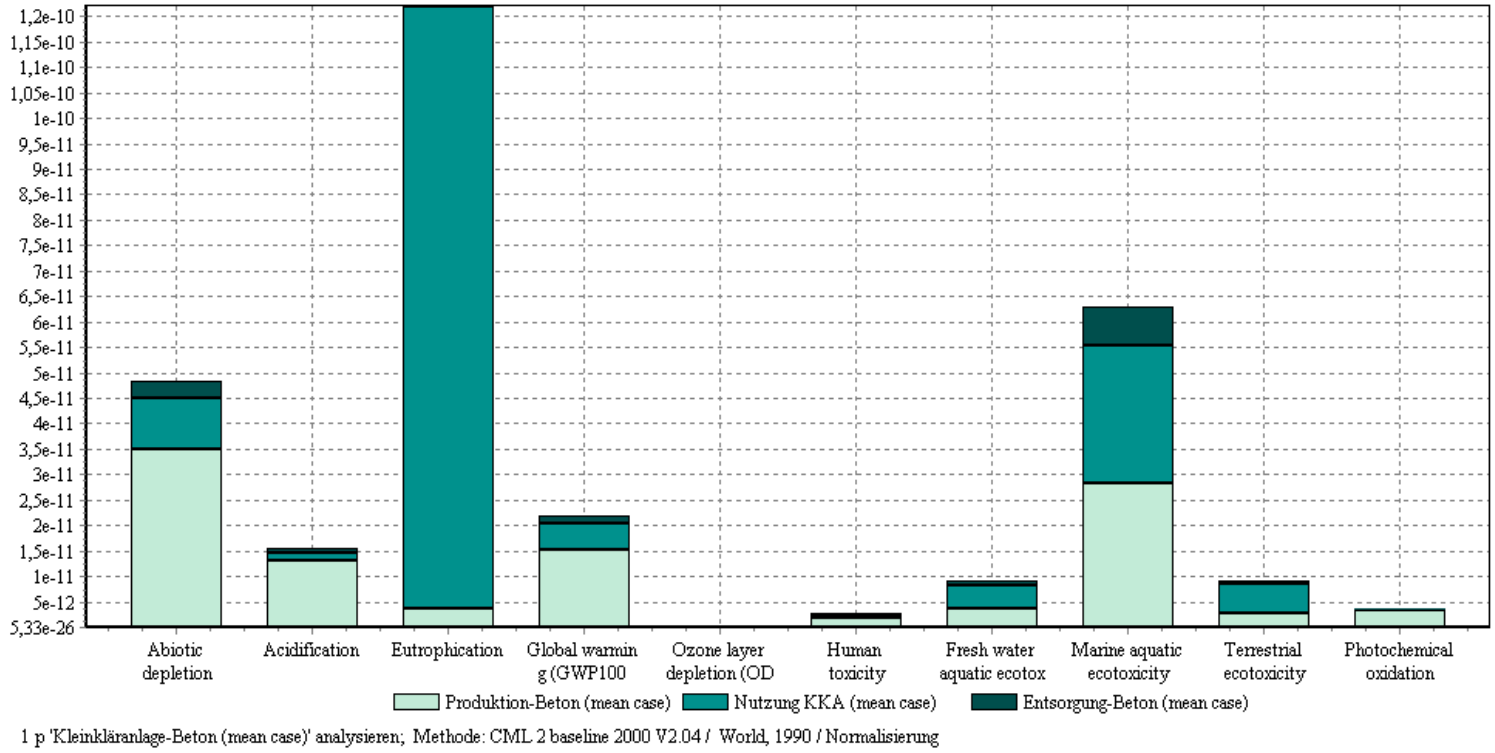
Tank-polyethylen	Data					worst case	best case	mean case
amount (kg)	200	230	206	190	445	**445**	**190**	**254**
service life (years)	30-50		> 25			25	50	33
Number for 40 years (unit)						**1,6**	**0,8**	**1,2**

Small sewage treatment plant – concrete I:



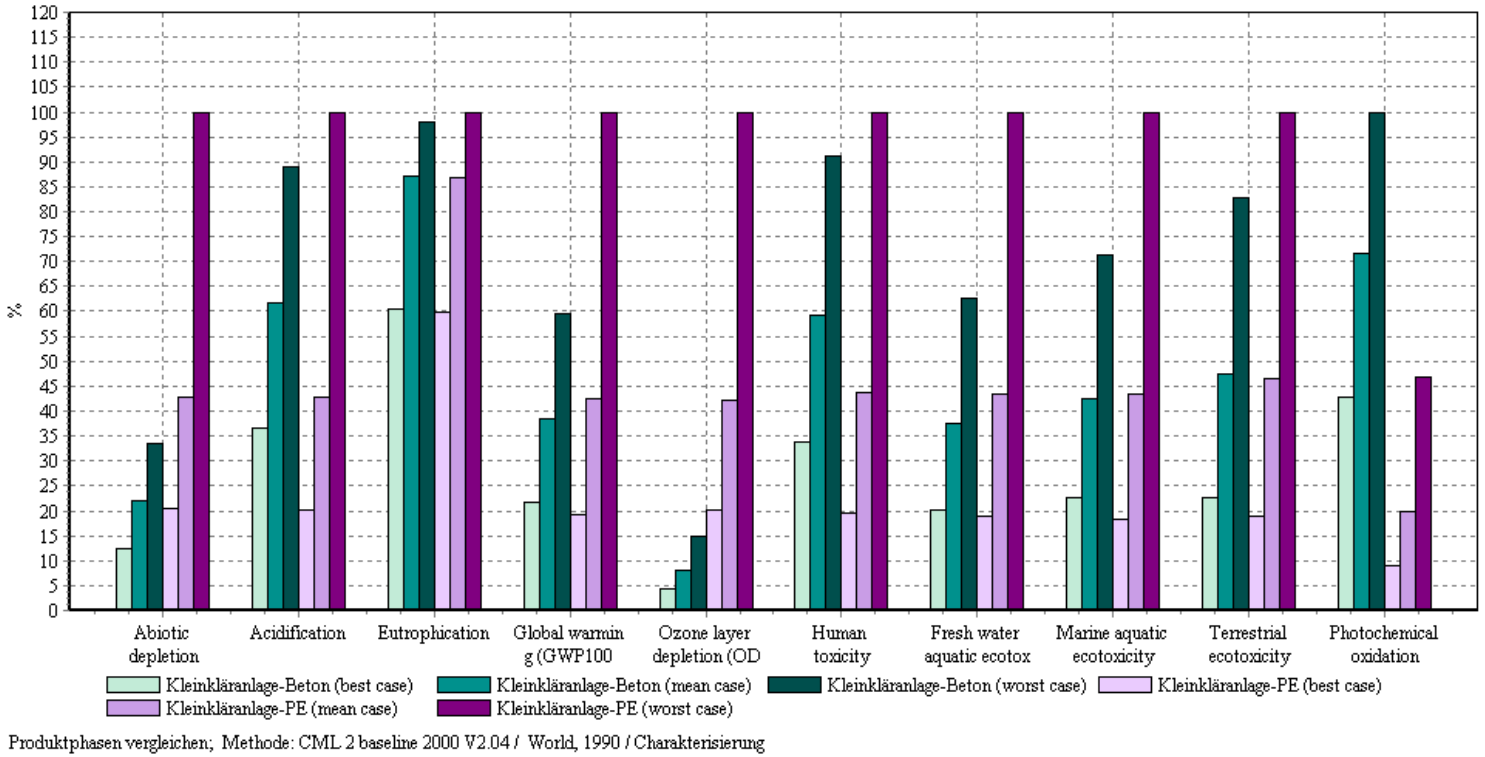
1 p 'Kleinkläranlage-Beton (mean case)' analysieren; Methode: CML 2 baseline 2000 V2.04 / World, 1990 / Charakterisierung

Small sewage treatment plant – concrete II:



1 p 'Kleinkläranlage-Beton (mean case)' analysieren; Methode: CML 2 baseline 2000 V2.04 / World, 1990 / Normalisierung

Small sewage treatment plant – comparison:



Produktphasen vergleichen; Methode: CML 2 baseline 2000 V2.04 / World, 1990 / Charakterisierung

Impact assessment and interpretation

Results

- Especially in the production and the operation phase high impacts on the ecosystem
- concrete tanks with lower environmental impacts than polyethylen tanks
- Need for further research in the field of small sewage treatment plant
- Bad database → cooperation with DIBt, DWA or manufacturers

Agenda

1. Basics of life cycle assessment (LCA)
2. Review of LCA studies
3. LCA of a central wastewater system
4. LCA of a decentral wastewater treatment systems
5. Summary

Summary

- No LCAs are facing the impacts of demographic change
- Existing LCAs are not consistent and hard (impossible) to compare
- Concrete is better than PE
- The bigger the better (low transferability!)
- Need for further research in the field of LCAs for urban drainage
- LCAs allow for the consideration of long life-times
- In combination with Life Cycle Costing (LCC) LCAs offer excellent decision-support.

Thank you for your attention!

For more questions: www.tu-dresden.de/wwbwlbu/en

E-Mail: bu@mailbox.tu-dresden.de

Technische Universität Dresden is validated according to EMAS regulations since January 2003, successful revalidation in December 2006.

Information: http://www.tu-dresden.de/umwelt/english.htm