



Decision Support System for Insects Production

Anita Bhatia, N. Mouhrim, A. Green,
D. Peguero, A. Mathys, A. Tonda, V. Heinz and S.
Smetana

Prof. Dr. Sergiy Smetana
Head of Department Food Data Group
DIL e. V., D-49610 Quakenbrück, Germany

Institute of Food Quality and Food Safety,
University of Veterinary Medicine Hannover,
Foundation



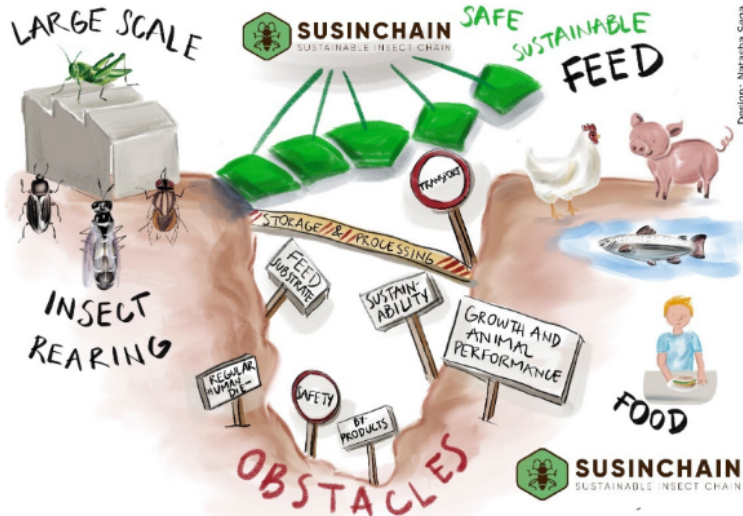
75th EAAP Annual Meeting
Florence – Italy

SUSINCHAIN online tool



SUSINCHAIN Decision Tool [Home](#) [Tool](#) [Feedback](#)

<http://susinchain.herokuapp.com/index>



Susinchain Tool

This calculation and recommendation tool has been developed by DIL e.V. in the scope of SUSINCHAIN project in 2021. It allows to calculate the approximate environmental impact in four categories of global warming potential (GWP), non-renewable energy use (NRE), Land use (LU) and Water use (WU). Additionally it provides the estimation on the potential cost of such production, in euro according to the prices in 2021. The tool is intended for the use by the companies and start-ups dealing with the insect mass rearing for food and feed. By using the tool, insect stakeholders can estimate the production impacts and costs at the design stage and identify the improvement strategies

Authors

Anita Bhatia, Sergiy Smetana

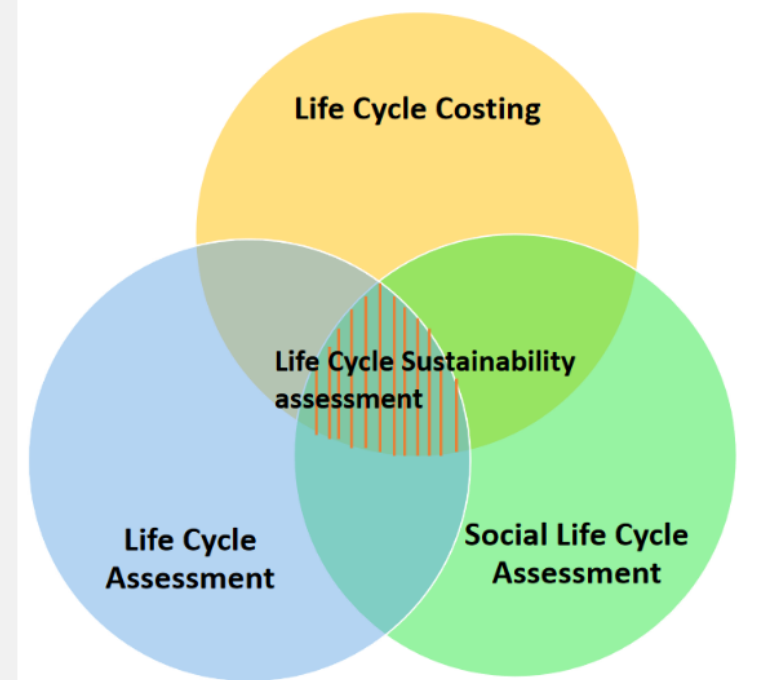
References

- Jolliet, O., Margni, M., Charles, R., Humbert, S., Payet, J., Rebitzer, G., & Rosenbaum, R. (2003). IMPACT 2002+: a new life cycle impact assessment methodology. The international journal of life cycle assessment, 8(6), 324-330.
- Bulle, C., Margni, M., Patouillard, L., Boulay, A., Bourgault, G., De Bruille, V., ... Jolliet, O. (2019). IMPACT World+: a globally regionalized life cycle impact assessment method. The International Journal of Life Cycle Assessment <https://doi.org/10.1007/s11367-019-01583-0>

[Click here for tool](#)



SUSINCHAIN
SUSTAINABLE INSECT CHAIN



Methodology

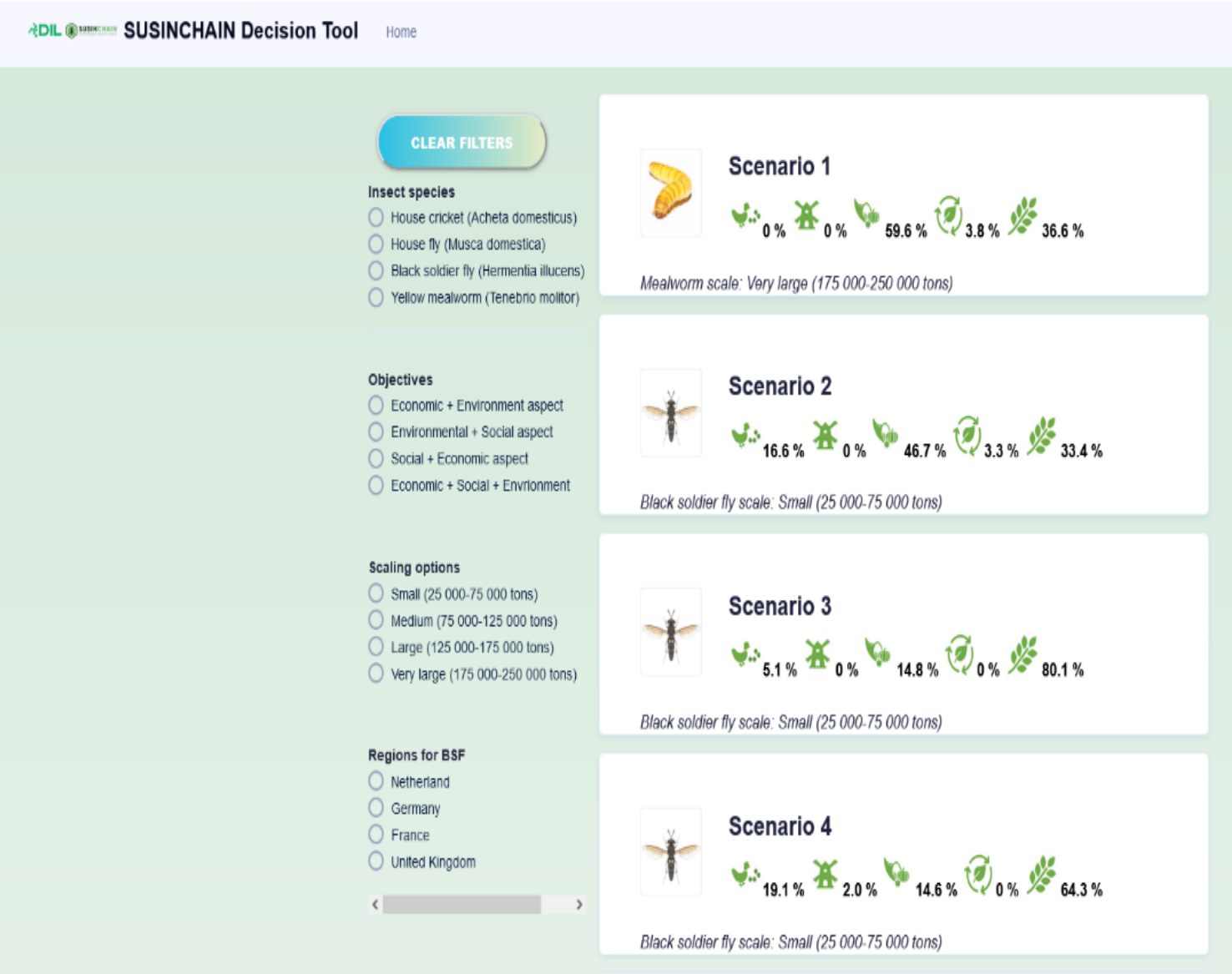
- The tool is based mainly on IMPACT 2002+ LCIA Methodology (Jolliet et al., 2003) for the calculation of environmental impacts.
- The costs of activities were calculated based on publicly available prices.
- Water use (water scarcity) was calculated using IMPACT WORLD+ methodology (Bulle et al., 2019)



SUSINCHAIN Decision Tool

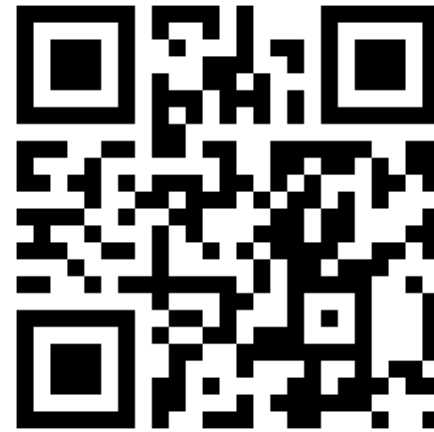
This study has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no 861976 project SUSINCHAIN.

Online Industrial DSS



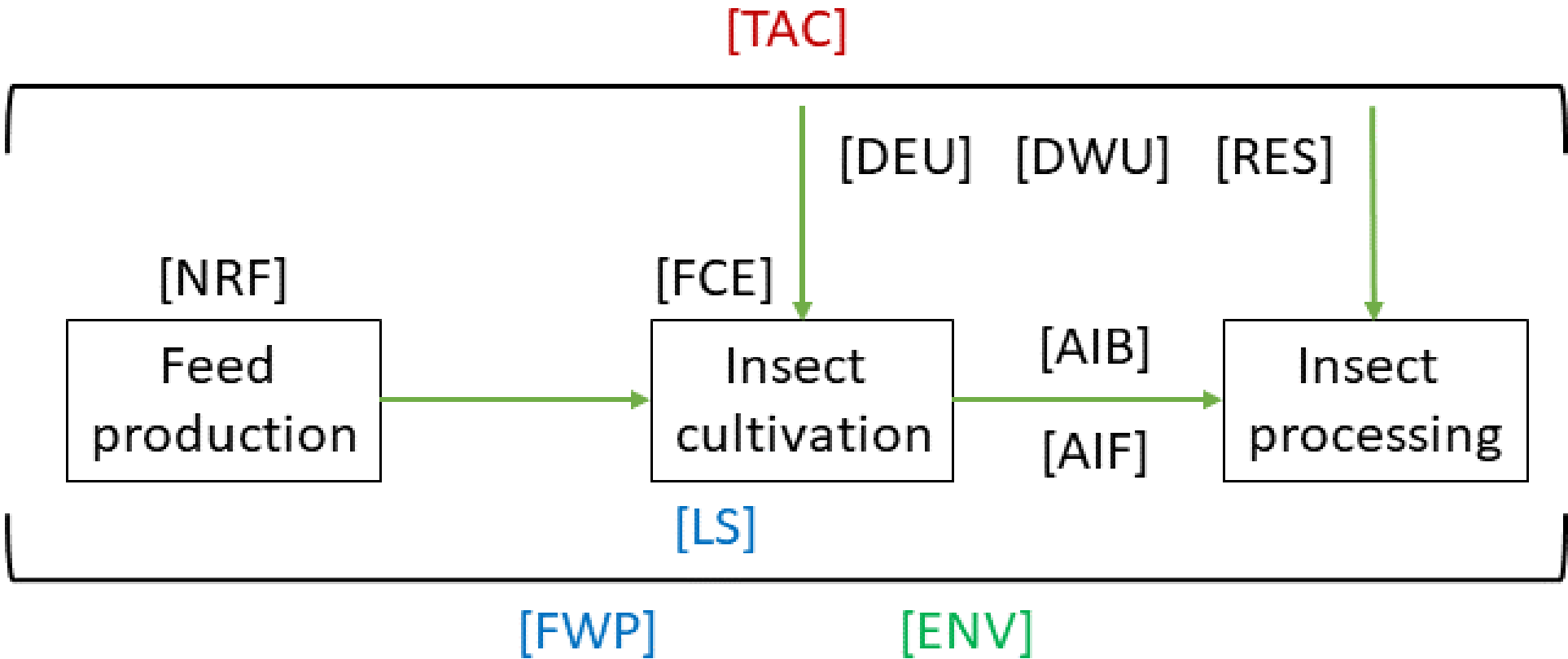
**Gap resolution in sAfeTy, NuTriTional,
aLLergeniciTy and Environmental
assessments to promote Alternative Protein
utilization and the dietary**

HORIZON EUROPE
€ 11.9 Million
01.09.2022 – 31.08.2026
COORDINATOR
STICHTING WAGENINGEN RESEARCH



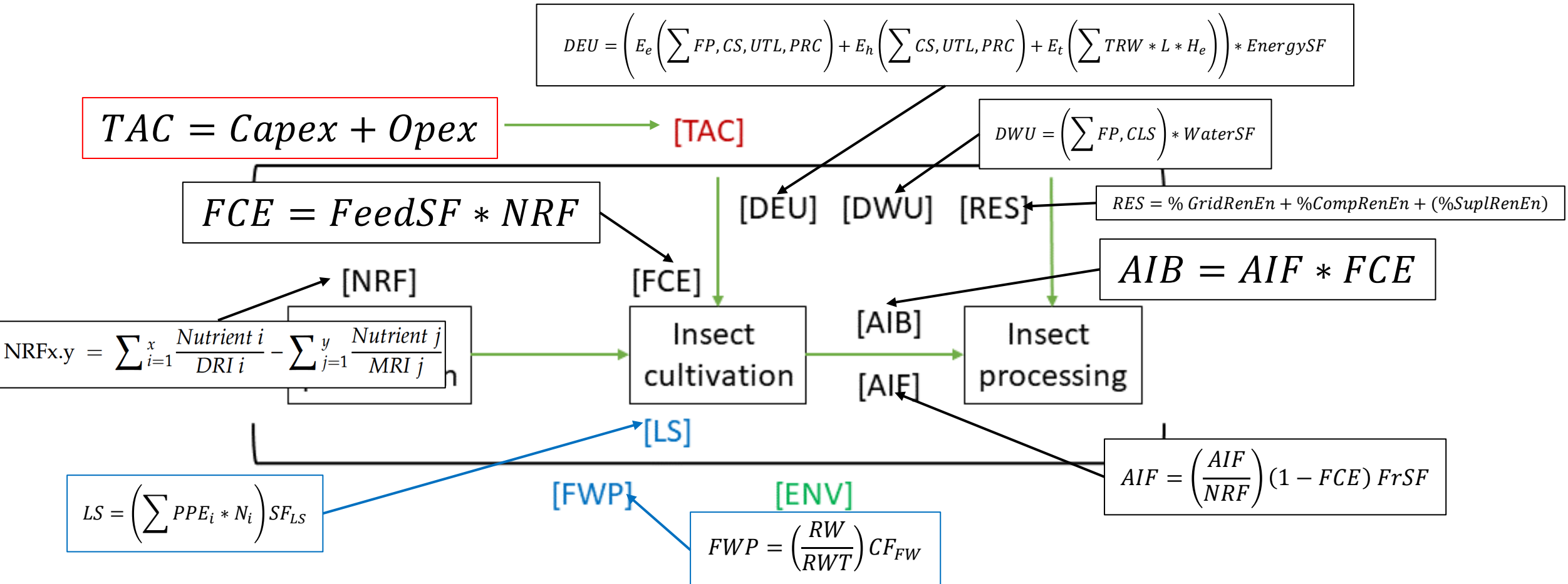
Faba bean	Lentil	Oat	Quinoa	Rapeseed	Microalgae	Single-cell proteins	Crickets	Cultured beef
								

Key factors identified for Multi-Objective Optimization (MOO)



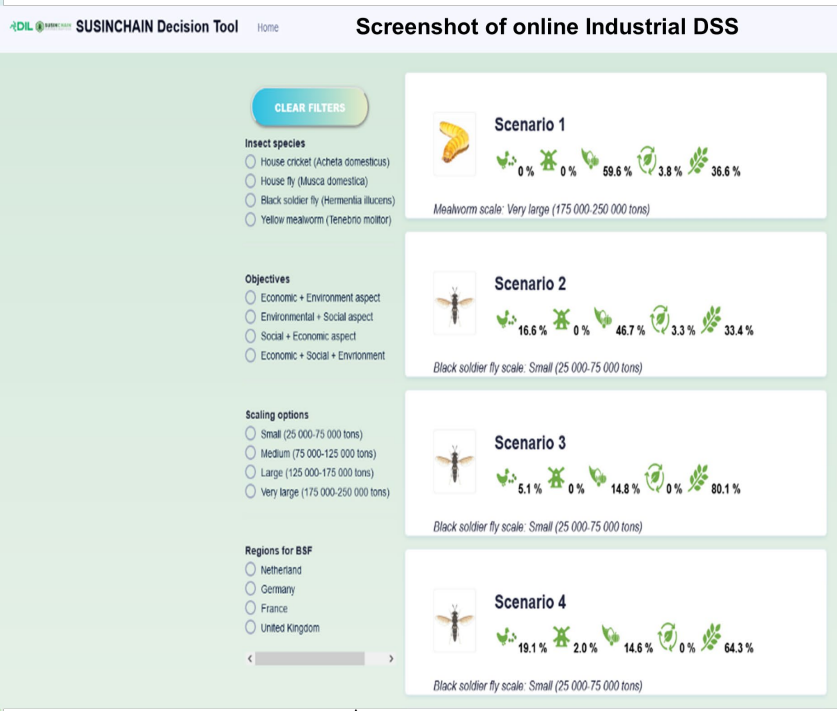
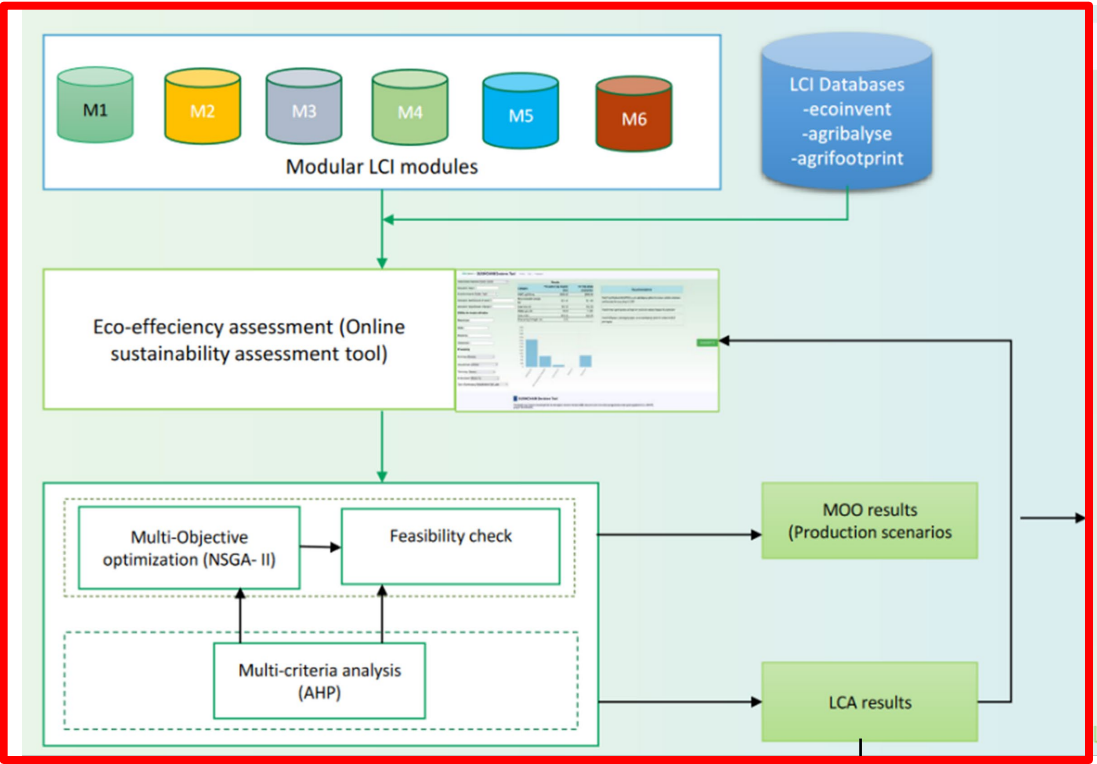
Criteria is in square brackets, red – economic, green – environmental, blue – social, black – applicable to a few aspects; AIB – amount of insect biomass; AIF – amount of insect frass; DEU – direct energy use; DWU – direct water use; ENV – integrated environmental impact; FCE – feed conversion efficiency; FWP – fair wage potential; LS – labor safety; NRF – nutritional value of feed; RES – renewable energy share; TAC – total annual cost

Sustainability is complex and ... complicated...

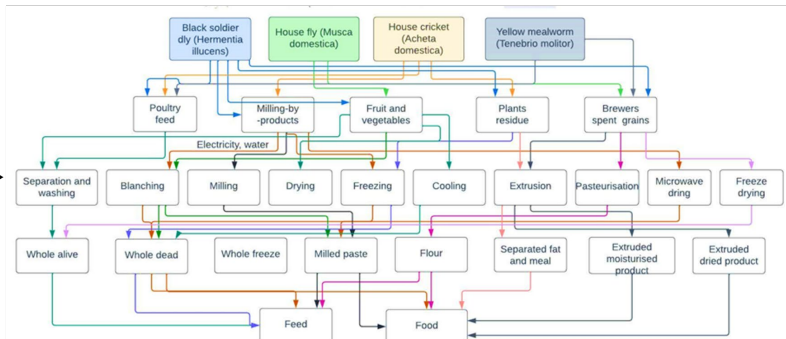
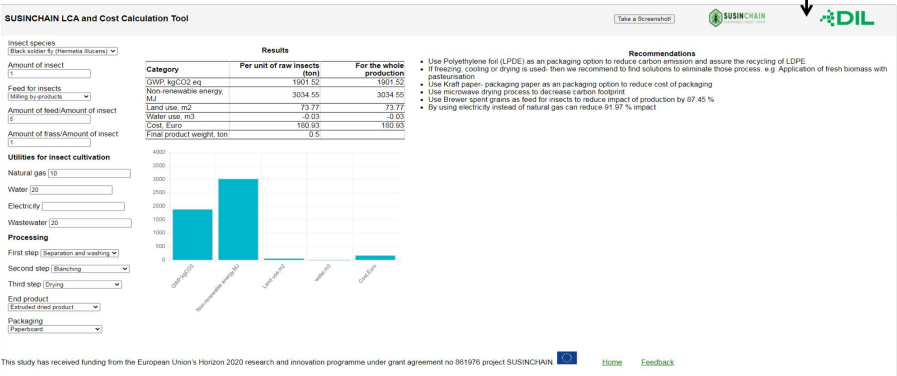


Criteria is in square brackets, red – economic, green – environmental, blue – social, black – applicable to a few aspects; AIB – amount of insect biomass; AIF – amount of insect frass; DEU – direct energy use; DWU – direct water use; ENV – integrated environmental impact; FCE – feed conversion efficiency; FWP – fair wage potential; LS – labor safety; NRF – nutritional value of feed; RES – renewable energy share; TAC – total annual cost

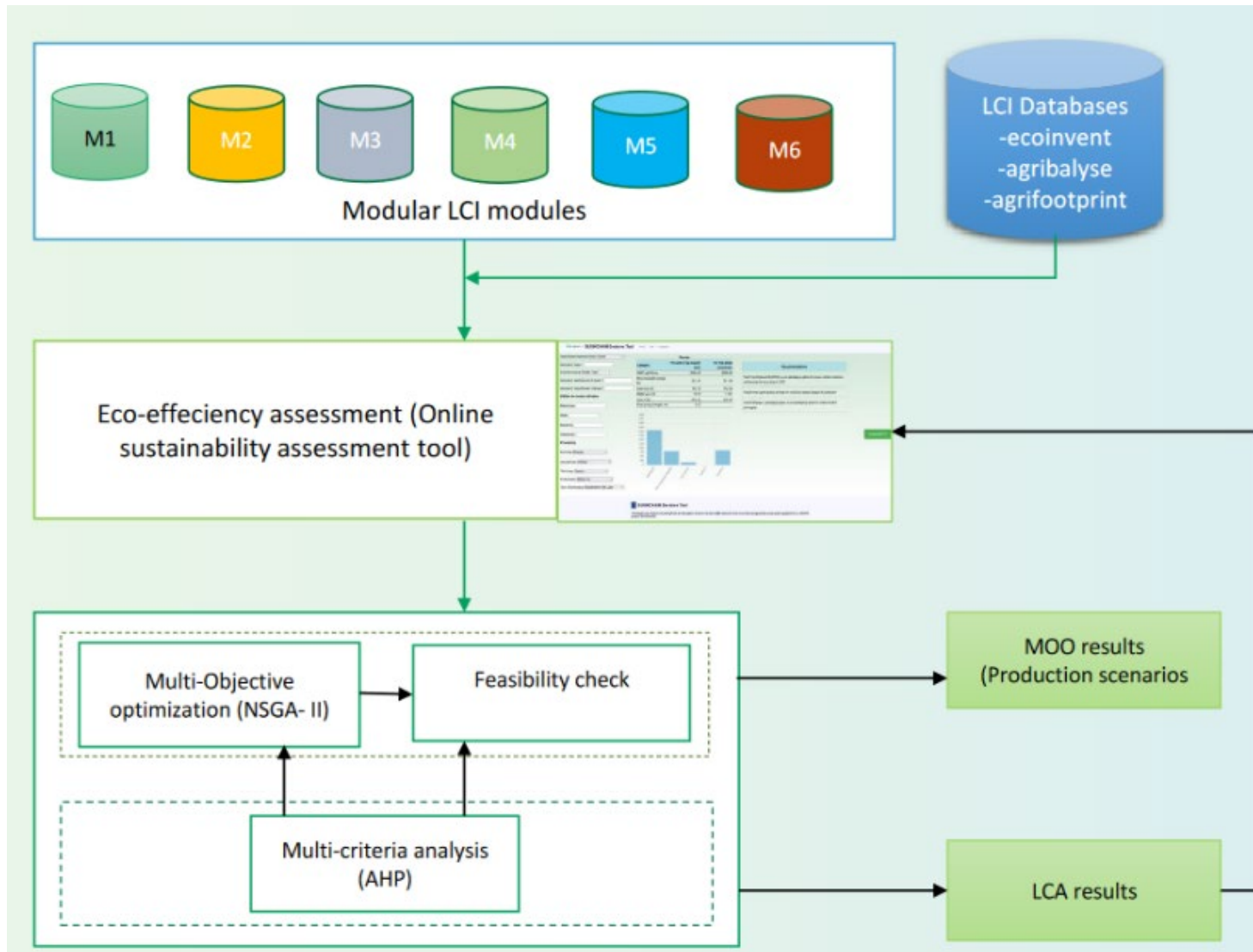
Designing Decision Support Tool



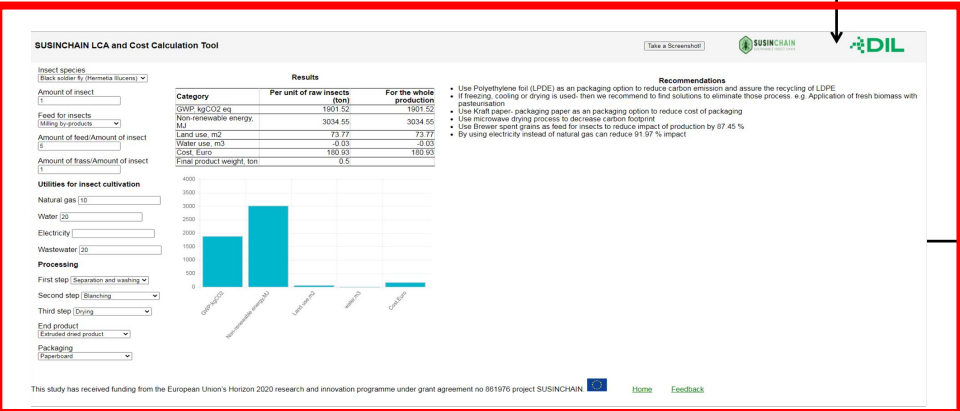
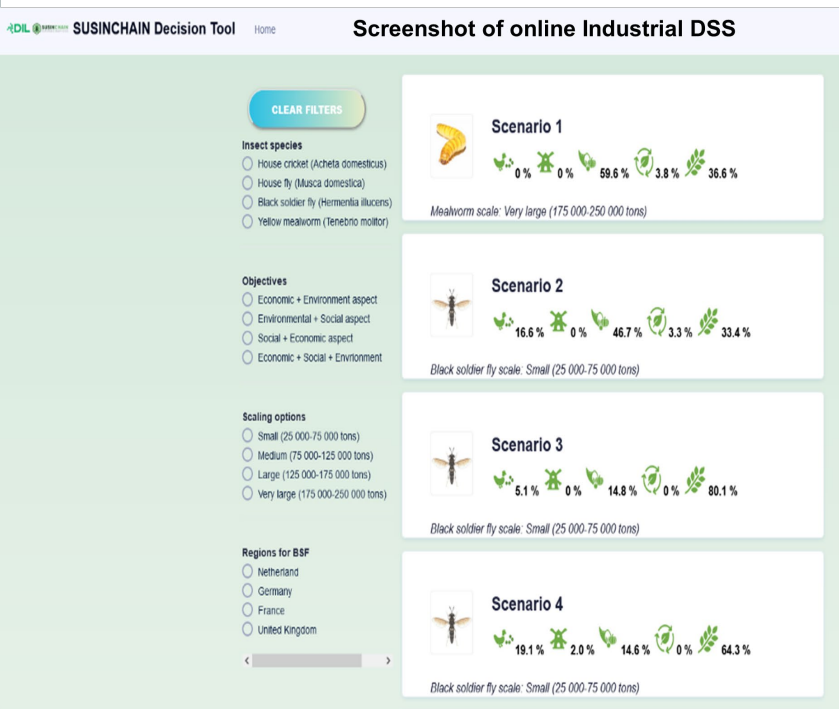
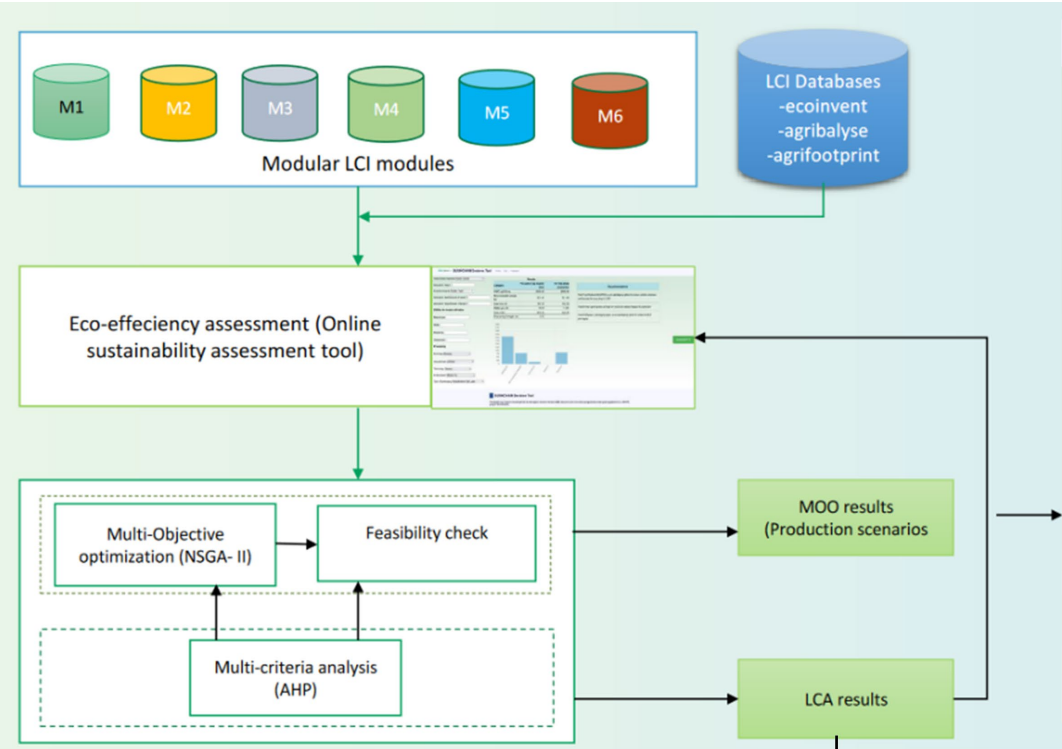
Industrial blueprint scheme for sustainable insect value chains



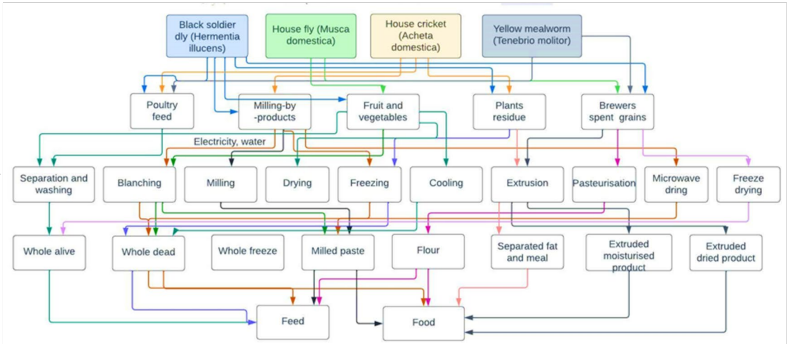
Modular Life Cycle Approach



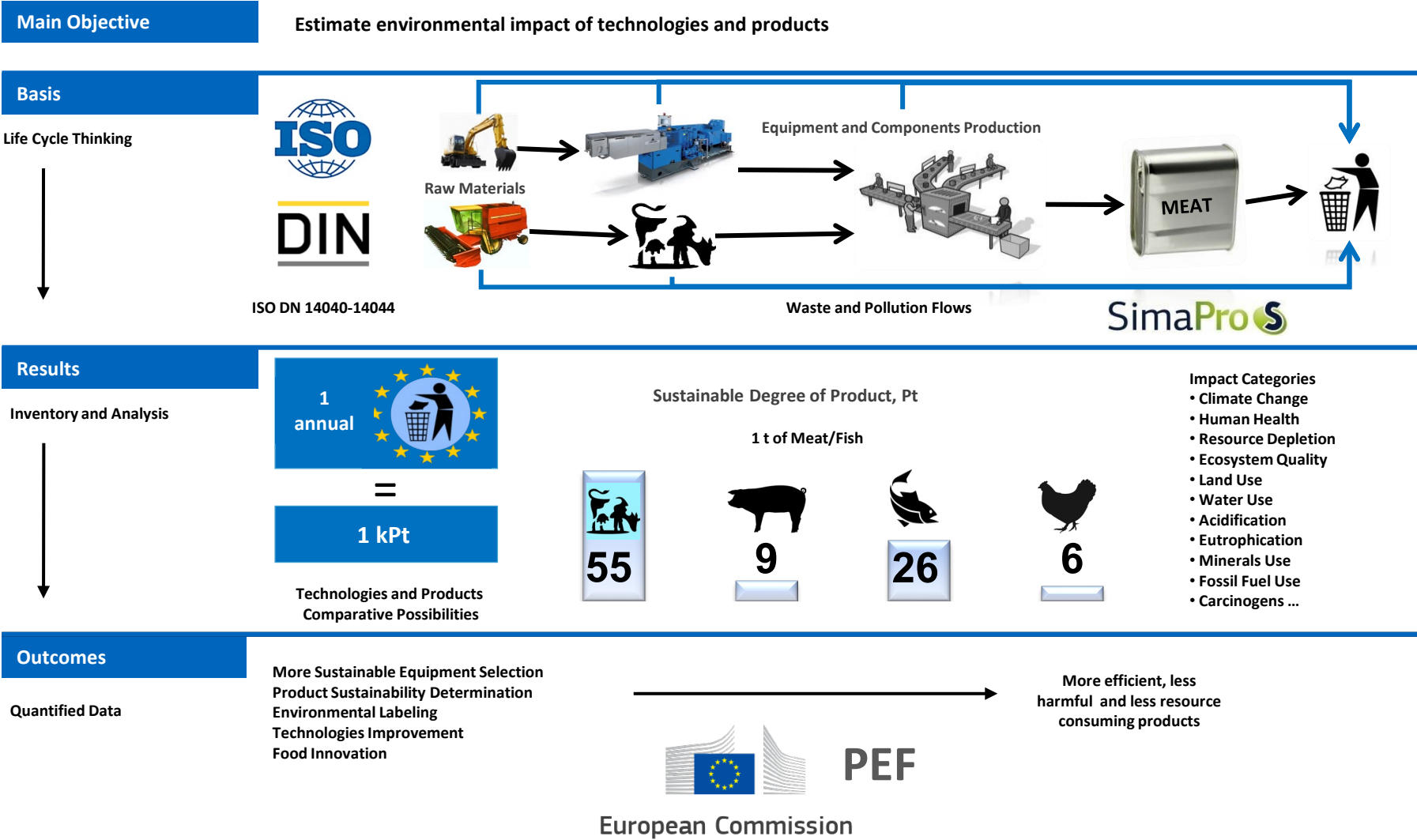
Structure of Decision Support Tool



Industrial blueprint scheme for sustainable insect value chains



Methodological insights: LCA



- Hotspots
- Best options
- Cradle-to-grave
- FU
- Comprehensive methods
- Potential impacts

Baseline LCA and LCC data



SUSINCHAIN LCA and Cost Calculation Tool

Take a Screenshot!



Insect species
Black soldier fly (Hermetia Illucens) ▼

Amount of insect
1

Feed for insects
Milling by-products ▼

Amount of feed/Amount of insect
5

Amount of frass/Amount of insect
1

Utilities for insect cultivation

Natural gas 10

Water 20

Electricity

Wastewater 20

Processing

First step Separation and washing ▼

Second step Blanching ▼

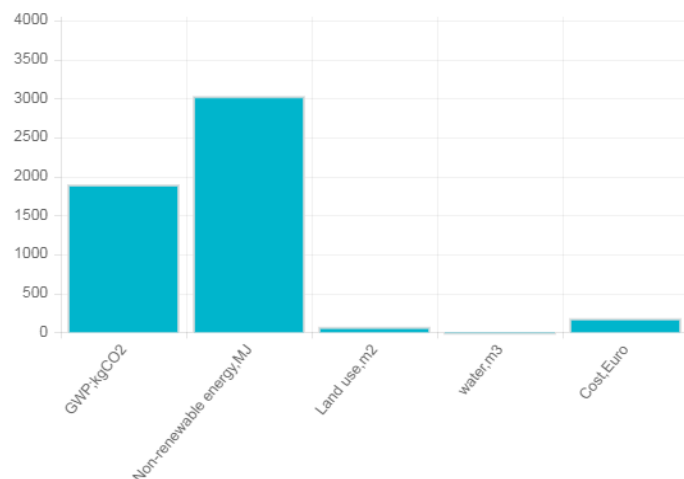
Third step Drying ▼

End product
Extruded dried product ▼

Packaging
Paperboard ▼

Results

Category	Per unit of raw insects (ton)	For the whole production
GWP, kgCO2 eq	1901.52	1901.52
Non-renewable energy, MJ	3034.55	3034.55
Land use, m2	73.77	73.77
Water use, m3	-0.03	-0.03
Cost, Euro	180.93	180.93
Final product weight, ton	0.5	

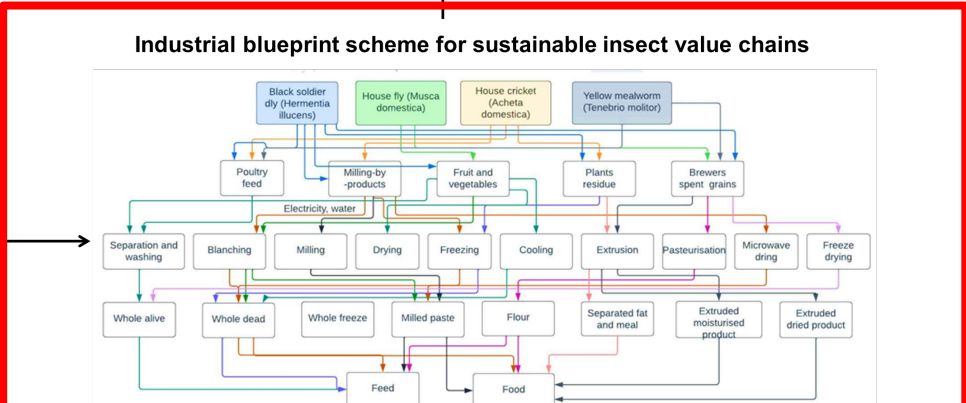
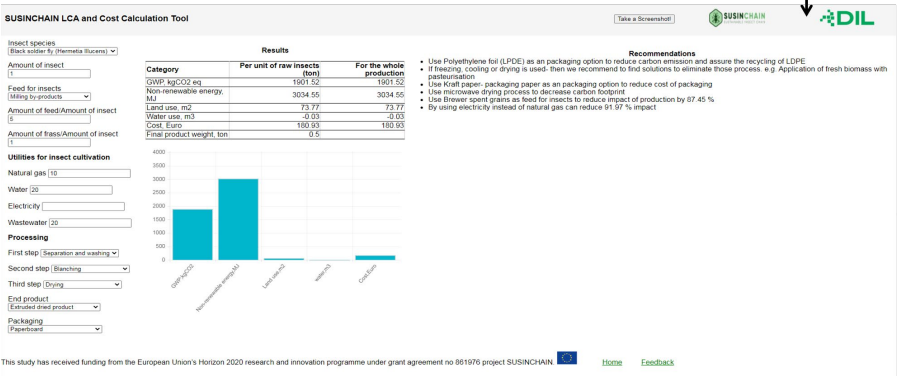
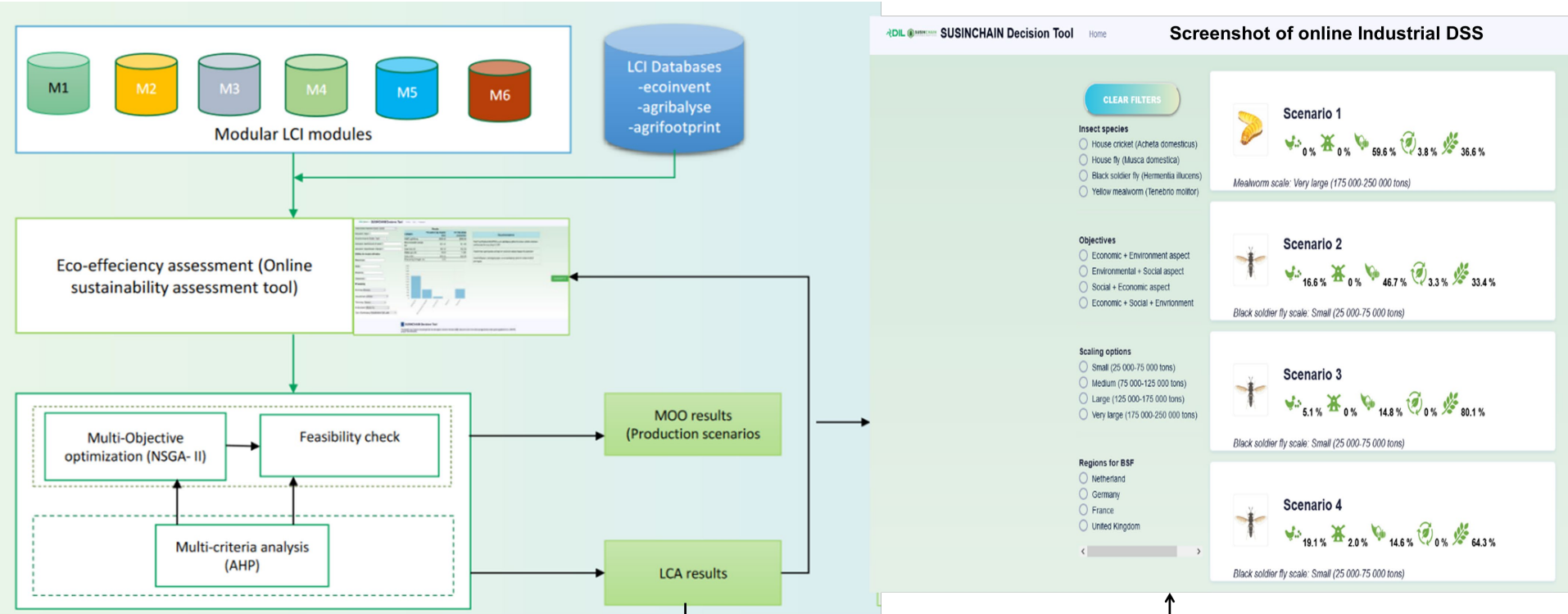


Recommendations

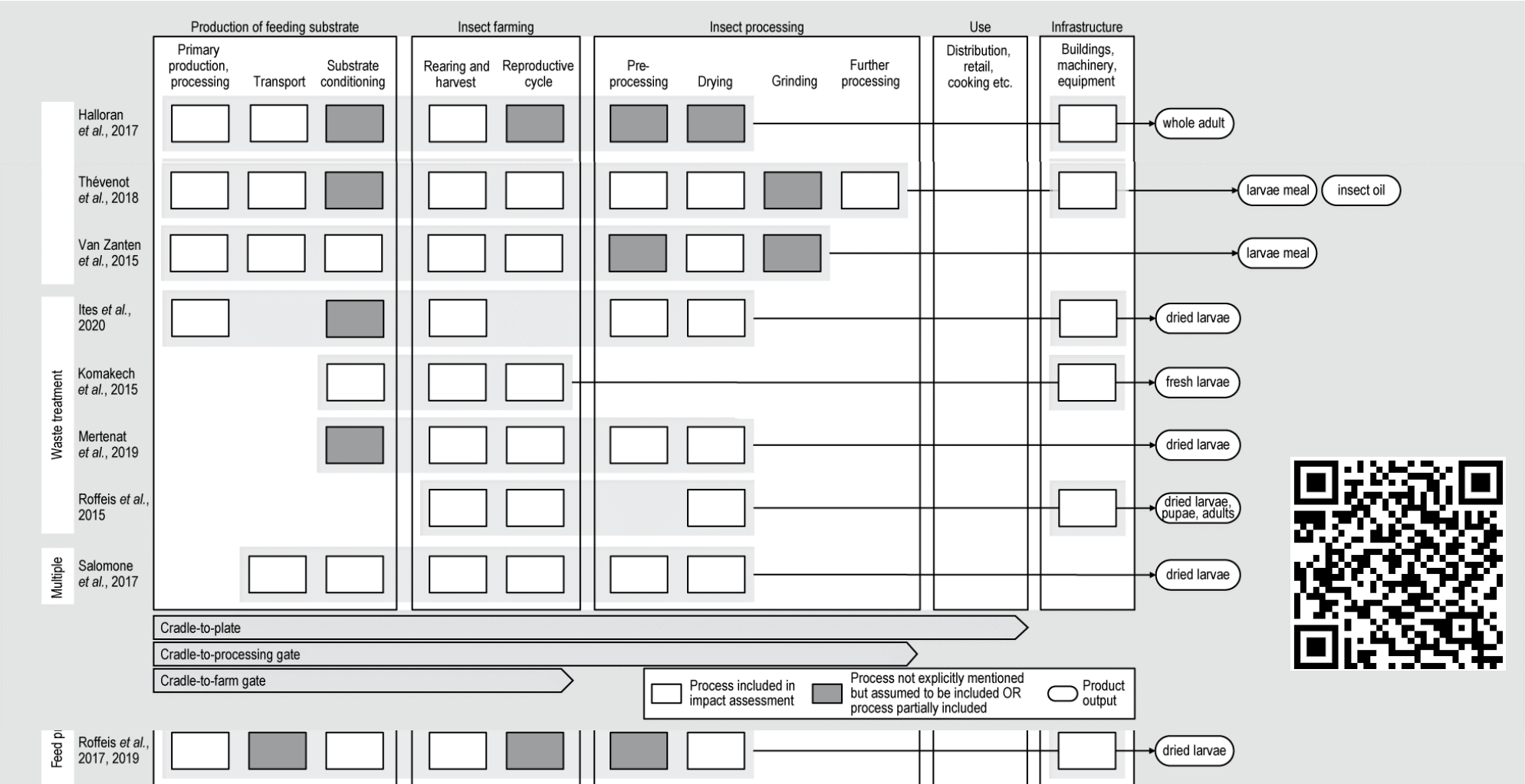
- Use Polyethylene foil (LPDE) as an packaging option to reduce carbon emission and assure the recycling of LDPE
- If freezing, cooling or drying is used- then we recommend to find solutions to eliminate those process. e.g. Application of fresh biomass with pasteurisation
- Use Kraft paper- packaging paper as an packaging option to reduce cost of packaging
- Use microwave drying process to decrease carbon footprint
- Use Brewer spent grains as feed for insects to reduce impact of production by 87.45 %
- By using electricity instead of natural gas can reduce 91.97 % impact



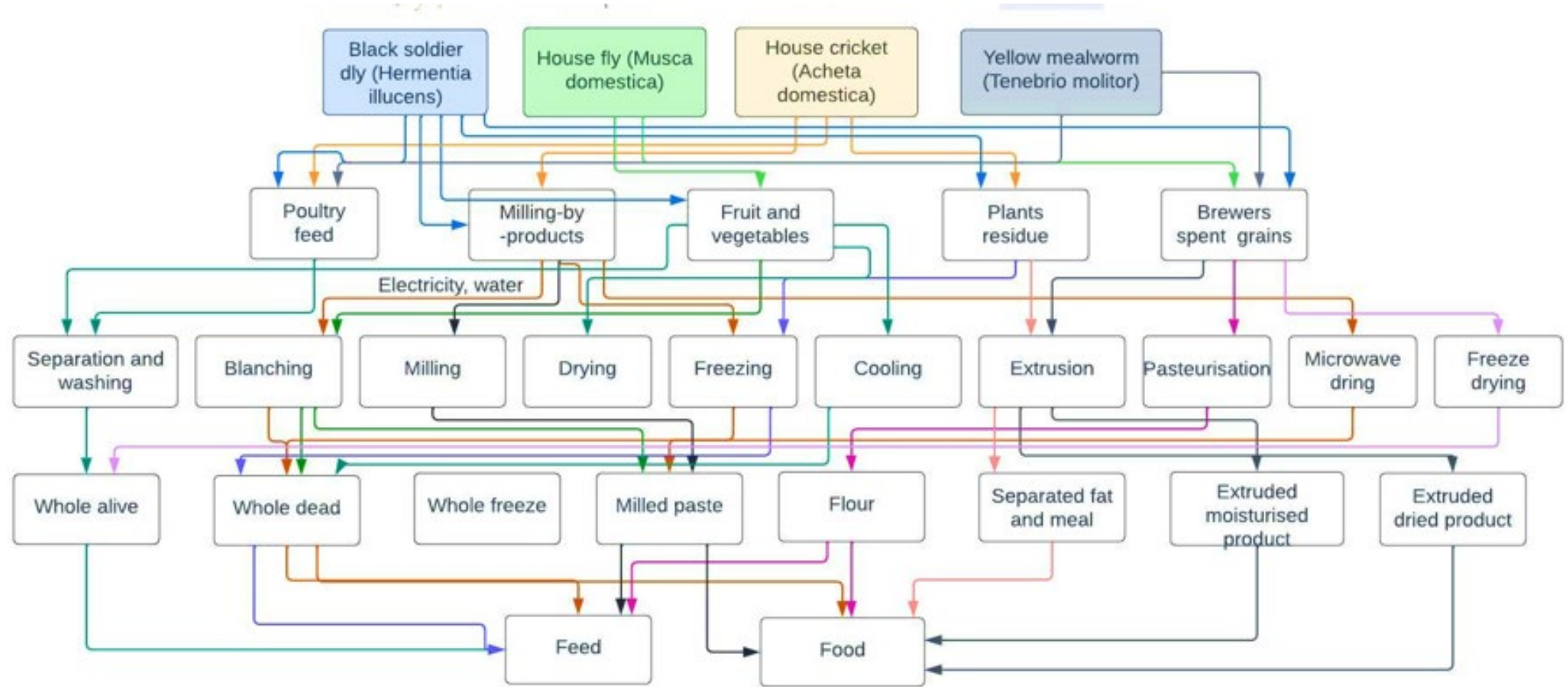
Structure of Decision Support Tool



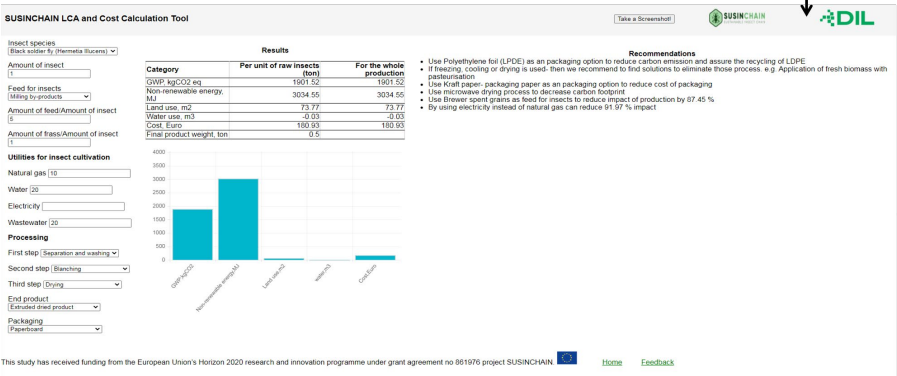
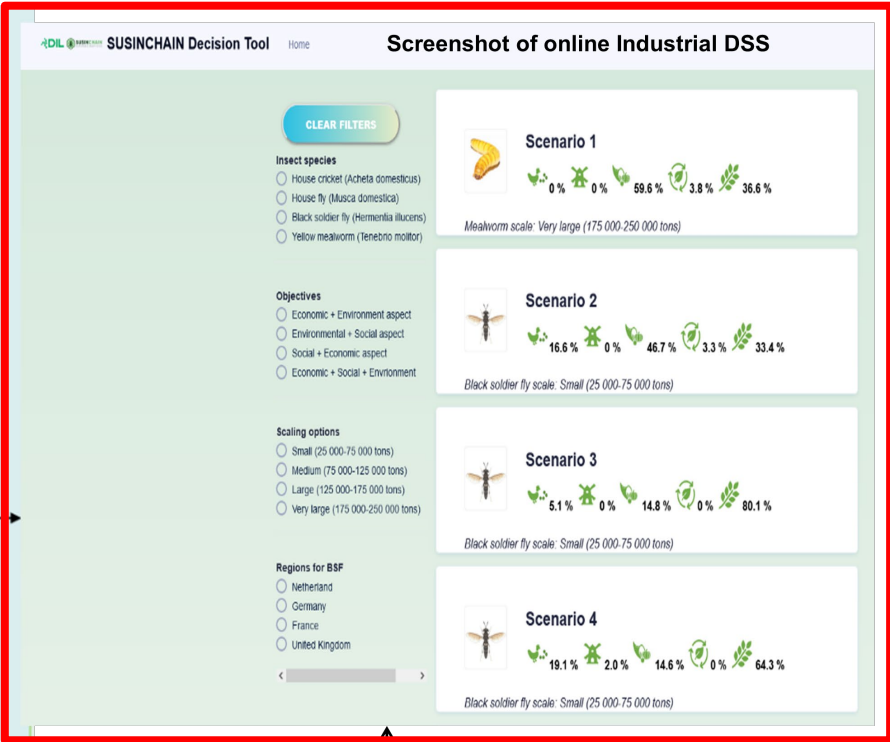
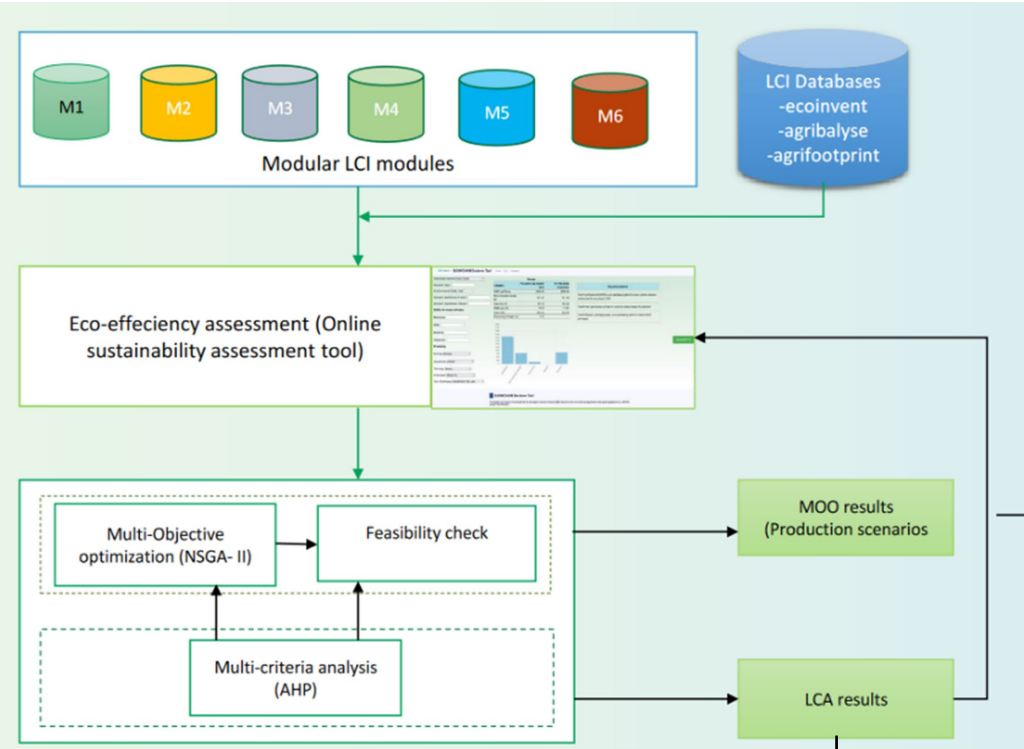
System boundaries overview



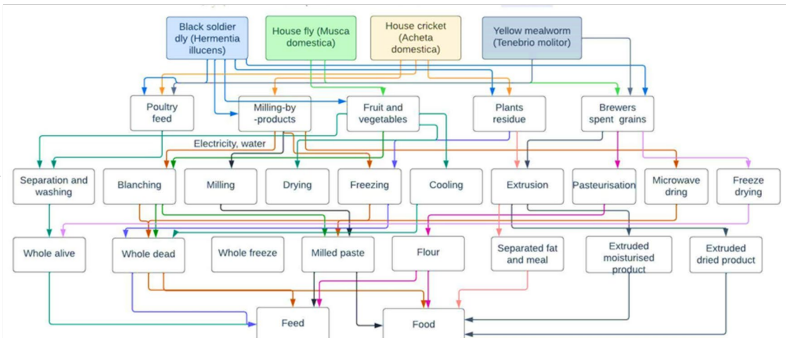
Industrial blueprint scheme for sustainable insect value chains



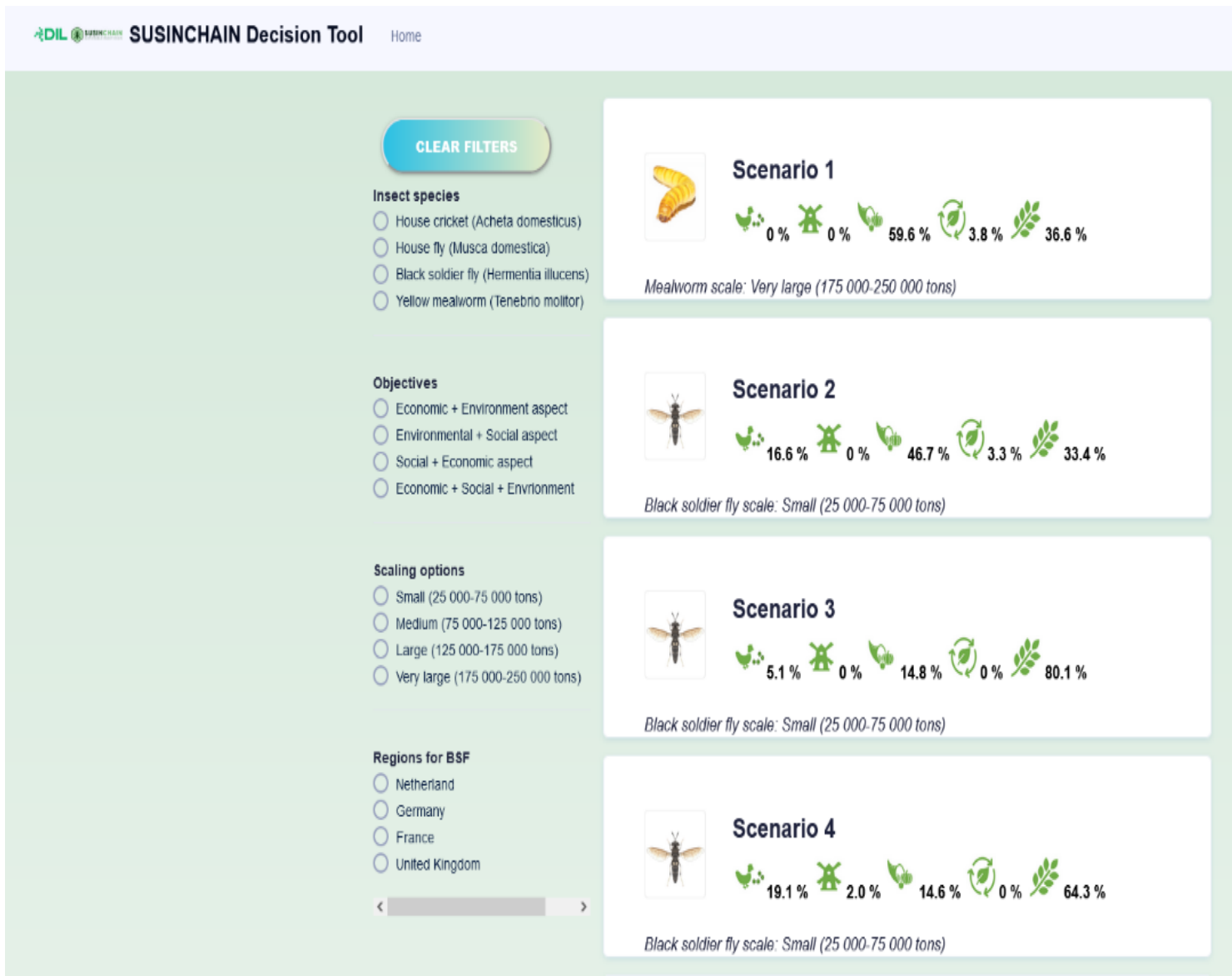
Structure of Decision Support Tool



Industrial blueprint scheme for sustainable insect value chains



Screenshot of online Industrial DSS



Take away messages



1. Proposed DSS based on modular approach to Life Cycle Assessment, economic costs and social factors allows to define the optimal insect production chains for four insect species based on multi-objective optimization (MOO).
2. The scenario factors include scale of production, location (within EU), and objectives of production.
3. They result in the recommendations for the feed compositions.
4. Validation of scenarios are required...





Acknowledgments

- SUSINCHAIN project received funding from the EU Horizon programme under grant agreement n° 861976
- Giant Leaps received funding from the EU HORIZON EUROPE programme under grant agreement No 101059632
- CIPROMED Project, with funding from the PRIMA programme under the Grant Agreement GA2231
- ADVAGROMED Project, with funding from the PRIMA programme (GA number: 02WPM1651)



Funded by the Horizon 2020
Framework Programme of the
European Union

Thank you for for your attention!

DIL Deutsches Institut für Lebensmitteltechnik e. V.
University of Veterinary Medicine Hanover

Prof. Dr. Sergiy Smetana
Food Data Group

s.smetana@dil-ev.de

