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Öko-Institut e.V.
Institut für angewandte Ökologie
Institute for Applied Ecology

Black Soldier Fly facilities in temperate and cold climate – important factors to be a climate friendly alternative in waste management

Workshop: Opportunities in Waste Sector and Agriculture: Animal Feed from Organic Waste, the climate-friendly Way - Black Soldier Fly

Online event, 16/05/2022

Project Overview

Identification of criteria for other high-quality recycling of organic waste
(Ermittlung von Kriterien für hochwertige anderweitige Verwertungsmöglichkeiten von Bioabfällen)

Project duration: 24/04/2018 – 31/10/2020

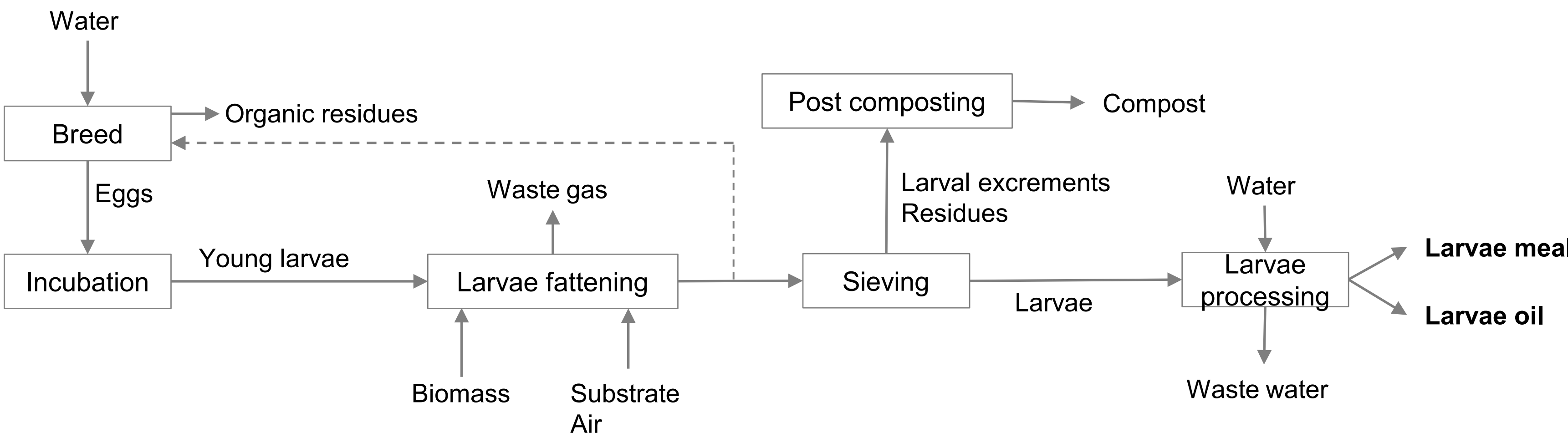
Project consortium: Öko-Institut e.V. Institut für angewandte Ökologie Institute for Applied Ecology; u.e.c. BERLIN

Funded by the German Environment Agency (UBA)
(FKZ 3717 34 341 0)

Umwelt Bundesamt

Black Soldier Fly Larvae – Process Profile

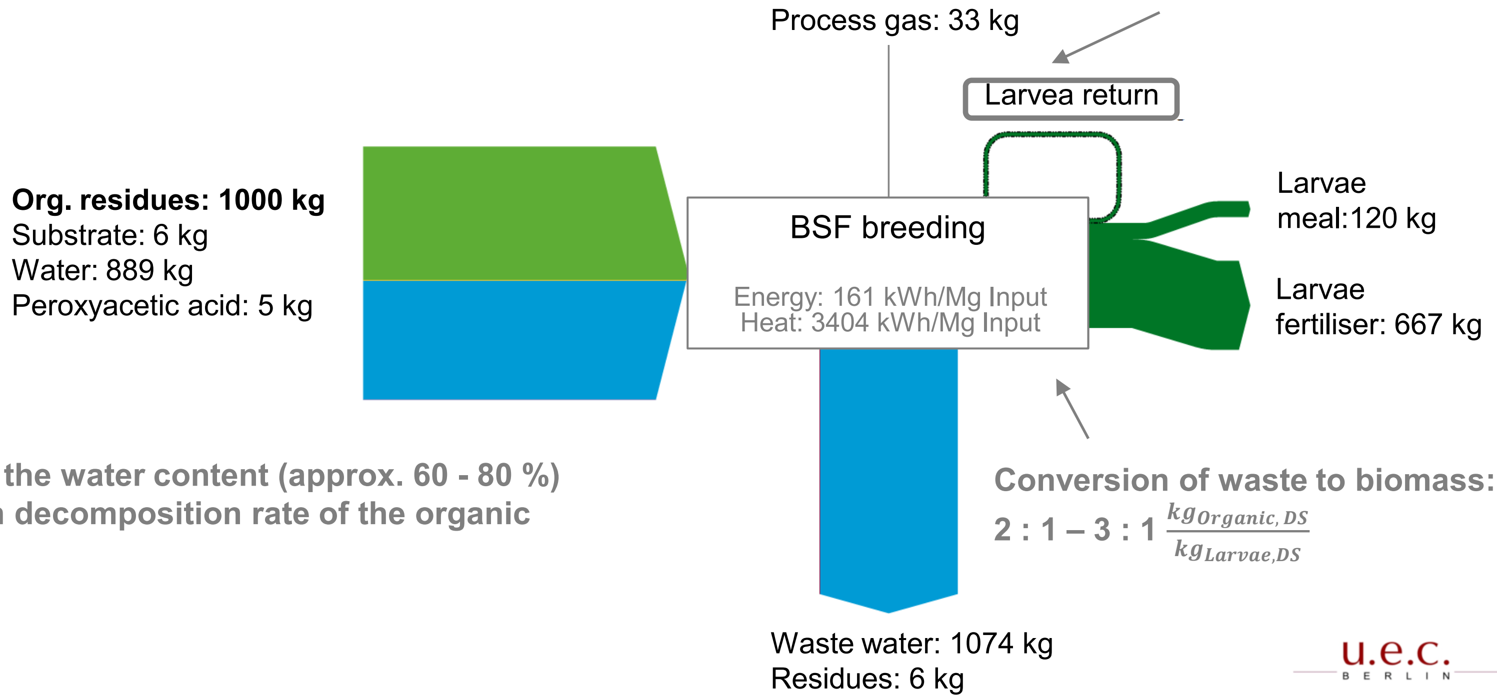
Use of biomass-containing waste for breeding black soldier fly larvae



Temperature	Air humidity	Light exposure	Cycle duration
28 – 30 °C	Approx. 60 %	Min. 500 W/m^2	Approx. 30 d

Suitable input materials: Organic waste (kitchen and food waste), organic residues from industry / agriculture

Black Soldier Fly Larvae – Mass Balance



Maintaining a sufficiently large population of reproductive flies

Adjustment of the water content (approx. 60 - 80 %) ensures a high decomposition rate of the organic waste.

Conversion of waste to biomass:
$$2:1 - 3:1 \frac{kg_{Organic,DS}}{kg_{Larvae,DS}}$$

- **Challenges: Hygiene is very important!** Feed law restricts economic breeding
- Material recovery
  - Larvae meal as feed (permitted in EU for aquaculture)
  - decomposed waste and larval rot as compost

Black Soldier Fly Larvae – State of Development

State of development and plants

- In Germany, there are only smaller plants in operation so far; internationally, there are a small number of plants on an industrial scale; R&D is going on
- Lack of assessment of the impact of economic breeding on the biological activity of the soldier fly and interactions with the environment
- Examples of plants:

Company	Location	Substrate	Capacity
AgriProtein	South Africa	Household waste	91,000 Mg/y
Enterra Feed	Langley, Canada	Biowaste	36,000 Mg/y
Hermetia	Germany	Rye grist	350 Mg Larvae meal/y
Nextprotein	France/Tunesia	Food waste	5-10 Mg/d

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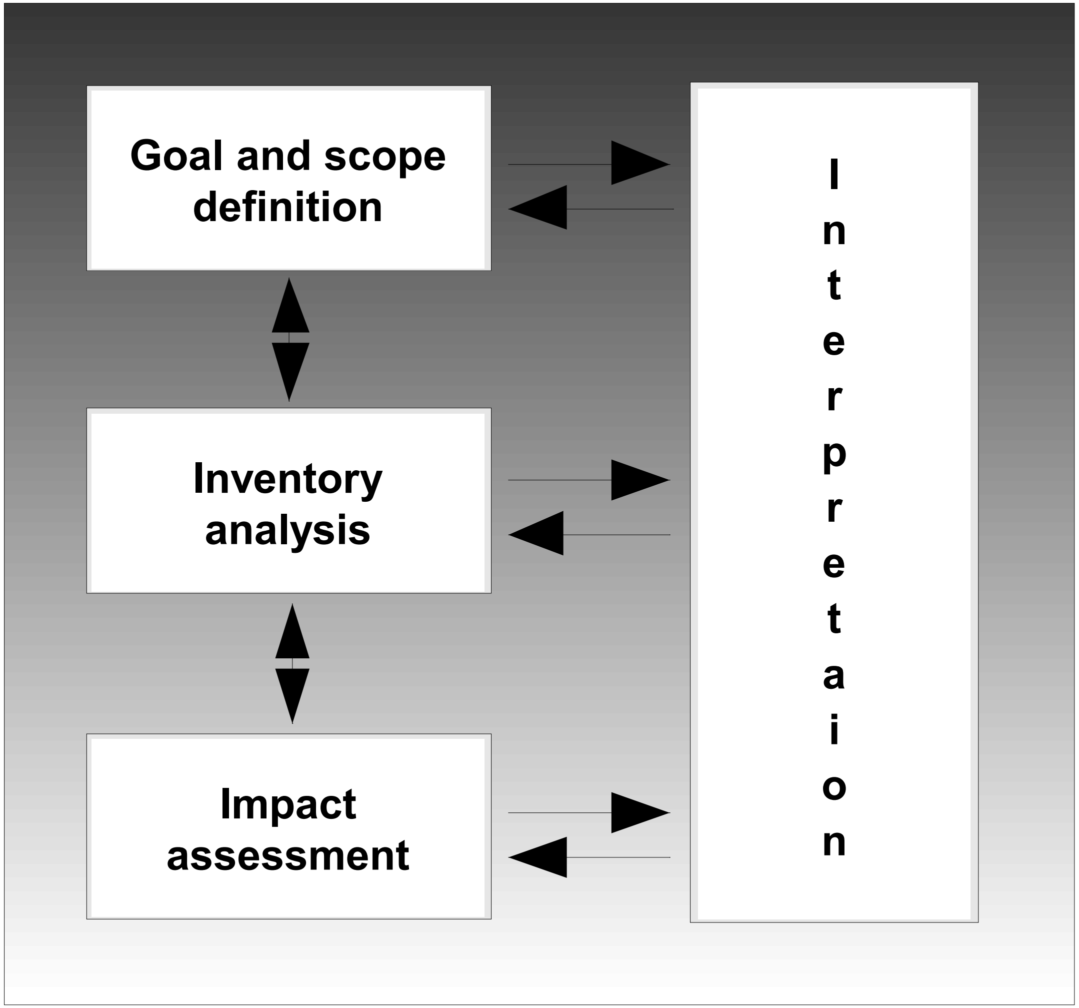
Phases of LCA Studies



1. Goal and scope definition
2. Inventory analysis
3. Impact assessment
4. Interpretation

Double arrows stand for an iterative approach

Brief description of the individual steps

1. **Goal and scope definition**
   Definition of the goal and the scope of the study

2. **Inventory analysis**
   Compilation of environmentally relevant inputs and outputs

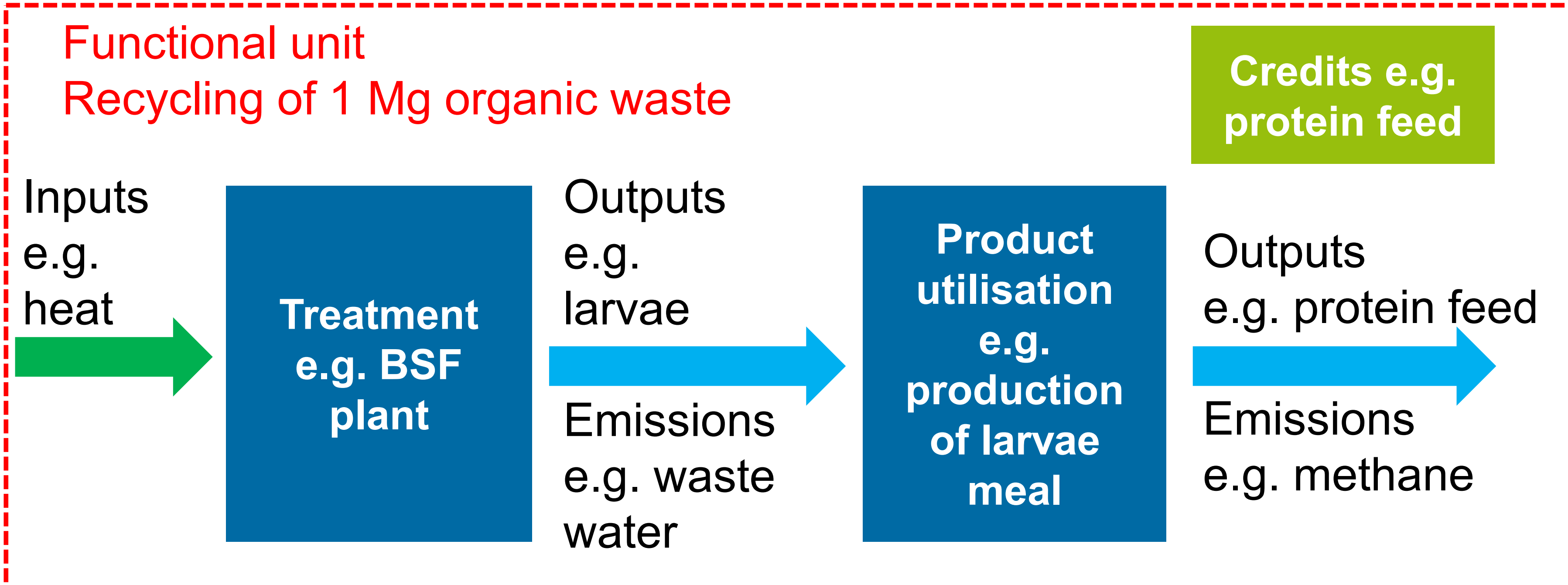
3. **Impact assessment**
   Assessment of the potential environmental impacts and weighting of the different impact criteria against one another (optional).

4. **Interpretation**
   Summary of the results of the life cycle inventory and the impact assessment according to the goal definition.

Basics of BSF LCA I

- Average electricity mix of Germany in 2020
- Biogenic CO_2 was not accounted for
- Inventory data from procedure description

Scope



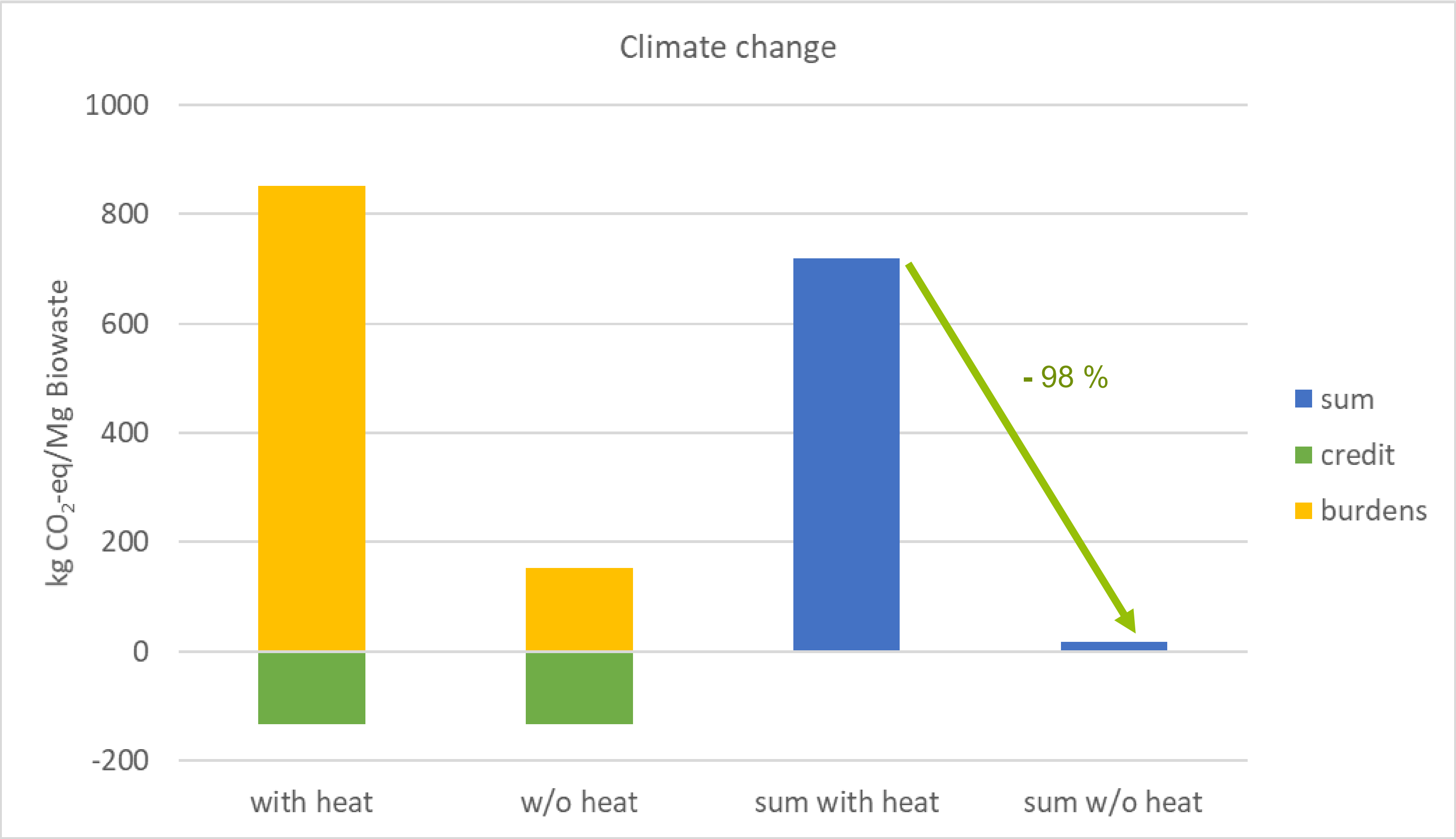
Basics of BSF LCA II

- Database ecoinvent 3.4 APOS
- Impact assessment method ReCiPe 2016 Midpoint (H)

Impact categories

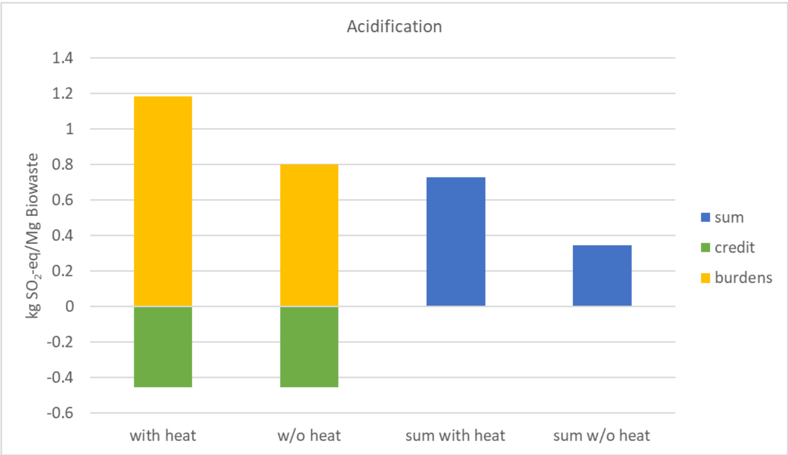
- Climate change (GWP in kg CO_2-eq)
- Terrestrial Acidification (AP in kg SO_2-eq)
- Freshwater Eutrophication (EP in kg P-eq)
- Ozone formation (POCP in kg NO_X-eq)
- Terrestrial Ecotoxicity (in kg 1,4-Dichlorbenzol (1,4-DCB))
- Fossil resource scarcity (in kg oil-eq)
- Mineral resource scarcity (in kg Cu-eq)
- As separate method: CED (Cumulate Energy Demand, fossil) (in MJ))

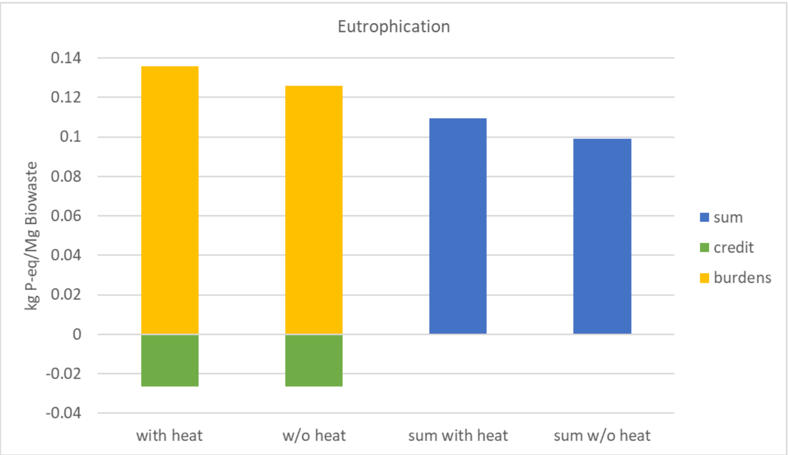
LCA results – Climate change

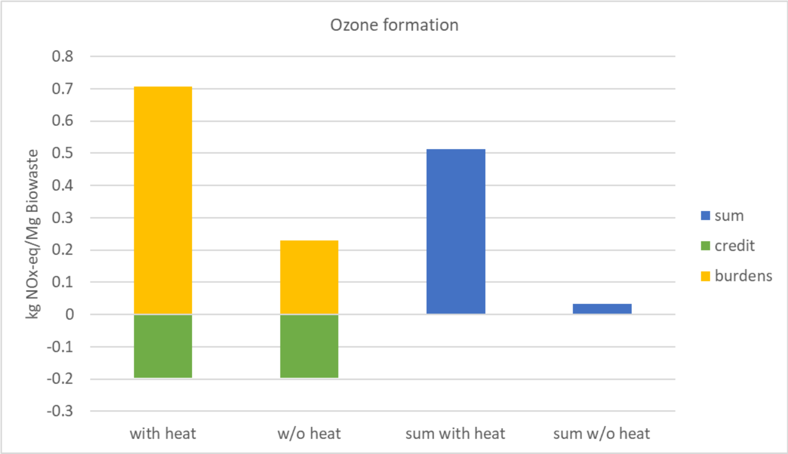


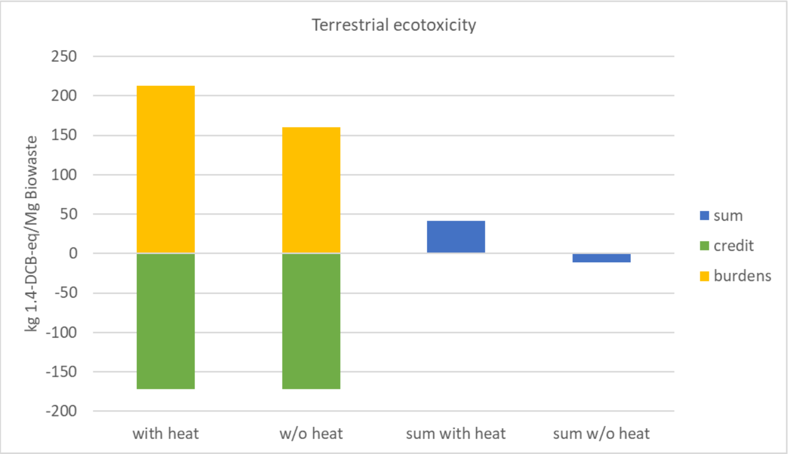
Composting: 25 kg CO_2-eq/Mg biowaste
Biogas plant: -75 kg CO_2-eq/Mg biowaste

LCA results – Acidification, Eutrophication, Ozone Formation, Terrestrial Ecotoxicity









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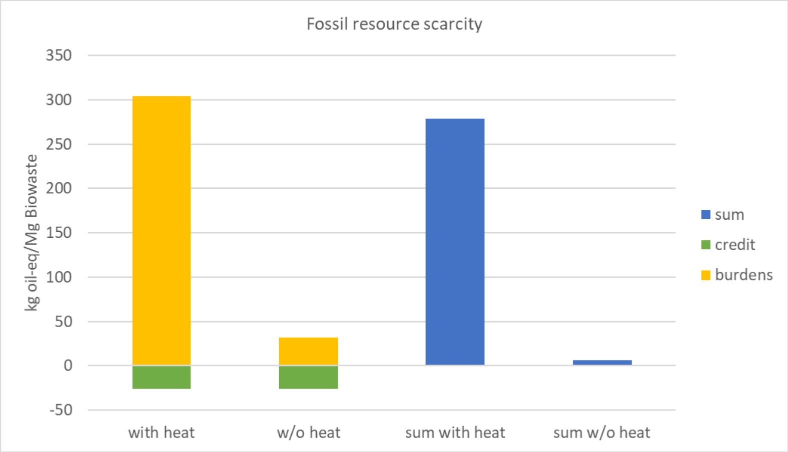
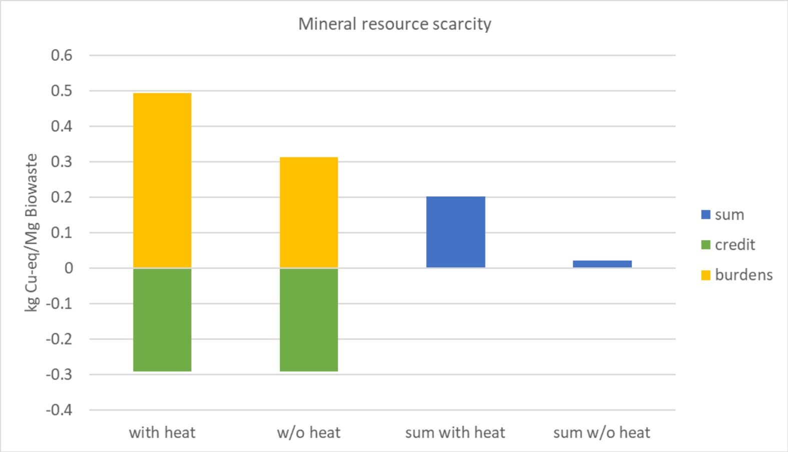
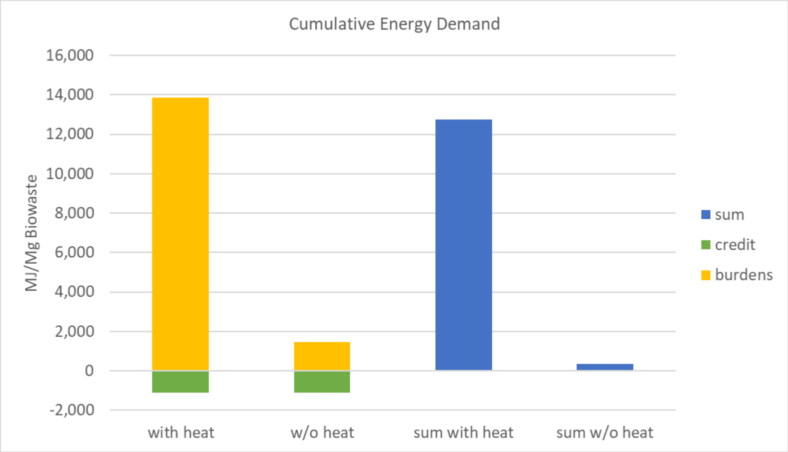
LCA results – Fossil Resource Scarcity, Mineral Resource Scarcity, Cumulative Energy Demand







Conclusion

Soldier fly larvae represent a promising process, if at least one of the following options is possible

- the high demand for heat can be met from process waste heat
  - → choice of a suitable location e.g. near a MSW plant or a biogas plant with CHP to use waste heat
- sufficient insulation of the building envelope
- use of renewable energies for heat supply e.g. solar thermic installations

Thank you very much for your attention