Residual biomass can be converted to edible ingredients, but with limited environmental benefits

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1 Context: “Waste-to-nutrition” pathways

What ?
Transforming unused or underused organic streams into food and feed

Why ?
- ❑ Decoupling food production from arable land
- ❑ Shorten nutrients cycles

Problem ?
- ❑ Uncertain scaled performances
- ❑ Residual biomass is constrained
- ❑ Unharmonized existing assessments

Where to start?
- ❑ Review of technical possibilities
- ❑ Prescreening of the most promising options

Insects biorefinery (BSF)

Microbial proteins (MP) production

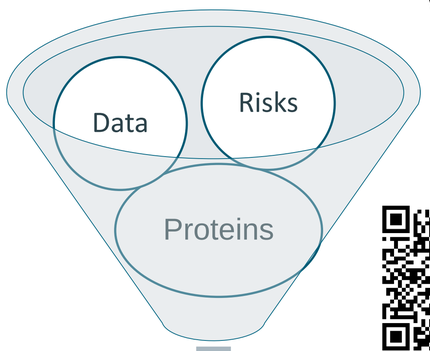
Solid fermentation (SSF)

Green biorefinery (GB)

Mycoproteins production (Myco)

Challenge: all involve different unit operations, suitable feedstocks, interactions with feed and non-feed services

950 Waste-to-nutrition pathways (Javourez et al., 2021)



5 selected pathways (**15** variants)

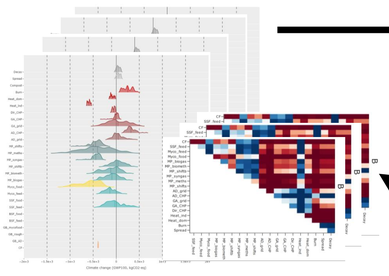
Credits: Unibio, Green Spot Technologies, Aarhus facilities (own photo), Nature’s Fynd, unsplash.com. Icons: Flaticon.com and Freepick.com

2 Method: Life Cycle Assessment (LCA) & Global Sensitivity Assessment (GSA)

Objective: Unravel under which conditions implementing the selected pathways generate net environmental benefits

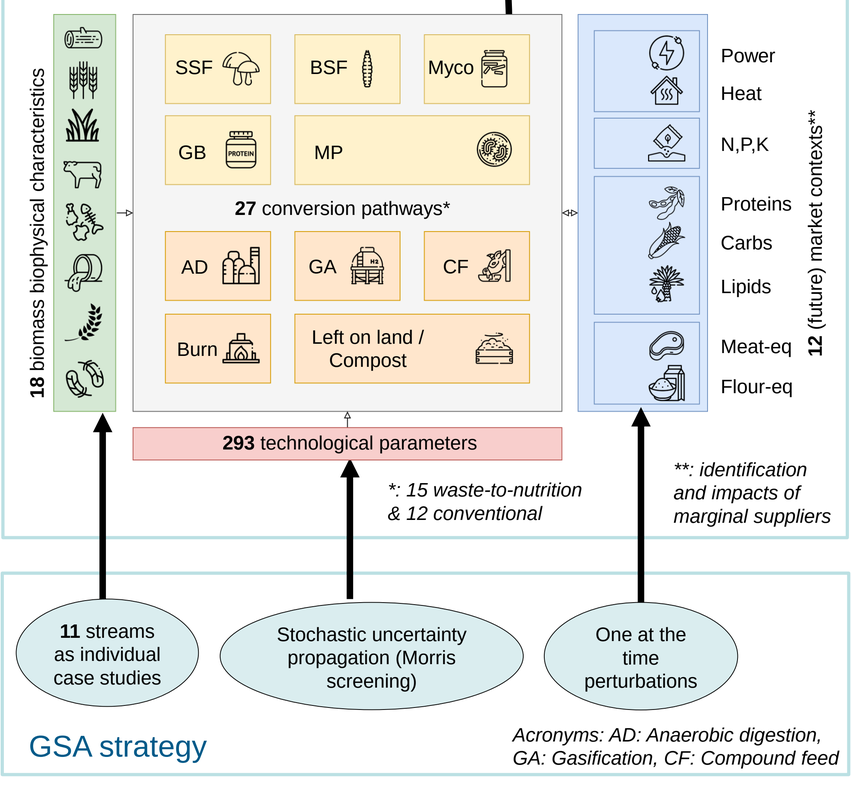
LCA results analysis

Functional unit: “Managing one tonne per year of a given residual stream”



Key outputs
- ❑ Forecasted range of scaled environmental performances
- ❑ Pathways ranking
- ❑ Key parameters with quantitative thresholds conditioning performances
- ❑ Enabling markets conditions
- ❑ Available for climate change, land use, water use, freshwater and marine eutrophication

Consequential LCA model

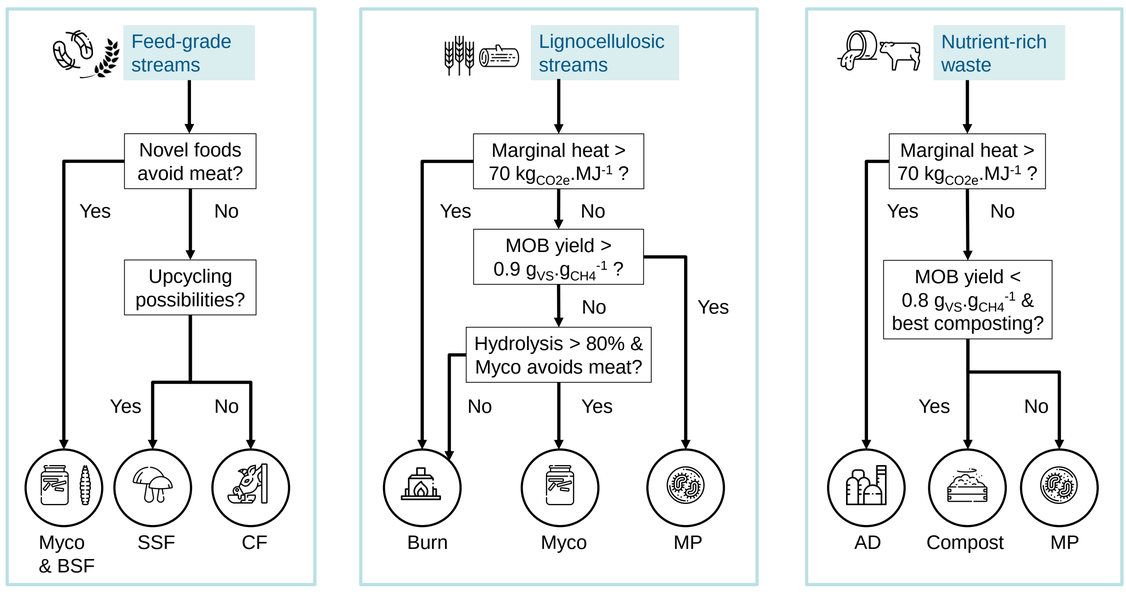


3 Key results

Detailed analysis in a PhD thesis available upon request (Javourez, 2023)

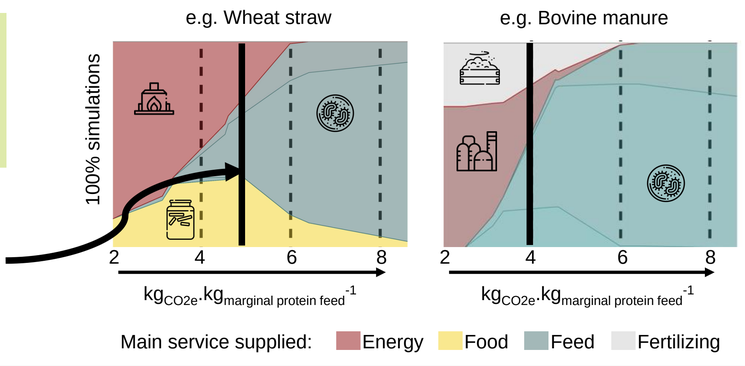
To ensure environmental benefits:
- ❑ Availability of renewable power and heat supplies are prerequisite
- ❑ Meat substitution by insects and mycoproteins is a prerequisite

Best environmentally performing pathways as a function of input stream’s type



Best pathways for climate change depend on future conventional protein feed production performances

Tipping point over which MP production becomes the best option even with suboptimal performances



3 Take home

- ❑ Residual biomass is no free lunch, unless directly edible
- ❑ Waste-to-nutrition pathways are adaptation, not mitigation strategies
- ❑ Substituting conventional food ingredients matters more than process eco-design

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