



# **Willingness to pay for environmental performance; the case of decentralised waste treatment systems**

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# Who am I?

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- ▶ **Ghent University**
  - ▶ Faculty of Bioscience Engineering
    - ▶ Department of Green Chemistry and Technology
- ▶ Topic: “sustainable design of process chains from waste”
- ▶ Assistant professor since 2016
  - ▶ 1 postdoc
  - ▶ 1 technician
  - ▶ Promotor/copromotor of 10 PhD students



# Strategy/equipment

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Designing separation trains towards desired purity for a specific application:

- Characterisation of product by chemical analysis (IR, GC-MS, HPLC, ICP, ...)
- Basic modeling (ASPEN)
- Pilot experiments
- Basic economic/environmental assessment

Available unit operations:

- ▶ Distillation (continuous, batch, vacuum, reactive)
- ▶ Membrane treatment (micro/nanofiltration)
- ▶ Adsorption units (ion exchange, active coal, ...)
- ▶ Absorption units
- ▶ S/L extraction (used for biomass, but also deinking, ...)
- ▶ L/L extraction
- ▶ Hydrocyclones
- ▶ Crystallisation
- ▶ Froth flotation
- ▶ Windshifting
- ▶ Friction washing

working volume between 1 to 10 L

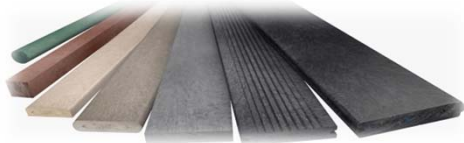


# Two main research topics: plastic waste

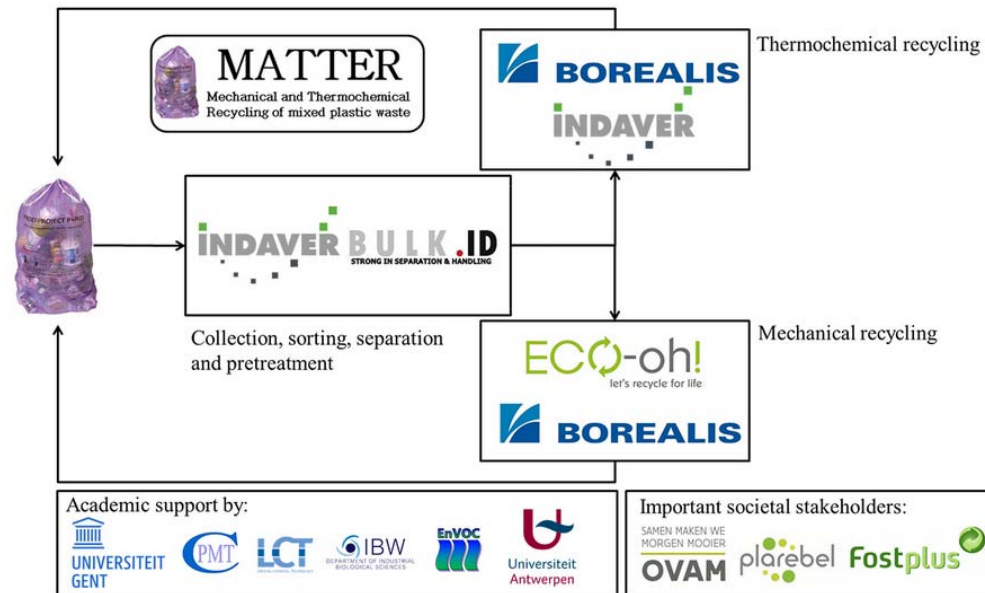
## Plastic waste



(Froth) Flotation  
Cyclones  
Solvent treatment  
windshifting  
Solvent recycling  
Deodorization/deinking



Plastic product



## Other sample projects:

- PROFIT: Bringing the municipal waste refinery to a next level: Plastic Recuperation and valOrisation FIT for use
- PSYCHE: Conversion of plastic waste to base chemicals via gasification

# Two main research topics

## Fruit and vegetable waste



Homogenisation

Precipitation

Selective adsorption

S/L, L/L Extraction

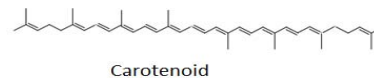
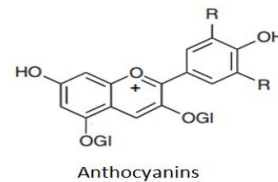
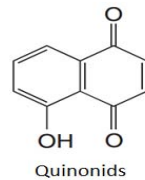
Distillation

Affinity & stability testing



Natural dyes/fatty acids  
Chemical building blocks

## Dyes/derivates



Color?  
Affinity?  

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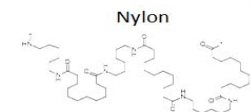
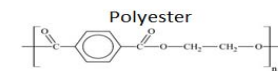
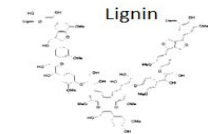
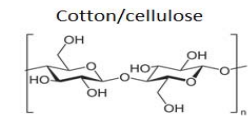
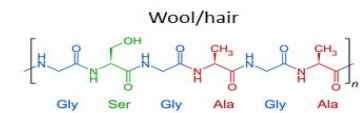
Stability?  
Price?

Derivatization  
Mordants/Surfactants  
pH  
Temperature

### Washing fastness

### Photodegradation

## Fibers



## Other sample projects:

- Optimisation of the distillation process of fatty acids from fats
- ALPO: Specialty polymers from algae

## Now on topic: the starting questions

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- ▶ Do people “care” about their wastewater treatment?
  - Do they have any preference?
  - How do they value the performance of the treatment system?



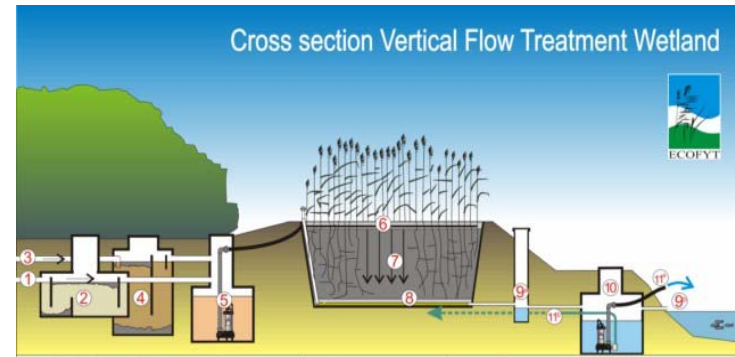


# Materials & Methods: the case study

## Centralised WWTS



## Decentralised WWTS



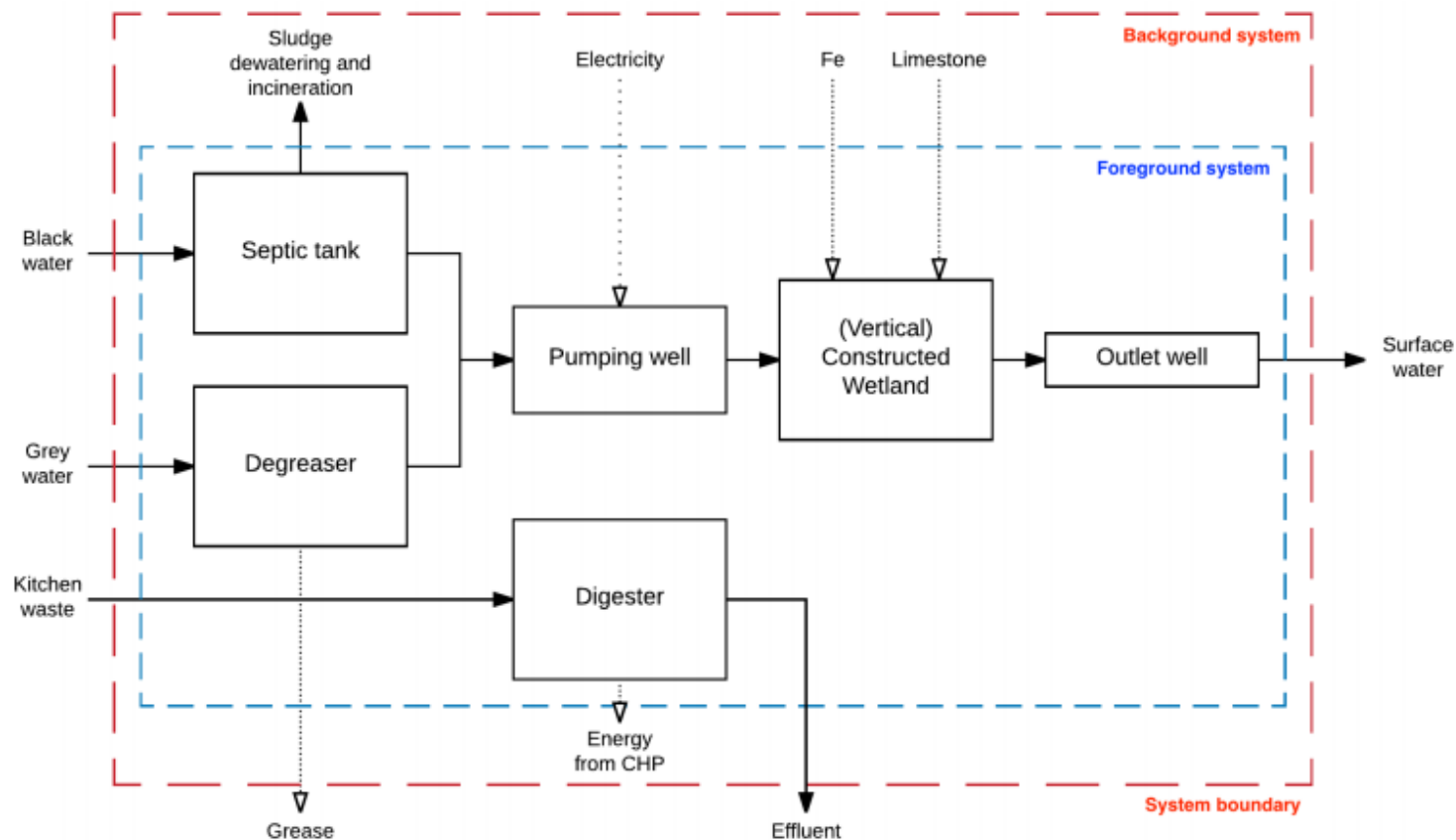
No resource recovery: Constructed wetland



With direct resource recovery: ZAWENT

# Materials & Methods: Data collection

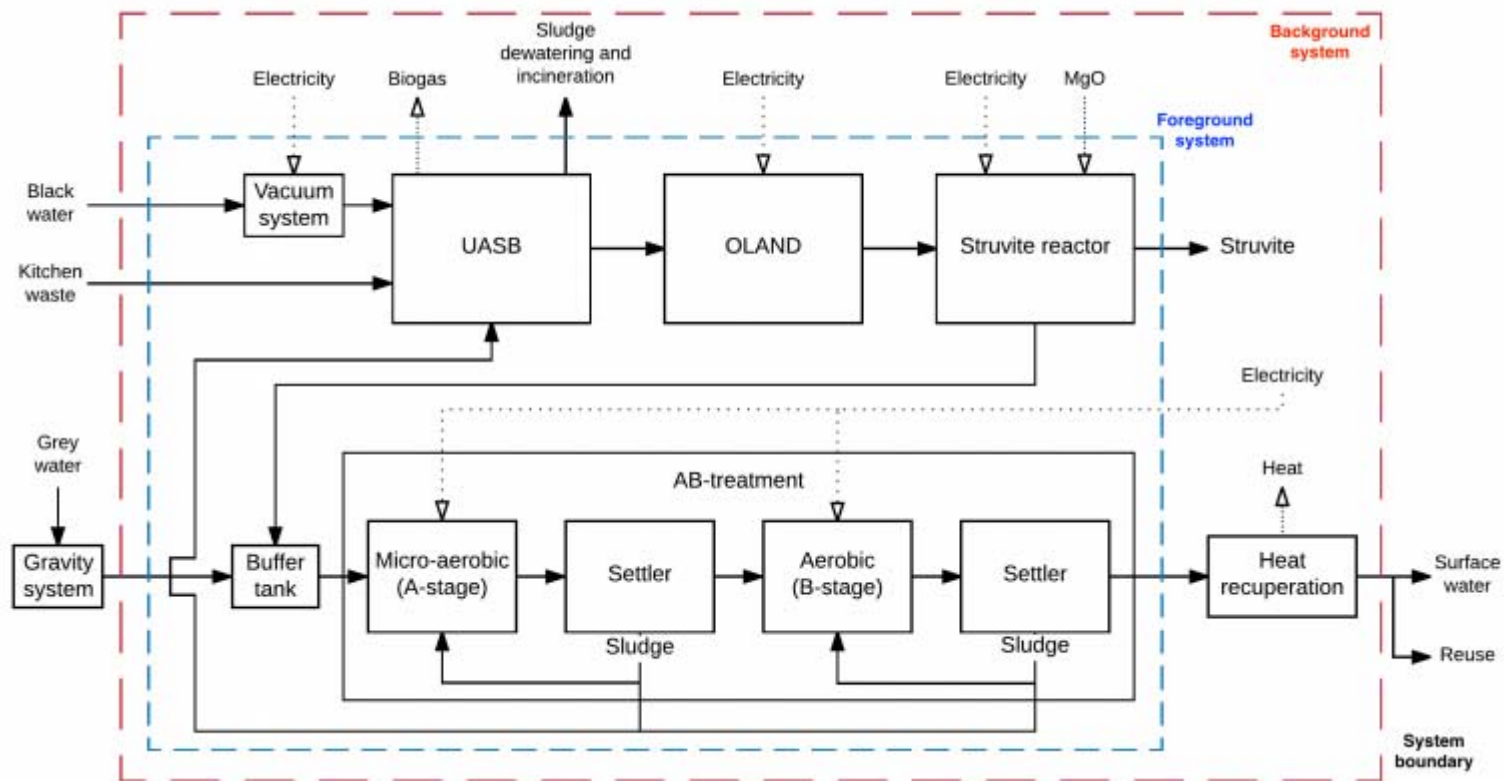
- ▶ Centralised: WWTP Eindhoven
- ▶ Decentralised: constructed wetland





# Materials & Methods: Data collection

- ▶ Centralised: WWTP Eindhoven
- ▶ Decentralised: ZAWENT (Zero AfvalWater met Energie- en NutriëntTerugwinning)



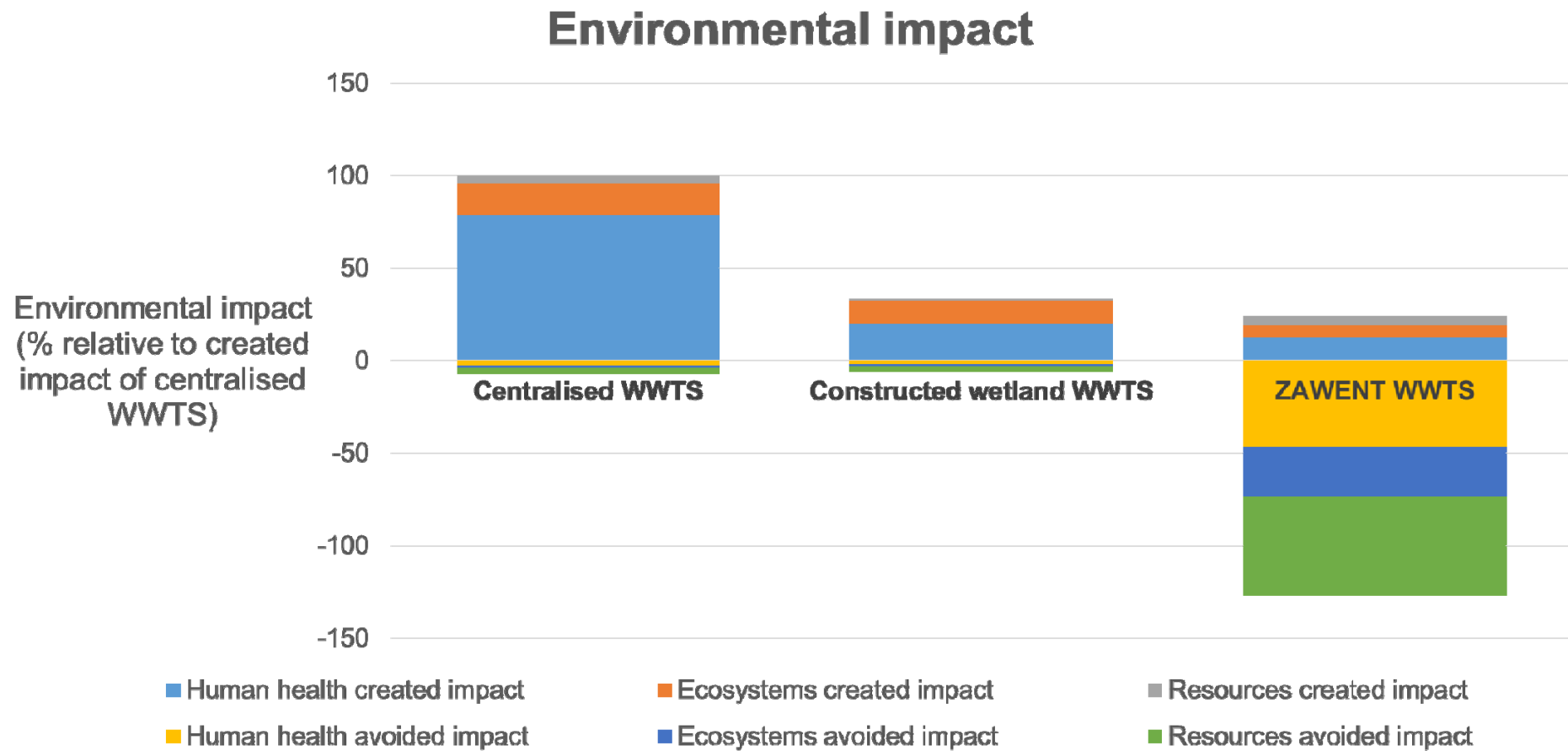
# Materials and methods

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- ▶ Life Cycle Assessment for environmental performans (Recipe Endpoint H)
- ▶ Life Cycle Costing for economic performance
- ▶ Stated Preference analysis for social aspects and WTP (Qualtrics software)
  - ▶ Choice experiments between the options based on
    - ▶ Environmental score
    - ▶ Cost
    - ▶ Participation
  - ▶ General opinion based on Likert scale
    - ▶ Awareness
    - ▶ Aesthetics
    - ▶ ...



# Results: LCA



# Results LCC

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	Centralised WWTS	Constructed wetland	ZAWENT
CAPEX (€/p/y)	-	10-150	33.13
OPEX (€/p/y)	-	2-30	37.00
Total costs (€/p/y)	122.89	12-180	70.13

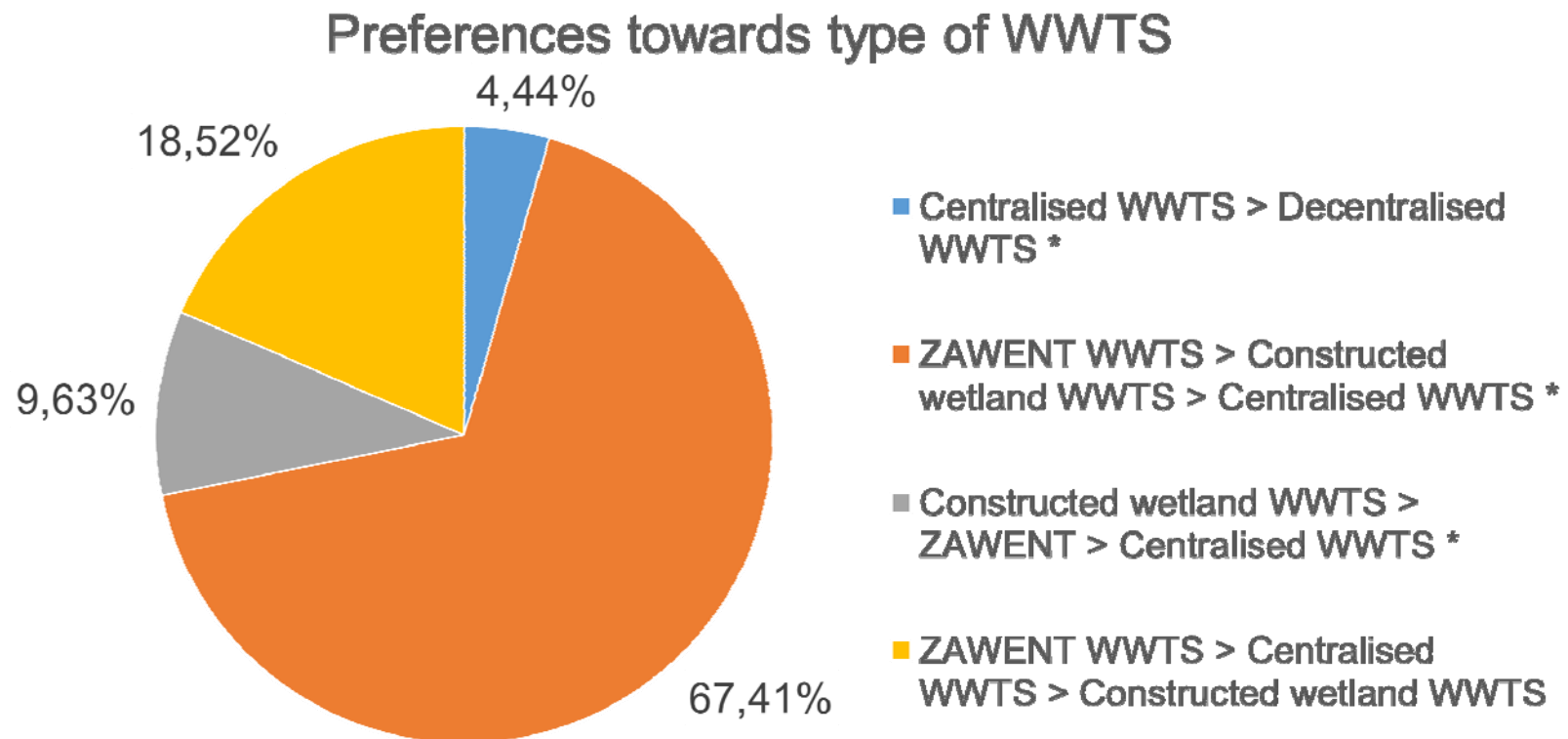
Note: €/p/y = euro per person per year.

- ▶ Generally bad data quality
  - ▶ For example no 'overhead' included in decentralised, whereas it is estimated as almost half of the cost of centralised WWTS
  - ▶ ZAWENT not operational yet. Also cost of building excluded
  - ▶ Wetlands: way of construction, scale, soil type, ...
  - ▶ ...



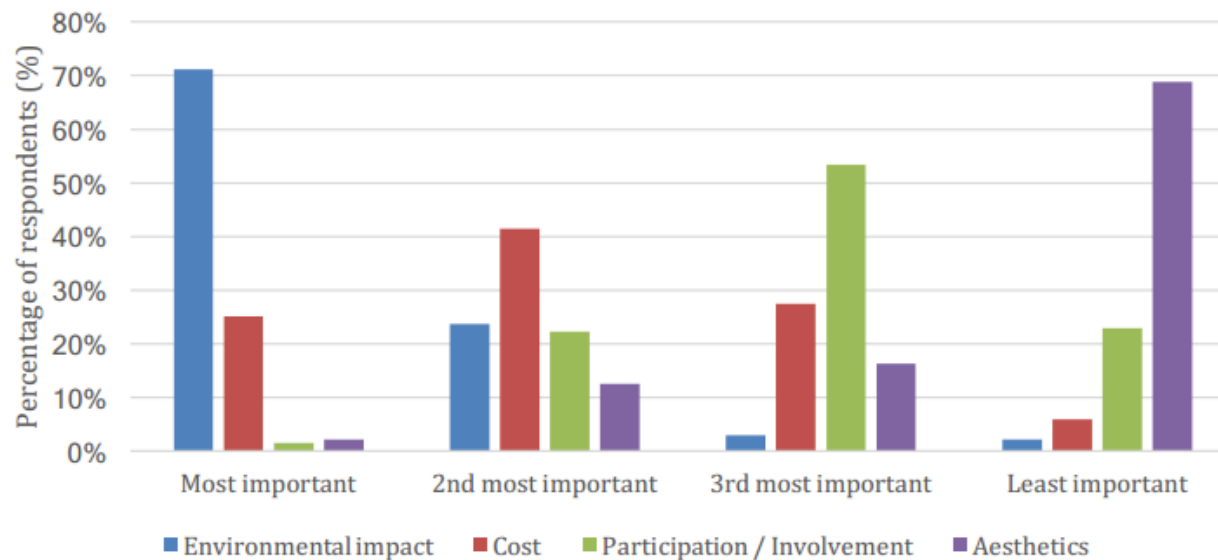
# Results: stated preference

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# Results: stated preference

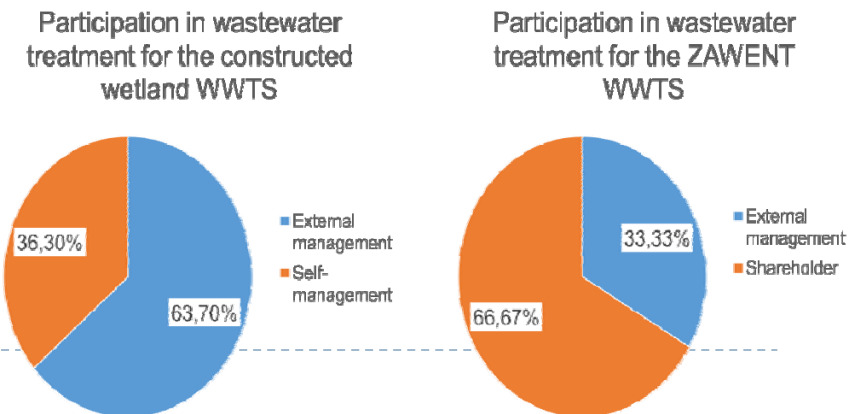
Order of importance of the choice experiment parameters



This means respondents are willing to pay extra

Especially if they can gain profit one day

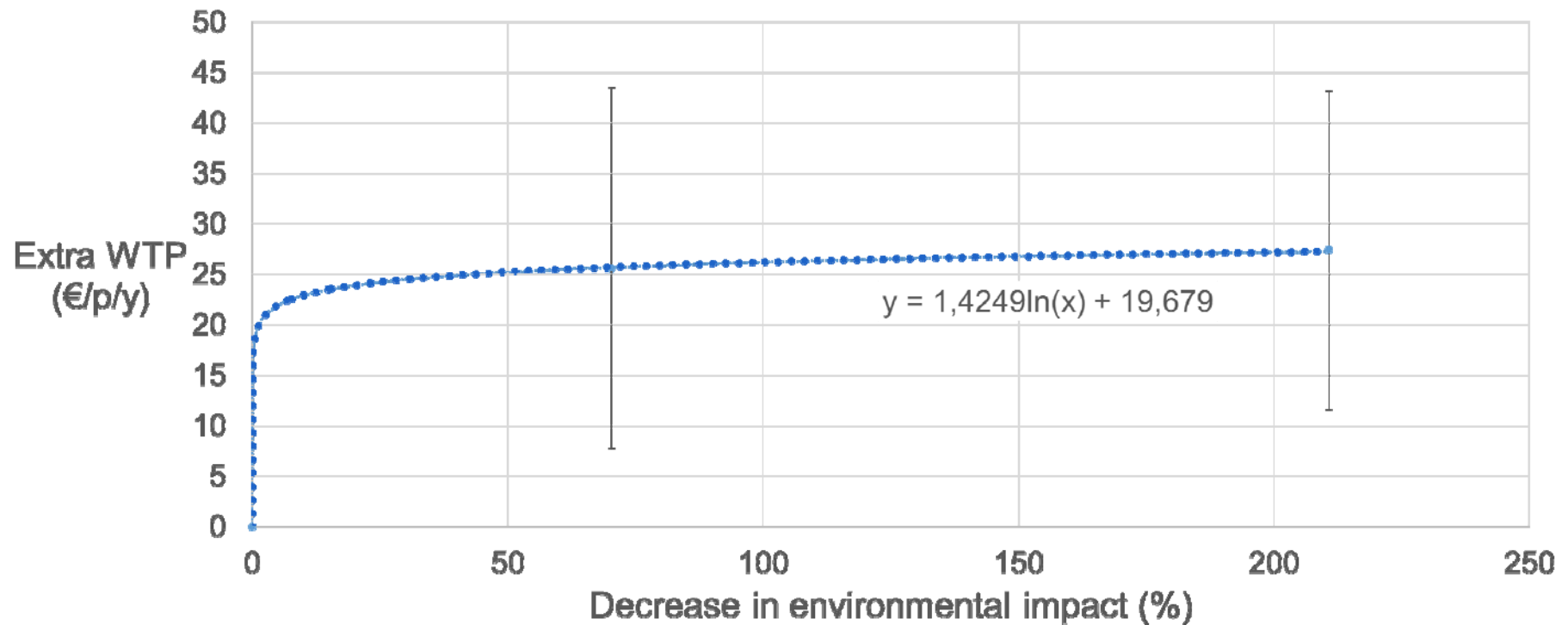
How much?



# WTP analysis

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Extra WTP in function of percentage of environmental impact decrease





# Conclusions

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- ▶ Decentralised systems seem to perform better related to environmental impact
- ▶ Decentralised systems seem to perform better related to economic cost, but with high uncertainty
- ▶ People value environmental impact
- ▶ Not endlessly + their understanding of environmental impact is not sufficient (they don't care/know/value if it is 10 or 100% reduction)
- ▶ Potential thesis student bias in the result
- ▶ A combination of sustainability assessment methods is fun



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