CHALMERS
UNIVERSITY OF TECHNOLOGY

PRESENTATION PÅ WORKSHOP MILJÖSYSTEMANALYS NÄRINGSÅTERVINNING

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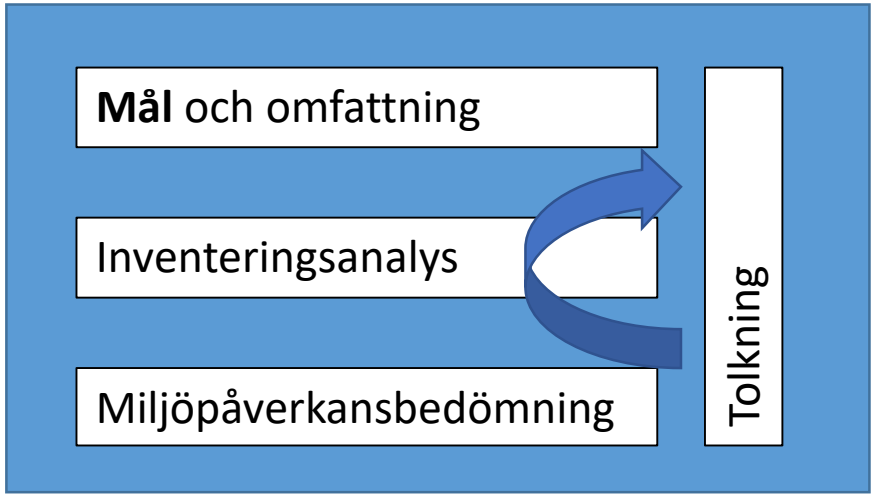
Livscykelanalys



En LCA kan bara svara på den fråga som ställdes vid studiens utformning!

- Syfte med studien?
- Vilken fråga ska besvaras?
- Hur ska resultaten användas?
- Till vem riktar sig studien?

Systemgränser

- Vad skall ingå?
- Tid? Prospektiv vs retrospektiv?
- Geografi?

Funktionell enhet

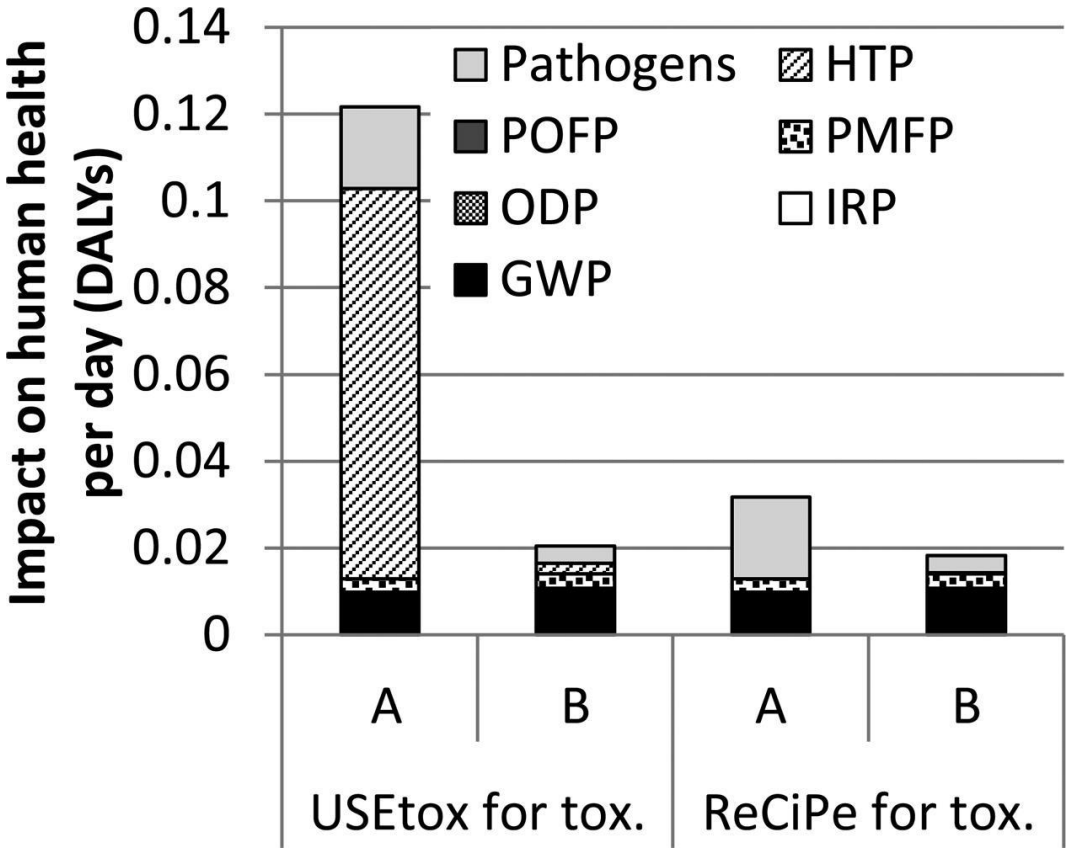
- Mängd slam eller inflöde till reningsverket (t.ex. ton slam)
- Näringsämnen (t.ex. kg P)

Miljöpåverkanskategorier

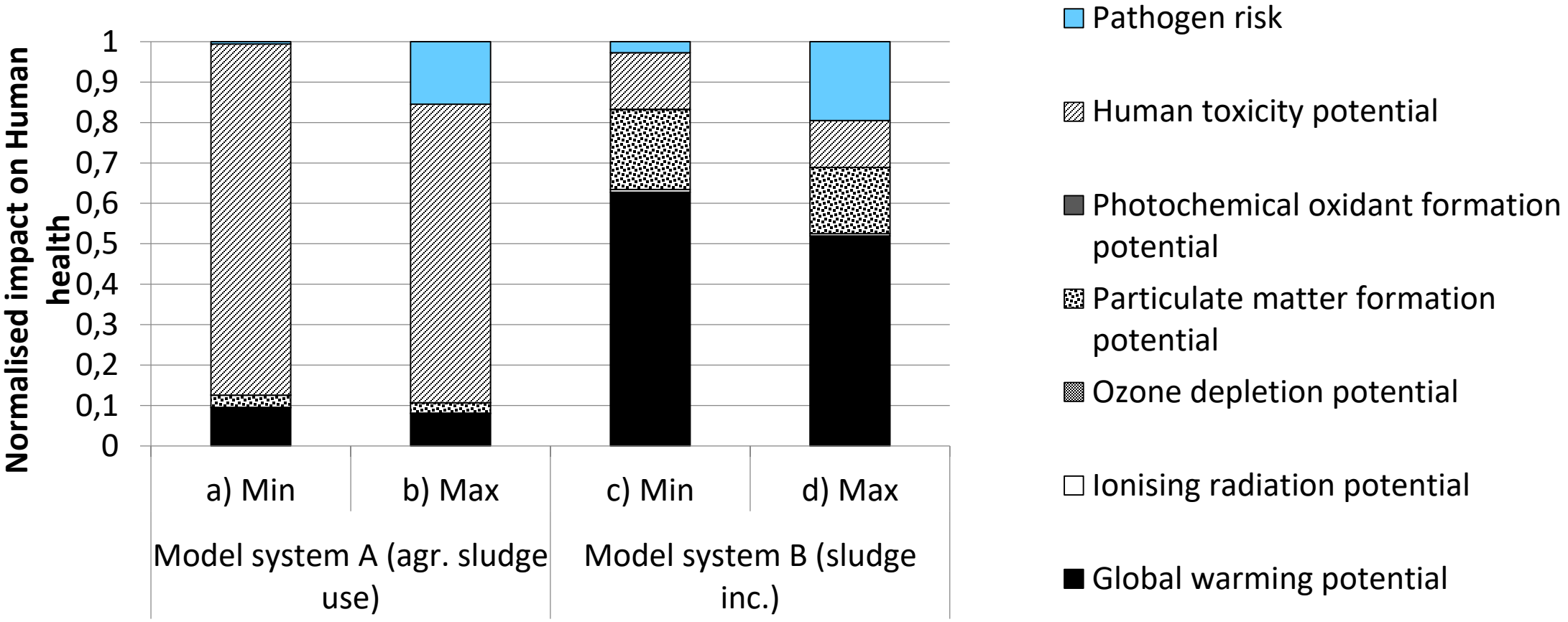
Exempel:

- Global warming potential
- Eutrophication potential
- Acidification potential
- Ozone depletion potential
- Human toxicity potential
- Ecotoxicity potential
- Photochemical oxidant formation potential

Humantoxicitet (Heimersson et al. 2014)

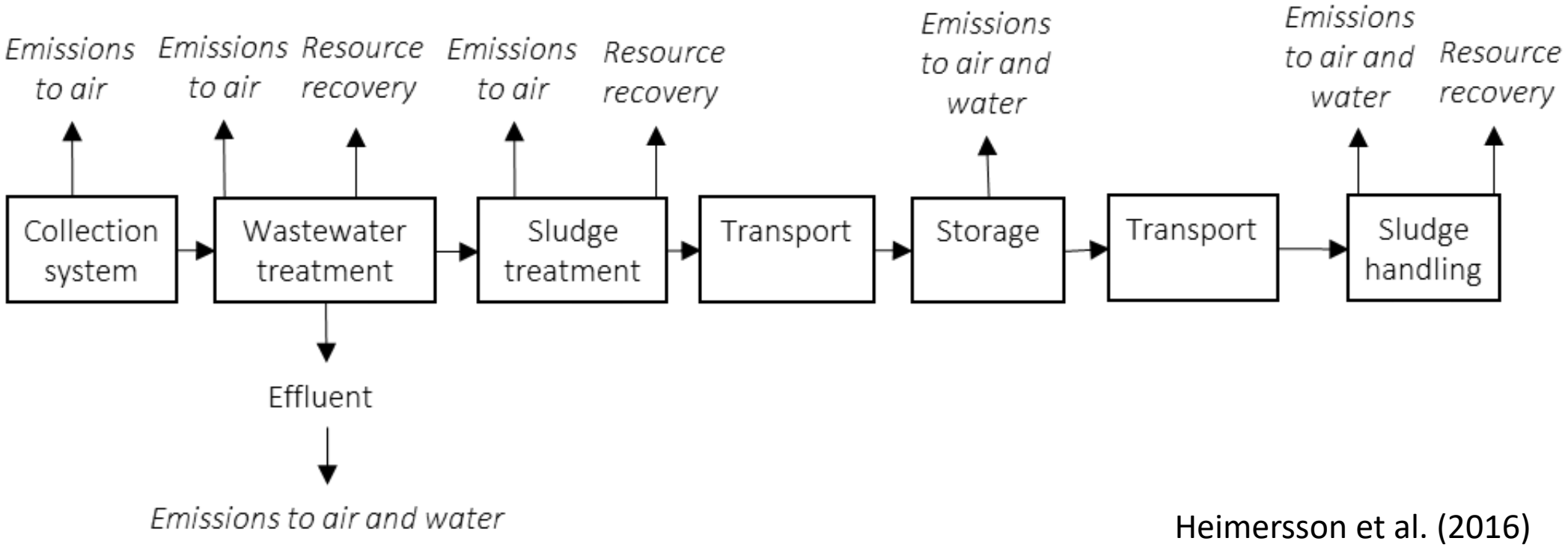


Patogenrisker (Harder et al. 2014; Heimersson et al. 2014)



Datainventering

Do LCA practitioners generally include the major relevant N, P and C flows in a relevant way to enable assessment of the impact categories most commonly assessed in LCA?



Heimersson et al. (2016)

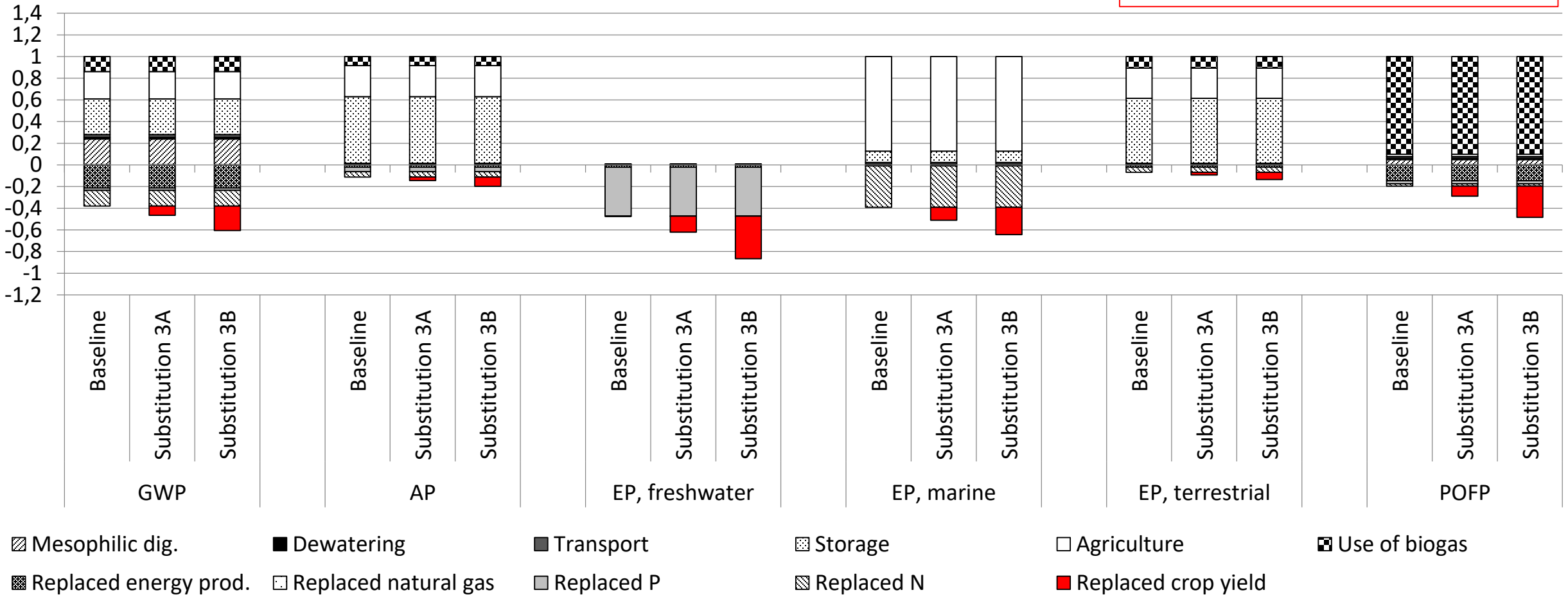
Allokeringsproblem

- Allokera mellan systemets olika produkter
- Substituera ersatt produkt

- N och P till åkermark
- Biogas

How, and under which conditions, could benefits other than N and P from sludge used as organic fertiliser be accounted for?

Heimersson et al (2017)



Bokförings- vs konsekvens- studie?

Bokförings-LCA

- Allokering (partioning) baserat på t.ex. massa eller ekonomiskt värde
- Bakgrundssystemet modelleras med medeldata

Konsekvens-LCA

- Substitution
- Bakgrundssystemet modelleras med marginaldata

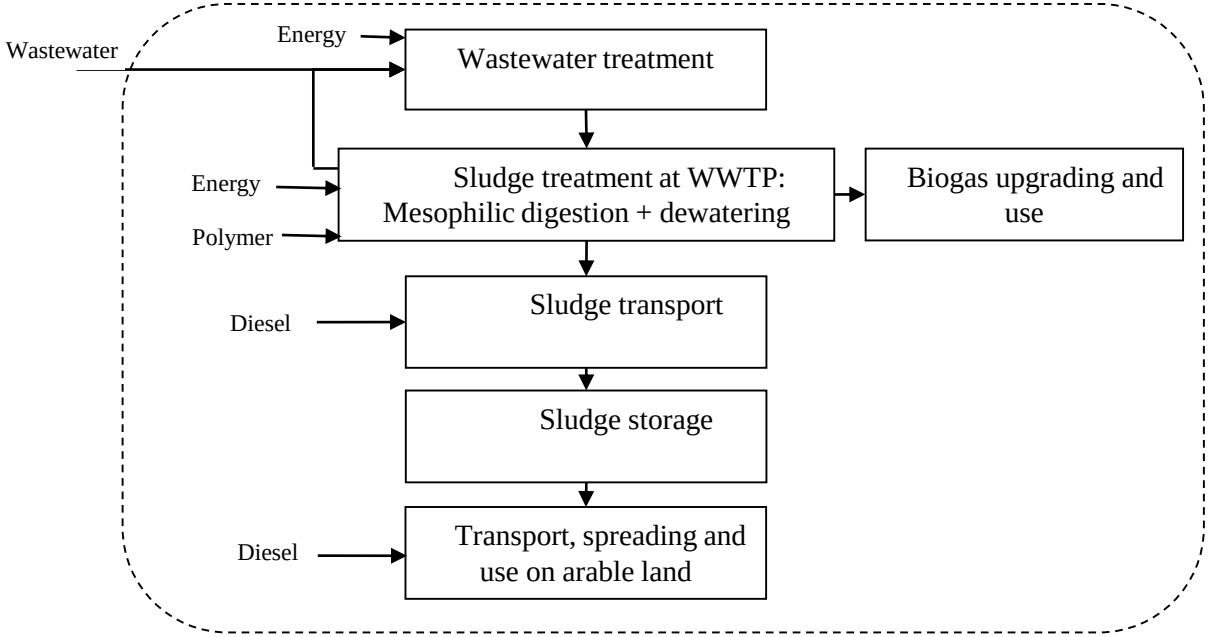
LCA questions	Judgement call	Approach	Description of approach
What environmental impact belongs to the WWT? How can this impact be reduced?	The WWT system includes only processes that cannot be physically distinguished from the WWT or the treatment of the WWT waste.	**ALCA 1**	A physical relationship is employed to identify joint processes. Average data is used for background processes.
	The WWT system includes also processes that must be there for legal reasons.	**ALCA 2**	A legal relationship is employed to identify joint processes. Average data is used for background processes.
How does the WWT affect the overall environmental impact of society? How does changes in the WWT affect the overall environmental impact of society?	The impacts of WWT on investments in electricity production are too uncertain to account for.	**CLCA 1**	A short time perspective on foreseeable consequences: biogas use in heavy vehicle is assumed to **replace natural gas.** Marginal data is used for background processes, **assuming coal-fired electricity generation**.
	The impacts of WWT on investments in electricity production are too important to exclude from the LCA and can be accounted for through a reasonable assumption.	**CLCA 2**	A long term perspective on foreseeable consequences: biogas use in heavy vehicle is assumed to **replace diesel**. Marginal data is used for background processes, assuming **70% wind power and 30% natural gas for electricity generation**.

Heimersson et al (2019)

Challenges for sewage sludge LCAs

- Attributional LCA
  1. Define the boundary of the system to be partitioned (joint processes)
  2. Define which flows that are functions and impacts from the joint processes
  3. Define a base for the partitioning

- Consequential LCA
  - Identify foreseeable consequences



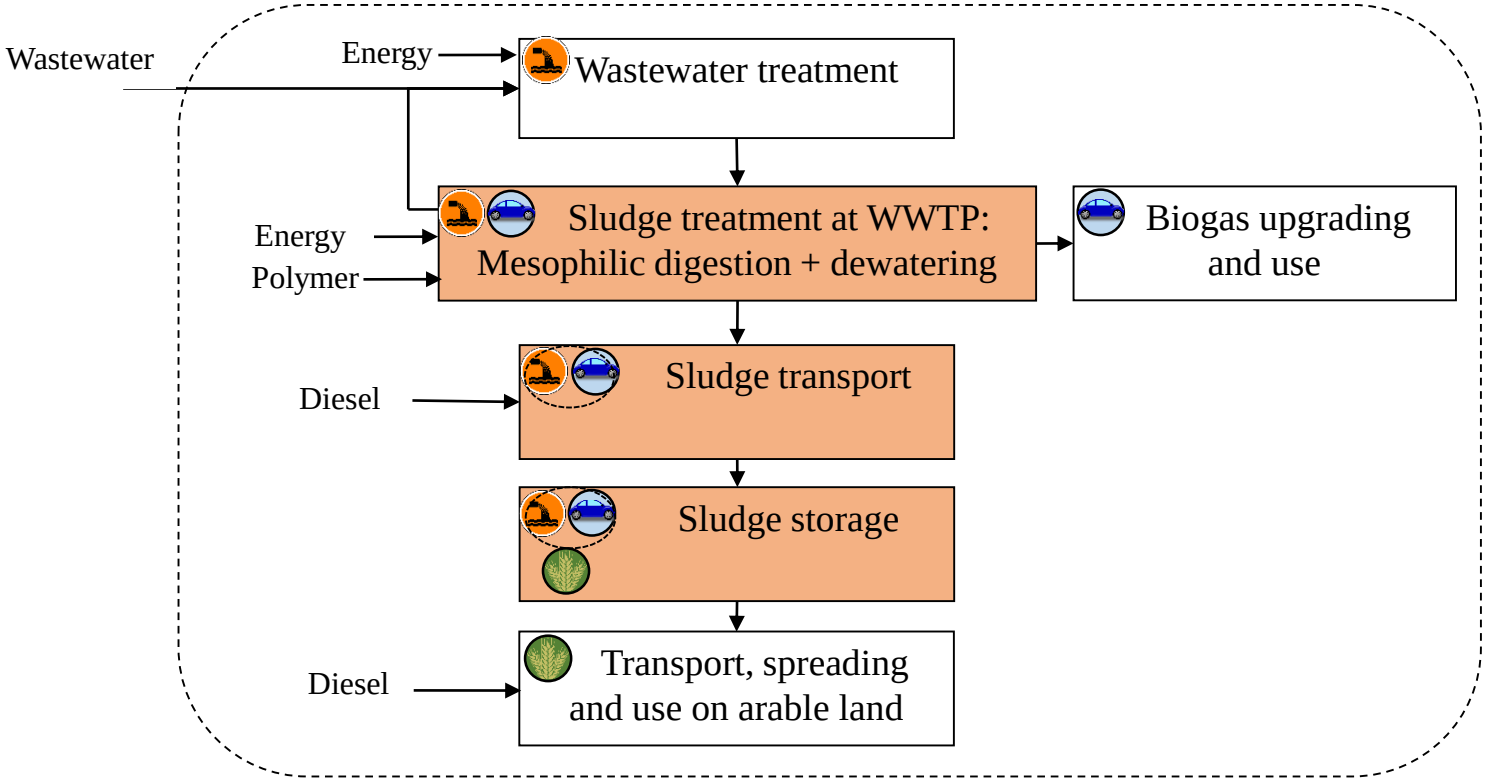
Heimersson et al (2019)

Attributional modelling (1)

Heimersson et al (2019)

Joint processes determined by **PHYSICAL** relationships

Physically joint – based on economic value of the flow



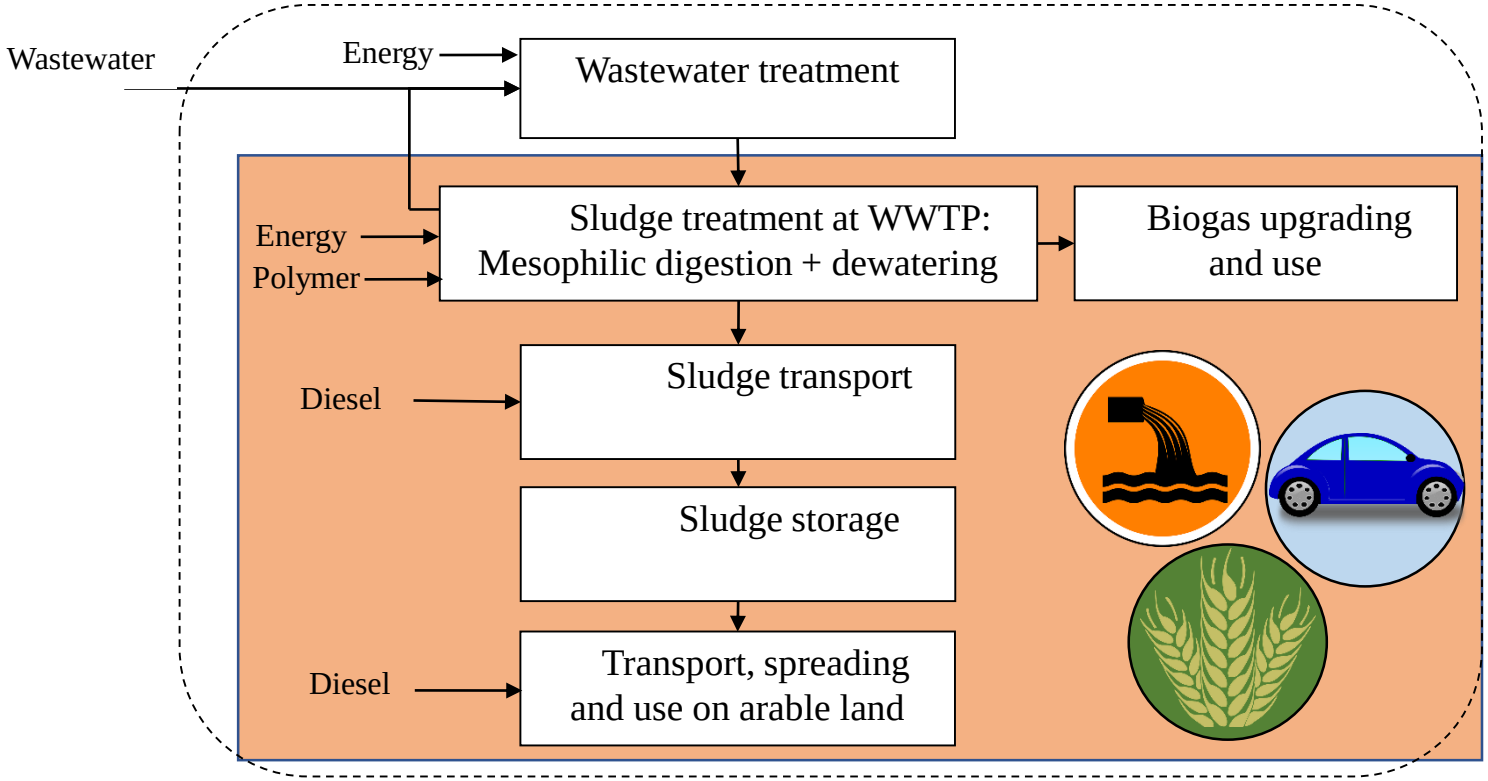
Three functions (services and products) of the system:

- (1) wastewater treatment service incl. management of resulting waste
- (2) production of biogas and use in vehicles incl. mgmt of resulting waste
- (3) production of fertiliser and use in agriculture

Attributional modelling (2)

Heimersson et al (2019)

Joint processes determined by **LEGAL** relationships



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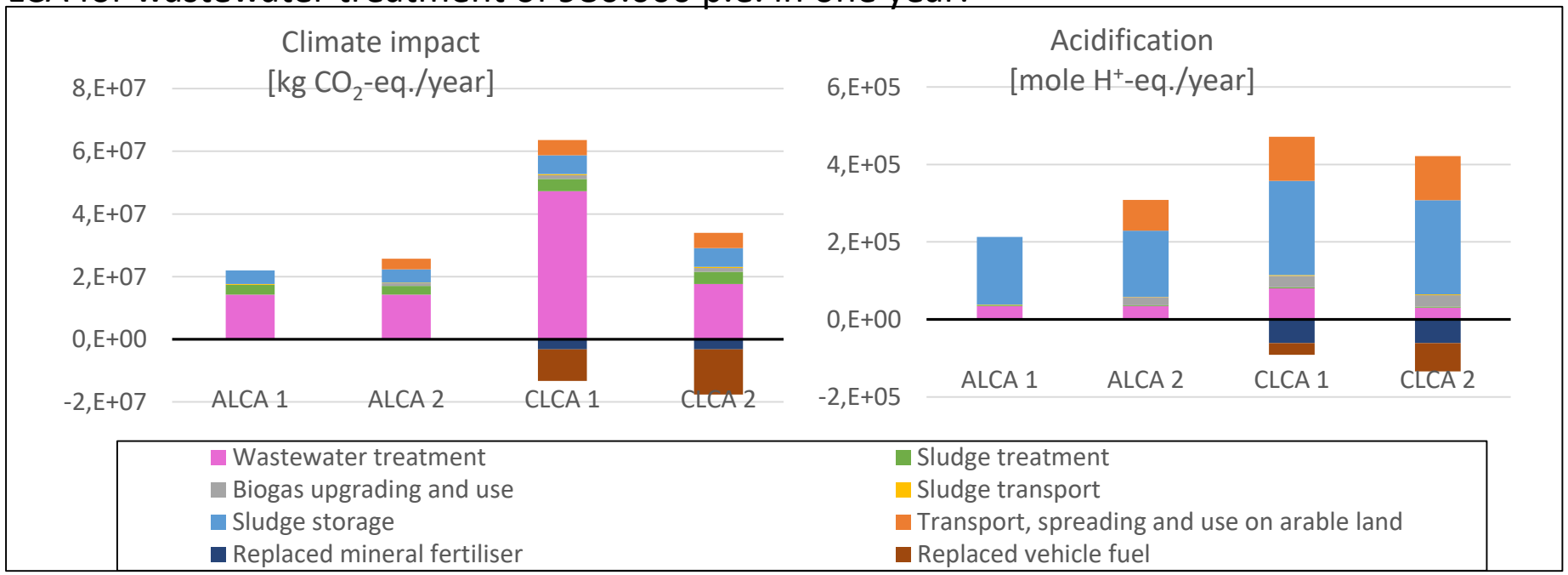
- (1) wastewater treatment service incl. management of resulting waste
- (2) production of biogas and use in vehicles incl. mgmt of resulting waste
- (3) production of fertiliser and use in agriculture

Results for different modelling approaches

Option	Description
ALCA 1	**Physical relationship** to identify joint processes. **Average data** for background processes
ALCA 2	**Legal relationship** to identify joint processes **Average data** for background processes
CLCA 1	**Short-term perspective** for foreseeable consequences: biogas use in heavy vehicle is assumed to replace natural gas Short-term perspective for **marginal data** for background processes: coal-fired electricity generation
CLCA 2	**Long-term perspective** for foreseeable consequences: biogas in heavy vehicle is assumed to replace diesel Long-term perspective for **marginal data** for background processes: 70% wind power and 30% natural gas for electricity generation

LCA for wastewater treatment of 980.000 p.e. in one year:



Heimersson et al (2019)

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