Assessing the environmental performance of circular economy options for biowaste flows at city-region level

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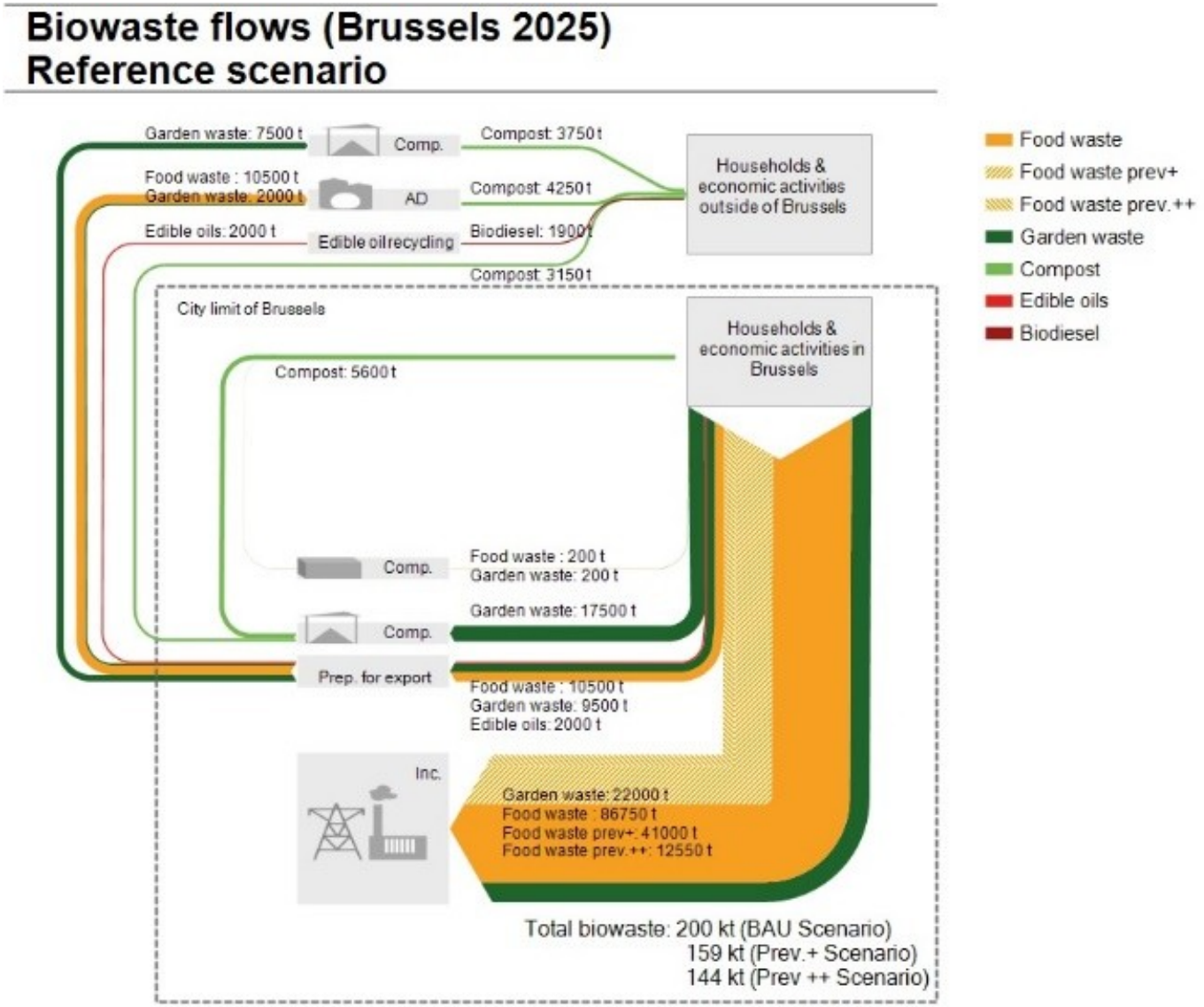
This research is conducted in the frame of the BRUCETRA project funded by the Brussels' capital region – Innoviris (2015-PRFB-3a)

Brussels' context

- Low (bio)waste management performance of Brussels
- High ambition to improve performance and boost local CE
  - Regional waste management program
  - Regional CE program (PREC 2016)
- Biowaste is priority stream with high potential for (local?) valorisation
  - 200kt –36% of the total collected mixed residual waste; 90% incinerated
- Which flows and how?
  - Future waste generation (prevention?)
  - Separate collection rate
  - Type of collection system
  - Technology mix
    - Low tech/high tech, centralised decentral



Biowaste definition: 'biodegradable garden and park waste, food and kitchen waste from households, restaurants, caterers and retail premises and comparable waste from food processing plants' (WFD)

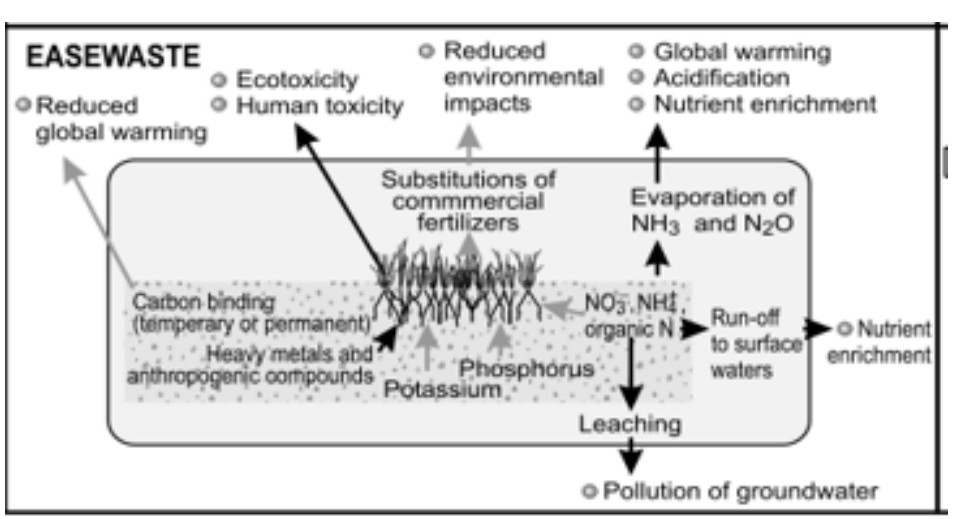
Environmental performance of biowaste

→ **Life cycle assessment to verify**

- Previous assessment emphasize importance of local conditions
- Previous assessment show contradictory results of the role of food waste incineration versus biological treatments

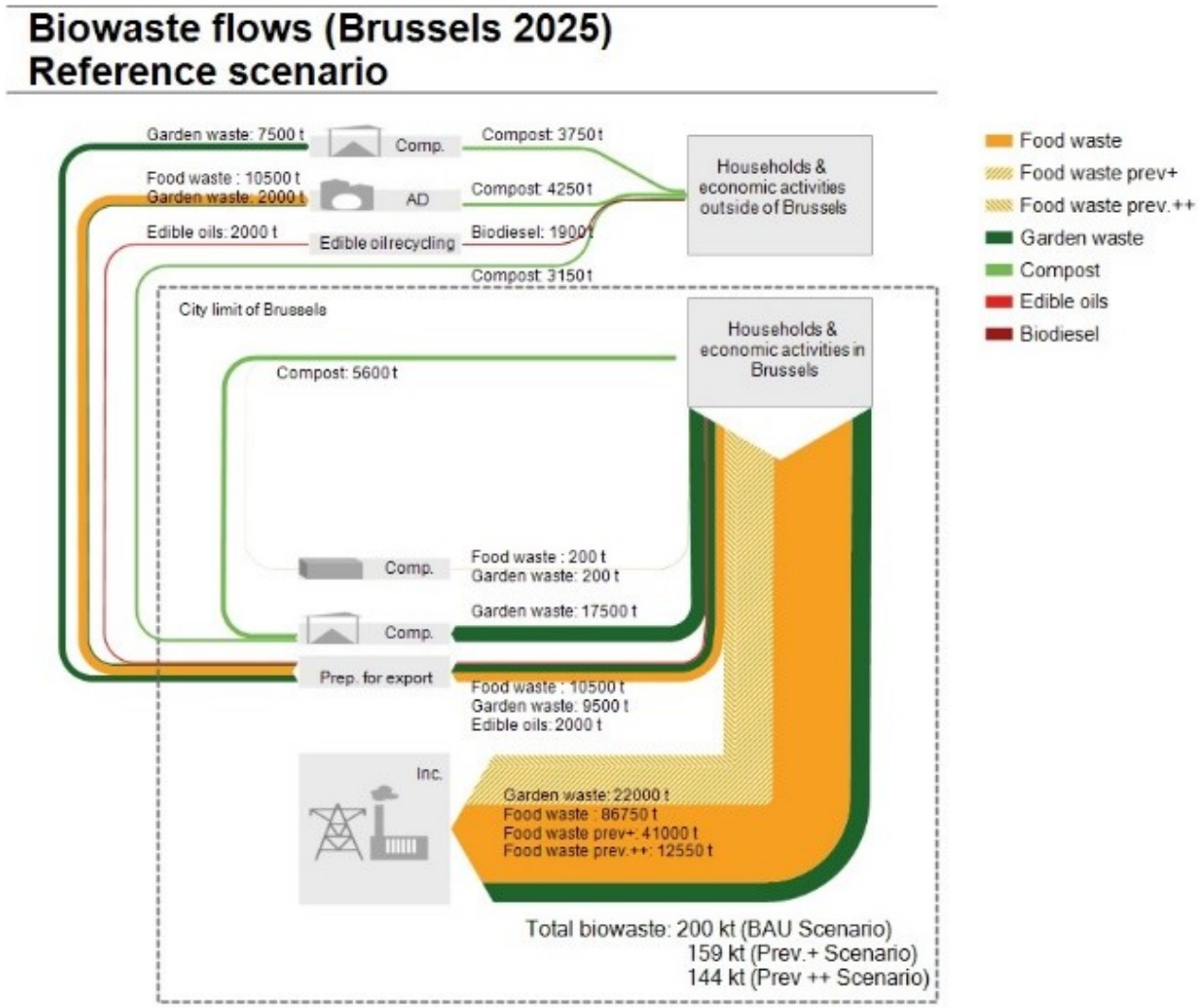
LCA and circularity of biowaste flows

- Follows the LC perspective & analyses environmental impacts and credits of all LC steps
- Whether ‘loops’ are closed locally/regionally or globally: via transport distances
- Positive effect of closing loops: substitution of fertiliser (positive effect), C sequestration
- Negative effects also considered

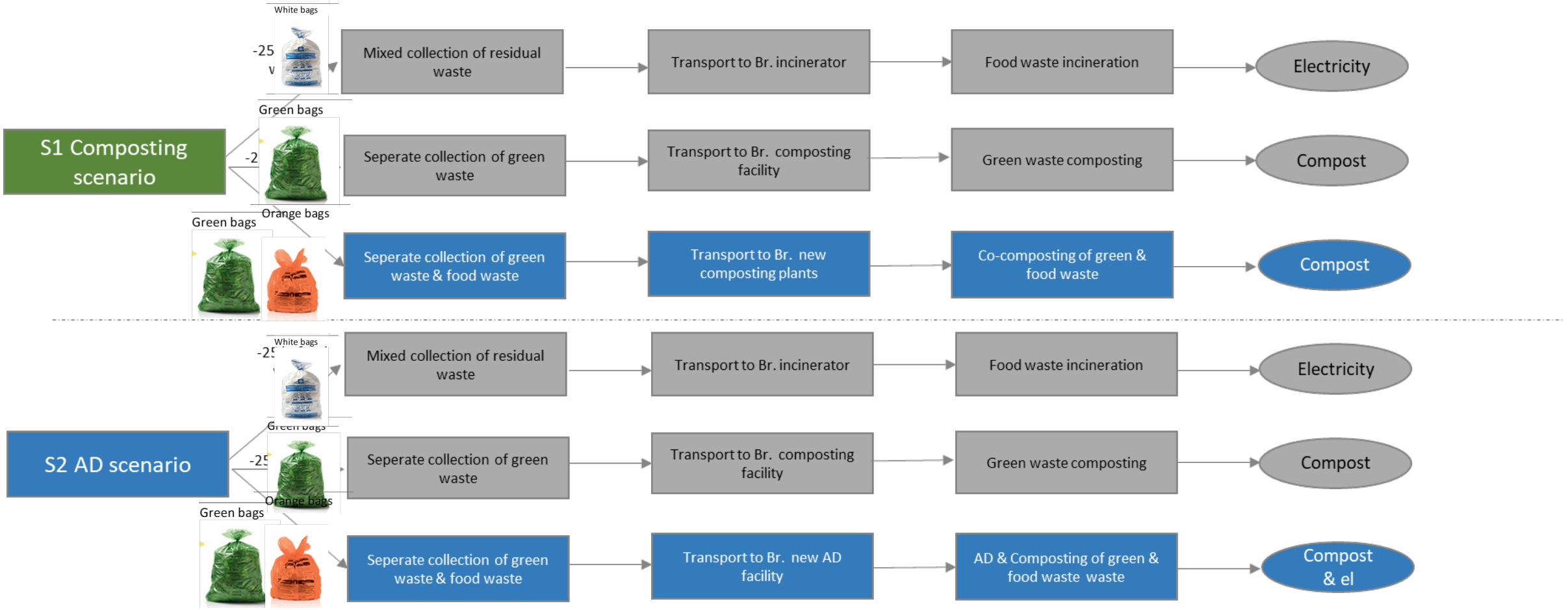


Product system & LCA method

- Study the flows that are supposed to change until 2025
- Potential analyses & discussion with policy makers: scenario of 50kt of biowaste
- Functional unit: Treatment of 50kt of biowaste
- Integrated solution for the management of green and food waste



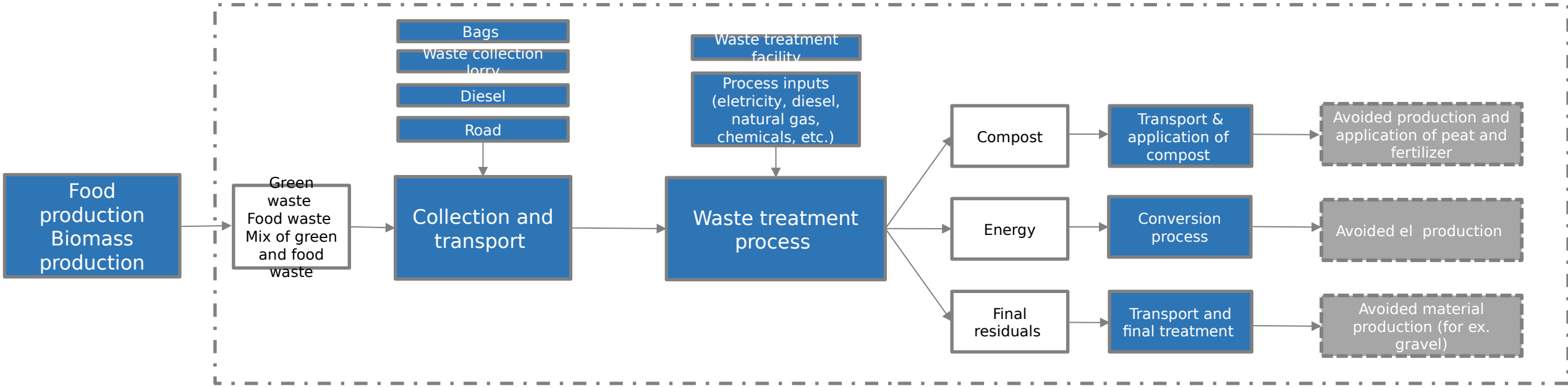
Product system & LCA method



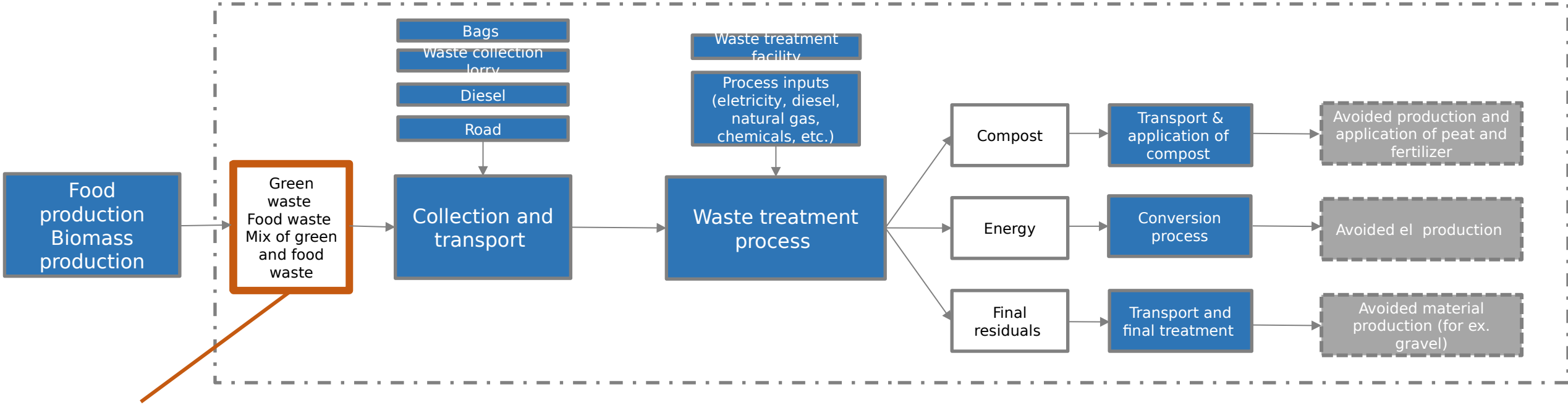
AD of food waste with post-composting of digestate with green waste

System boundaries

‘Bin to grave’ boundary

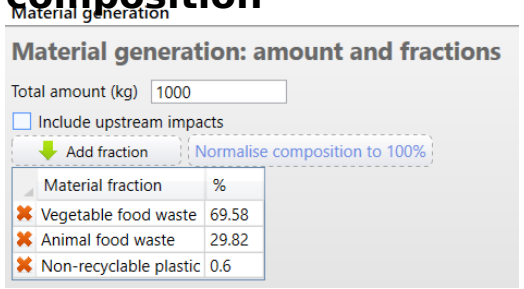


Data & models

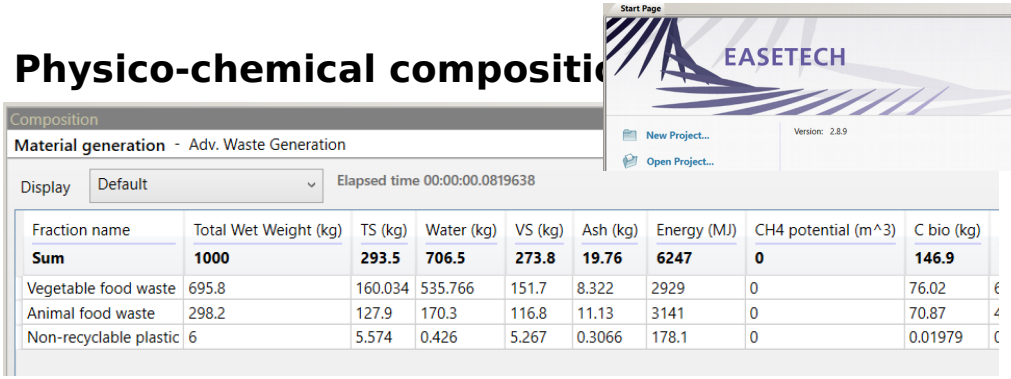


Local data:
Collection system & waste composition

Fractional composition



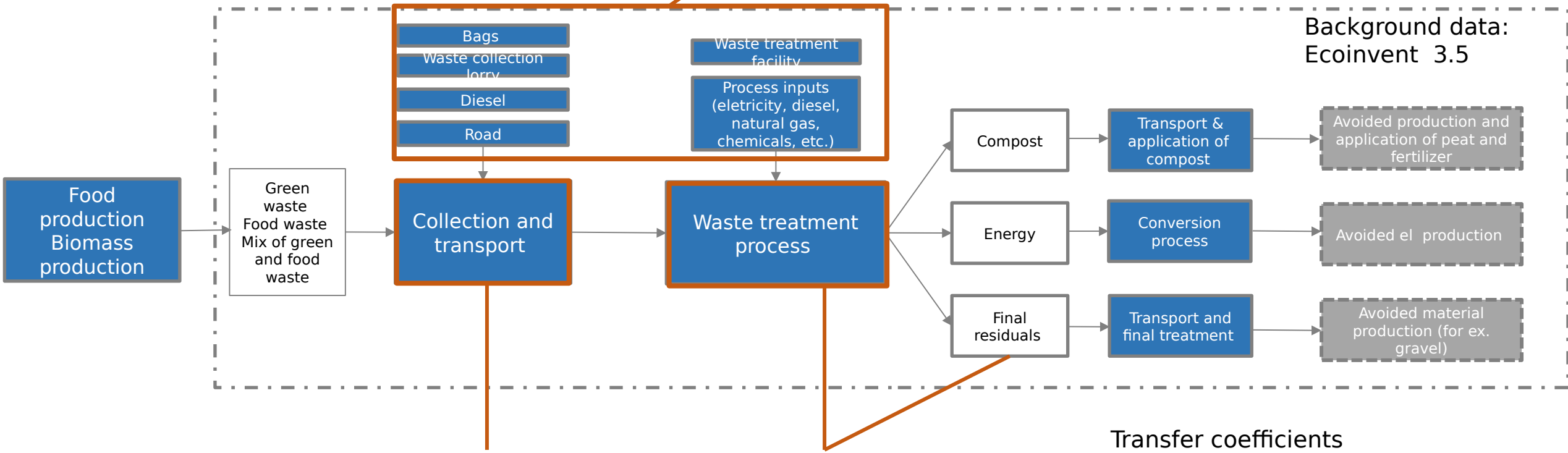
Physico-chemical compositi



Data & models

‘Bin to grave’ boundary

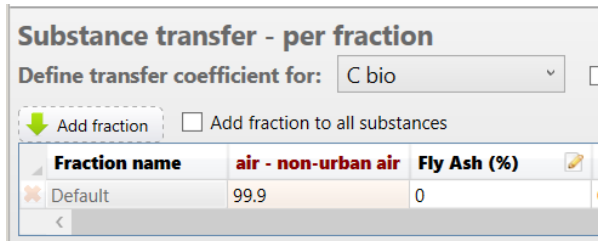
Background data:
Ecoinvent 3.5



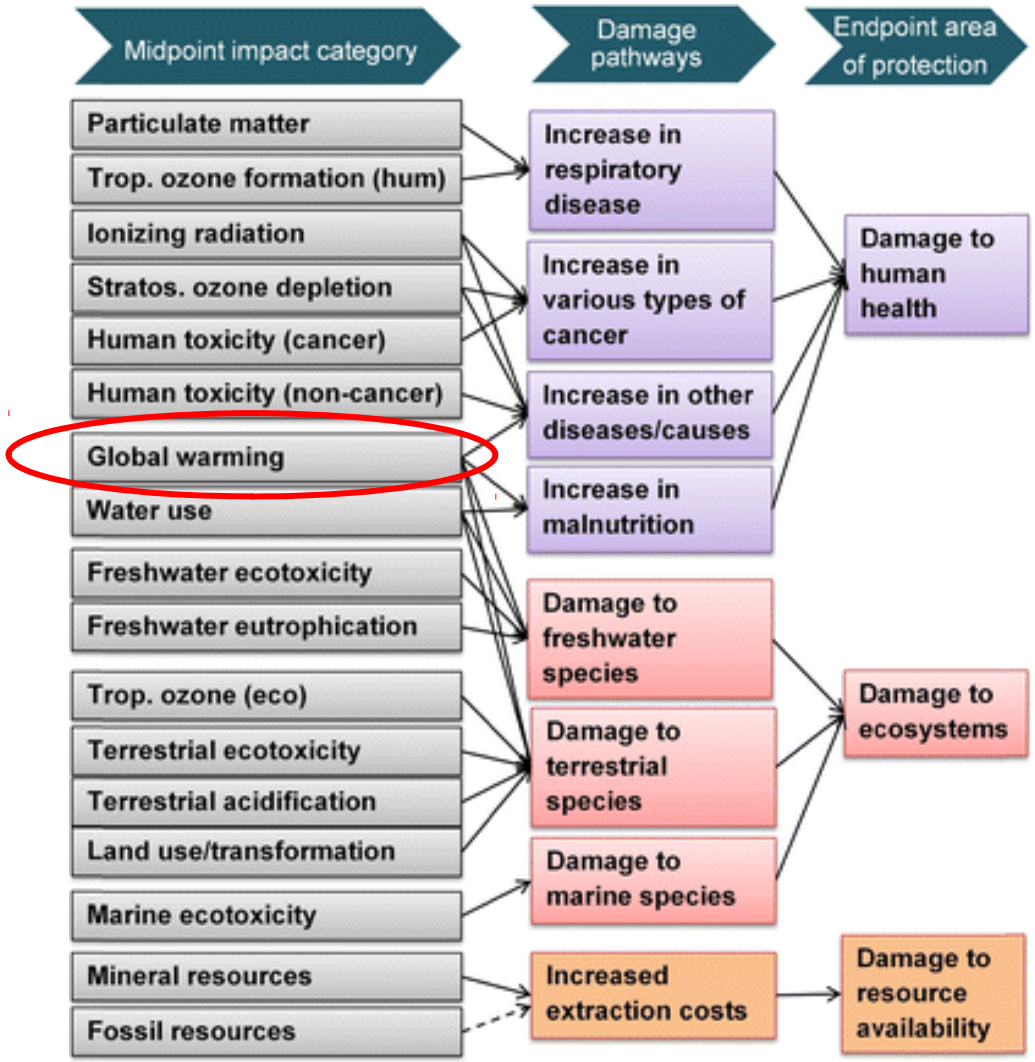
Local data:
Model for Brussels developed by KUL based on real transport data

Local data:
Input data from facilities & feasibility study

Transfer coefficients



Impact assessment



DALYs (disability adjusted life years), represents the years that are lost or that a person is disabled due to a disease or accident.

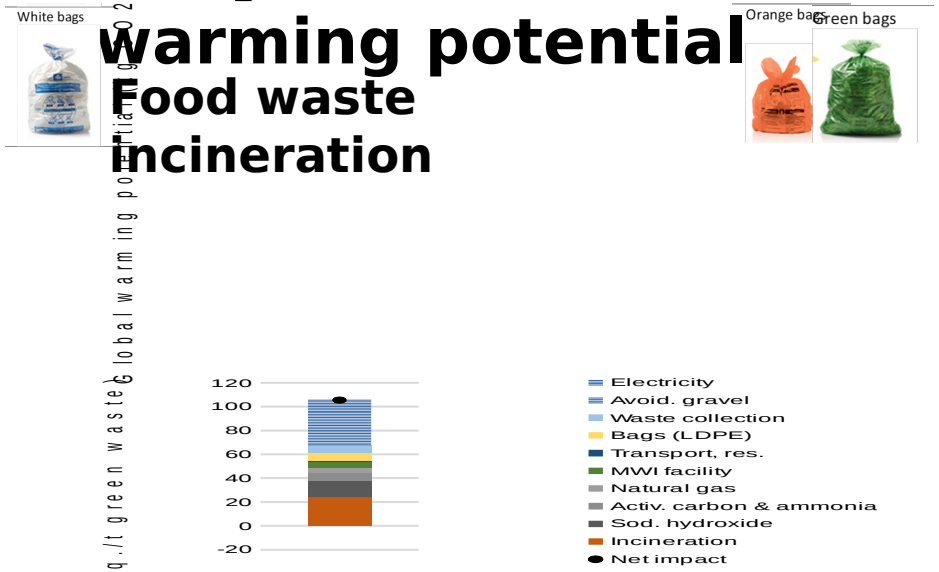
PDF: Potentially disappeared fraction of species•m2•year: local relative species loss in terrestrial, freshwater and marine ecosystems, respectively, integrated over space and time

The unit for resource scarcity is **dollars ($)**, which represents the extra costs involved for future mineral and fossil resource extraction

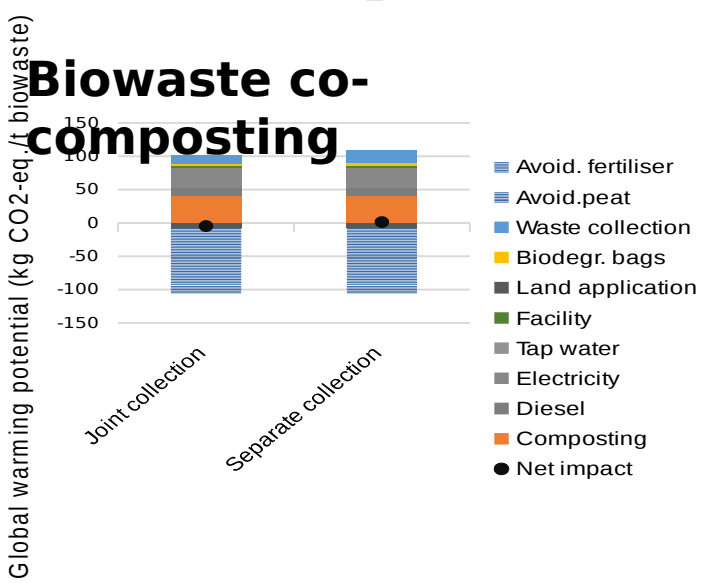
Huijbregts et al. 2017: ReCiPe2016: a harmonised life cycle impact assessment method at midpoint and endpoint level

Impact assessment at process level- global warming potential

Food waste incineration



Biowaste co-composting



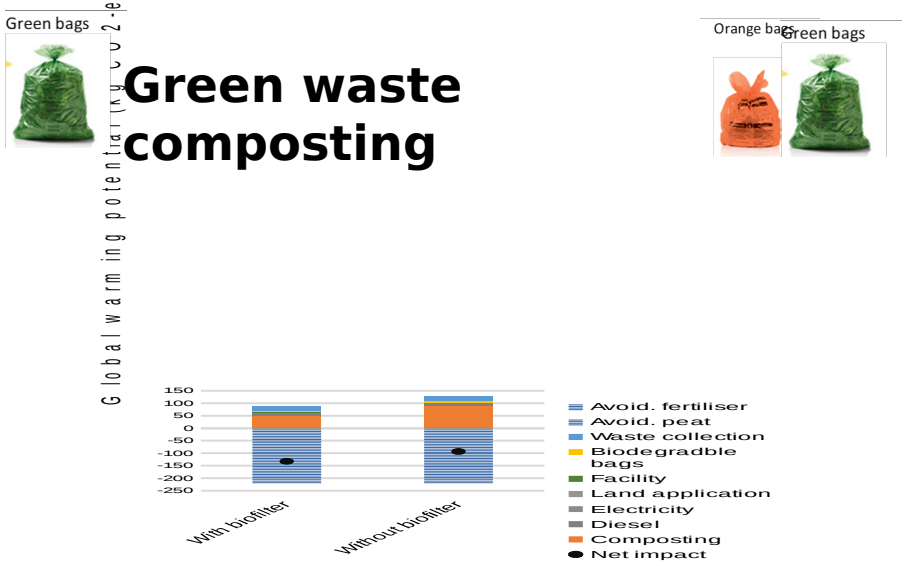
Main determinants:

Process emissions

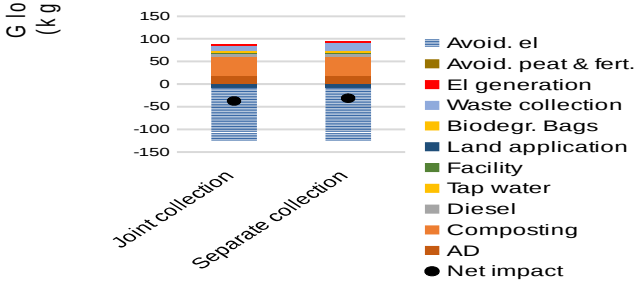
Peat & fertiliser substitution

Net result

Green waste composting

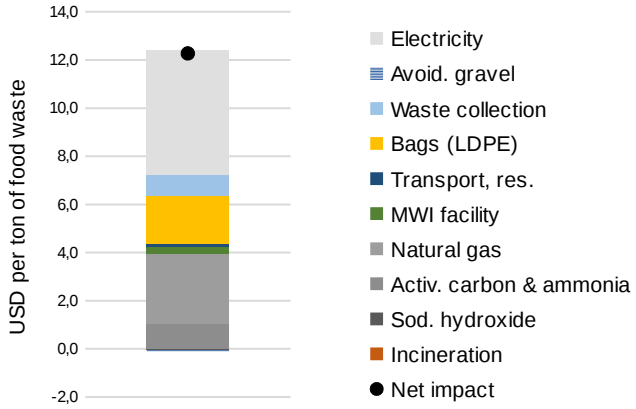


Anaerobic digestion



Impact assessment at process level- resource use

Food waste incineration



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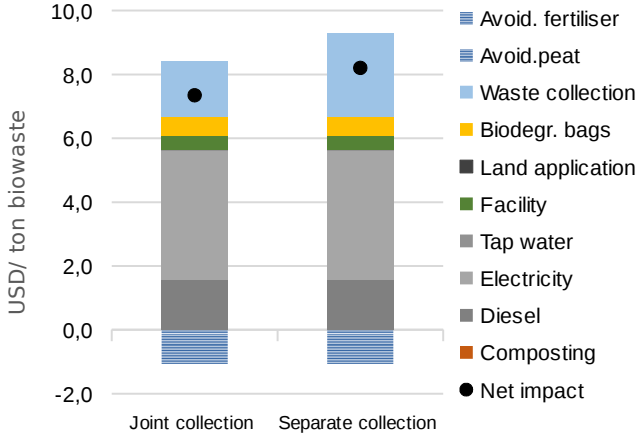
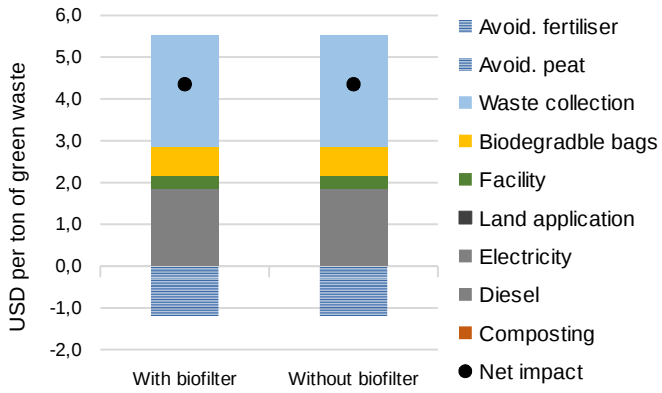


Green waste composting



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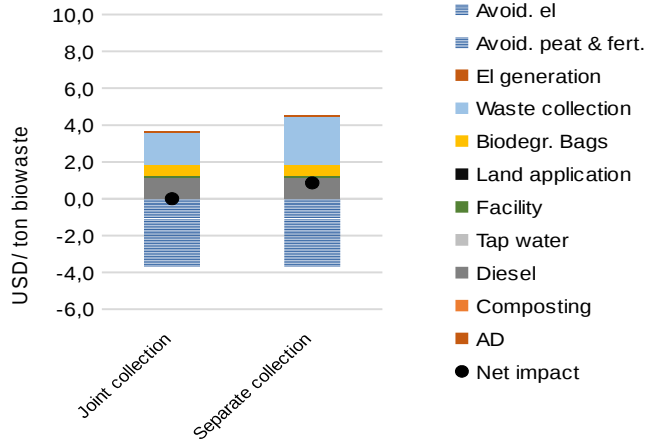
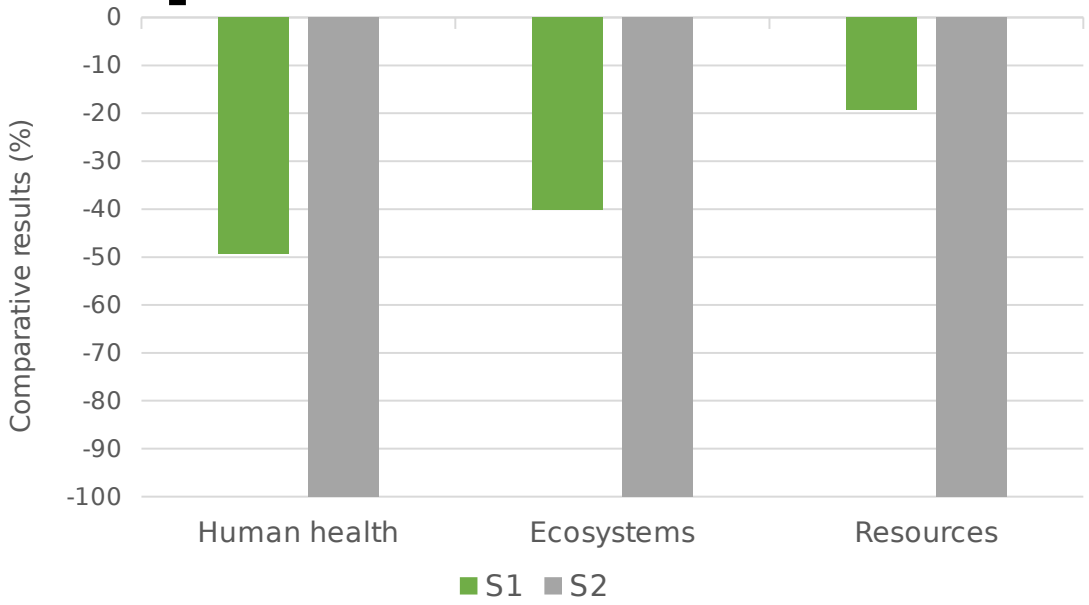


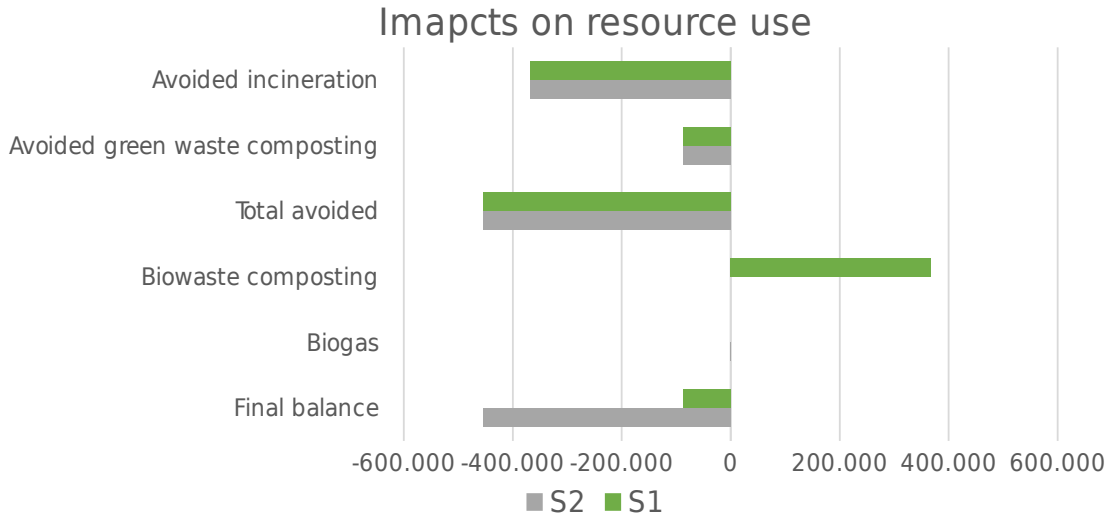
Main determinants:

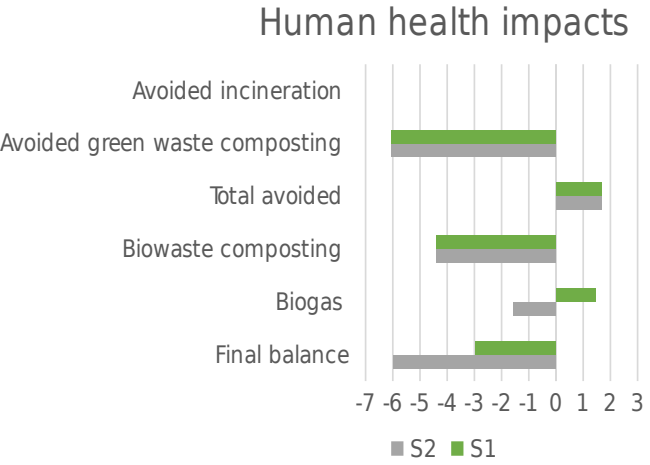
- Process inputs
- Waste collection
- Bags
- Peat & fertiliser substitution
- Electricity
- Net result

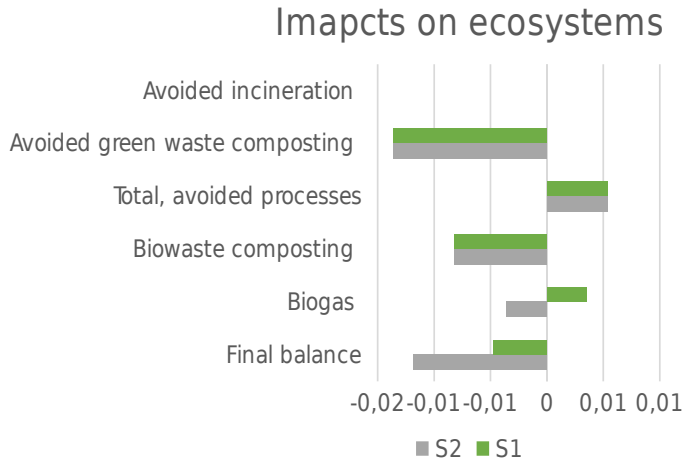
Impact assessment - scenarios

S1: composting
S2: AD









High potential for impact reduction in both scenarios

Discussion of key parameters- sensitivity

1. Compost yields & peat substitution

- Based on the current market conditions- private costumer in Brussels
- Depending on the price of the compost an agricultural application without peat substitution could also occur in the future
- → sensitivity analysis

2. Integrated modelling of impacts on the MSW incineration process- **electricity credit**
- Based on the physical reality on the incinerator

→ sensitivity analysis with varying electricity mixes

3. **Fugitive methane**
- Fugitive methane emissions may vary between 1% to 5%
- → sensitivity analysis

Conclusions & outlook

- Improvement potentials: bags collection, collection system
- Clear advantage for more circular solutions
  - Substitution effects: fertiliser & peat
  - Long term C-sequestration
  - Energy credit for avoided incineration
- Limits for the use at city scale: use of compost in gardens & parks is not a solution to close agricultural nutrient cycles
- LCA can provide a comprehensive assessment of biowaste management, but can not cover all environmental relevant aspects
  - Odour
  - Quality aspects of compost
  - Plastic impurities
- Decentral solutions & role of prevention
- Life cycle costing

Thank you for your attention

CONTACT INFORMATION

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