



HORIZON4PROTEINS

NEKTGEN PROTEIN smart protein SUSINCHAIN



SUSINCHAIN
SUSTAINABLE INSECT CHAIN

PERSPECTIVES OF SUSTAINABLE INSECT PRODUCTION CHAINS

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SUSustainable INsect CHAIN (SUSINCHAIN) aims to contribute to novel protein provision for feed and food in Europe by overcoming the remaining barriers for increasing the economic viability of the insect value chain and opening markets by combining forces in a comprehensive multi-actor consortium.



Factsheet

✓ Project Name	Sustainable INsect CHAIN
✓ Project Acronym	SUSINCHAIN
✓ Grant Agreement Number	861976
✓ Funding	European Union's Horizon 2020 Research and Innovation programme
✓ Topic	LC-SFS-17-2019 - Alternative proteins for food and feed
✓ Total Budget	8,68 Million €
✓ Start Date	1 October 2019
✓ End Date	30 September 2023
✓ Coordination	Stichting Wageningen Research, Netherlands

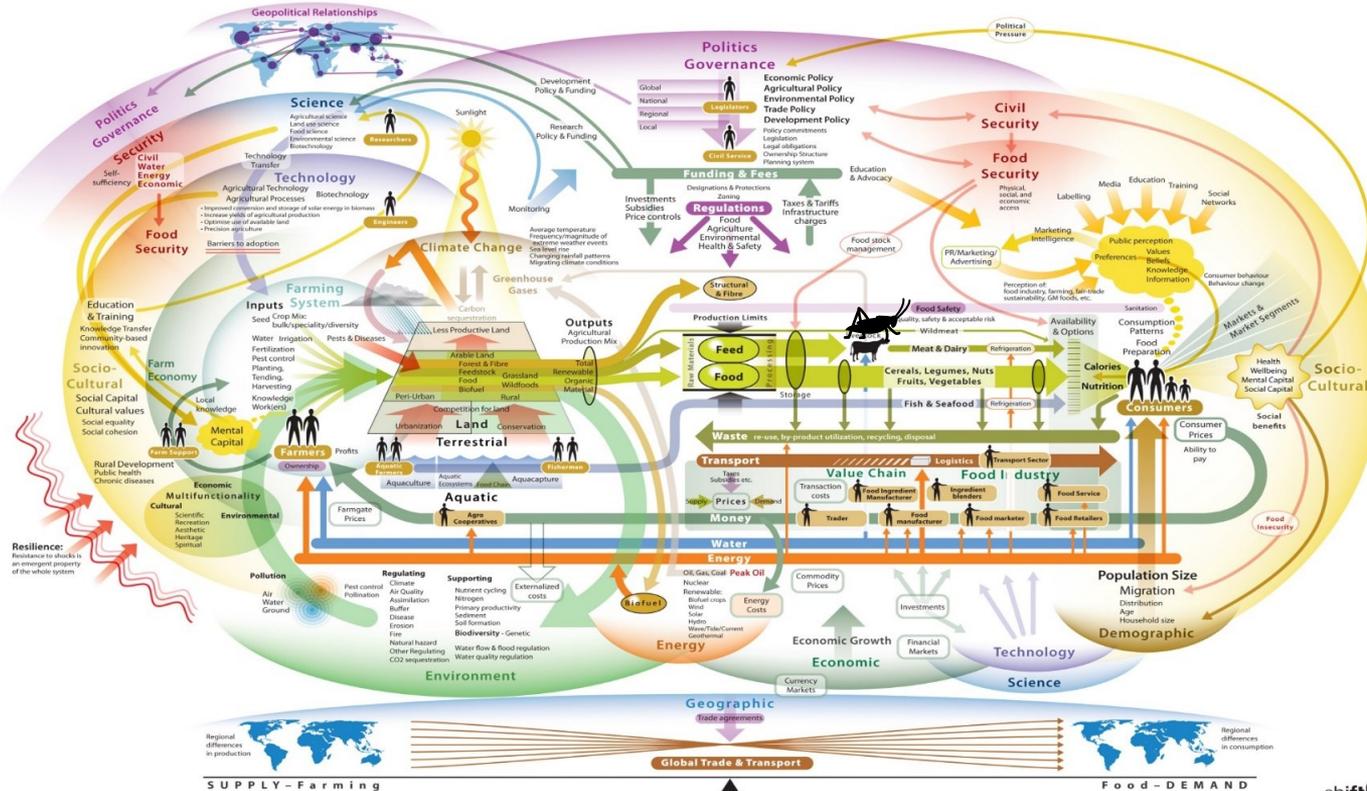
<https://susinchain.eu/>
<https://www.facebook.com/susinchain>
<https://twitter.com/susinchain>
<https://www.linkedin.com/company/susinchain/>

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DIETARY SHIFTS STUDIES FOR EMERGENCY



SUSINCHAIN
SUSTAINABLE INSECT CHAIN



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clarity in complexity

courtesy of ShiftN

METHODOLOGICAL INSIGHTS: LCA



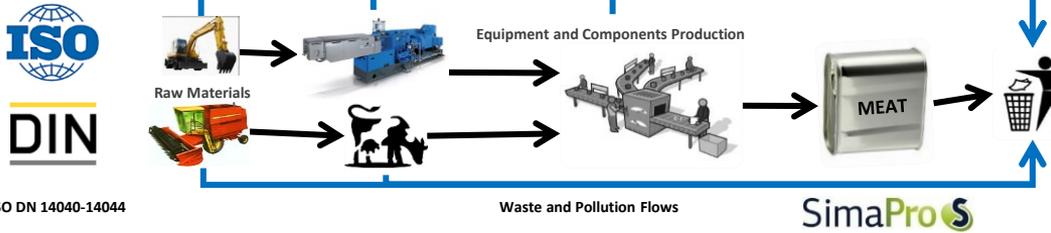
SUSINCHAIN
SUSTAINABLE INSECT CHAIN

Main Objective

Estimate environmental impact of technologies and products

Basis

Life Cycle Thinking



Results

Inventory and Analysis



Technologies and Products
Comparative Possibilities

Sustainable Degree of Product, Pt

1 t of Meat/Fish



Impact Categories

- Climate Change
- Human Health
- Resource Depletion
- Ecosystem Quality
- Land Use
- Water Use
- Acidification
- Eutrophication
- Minerals Use
- Fossil Fuel Use
- Carcinogens ...

Outcomes

Quantified Data

More Sustainable Equipment Selection
Product Sustainability Determination
Environmental Labeling
Technologies Improvement
Food Innovation



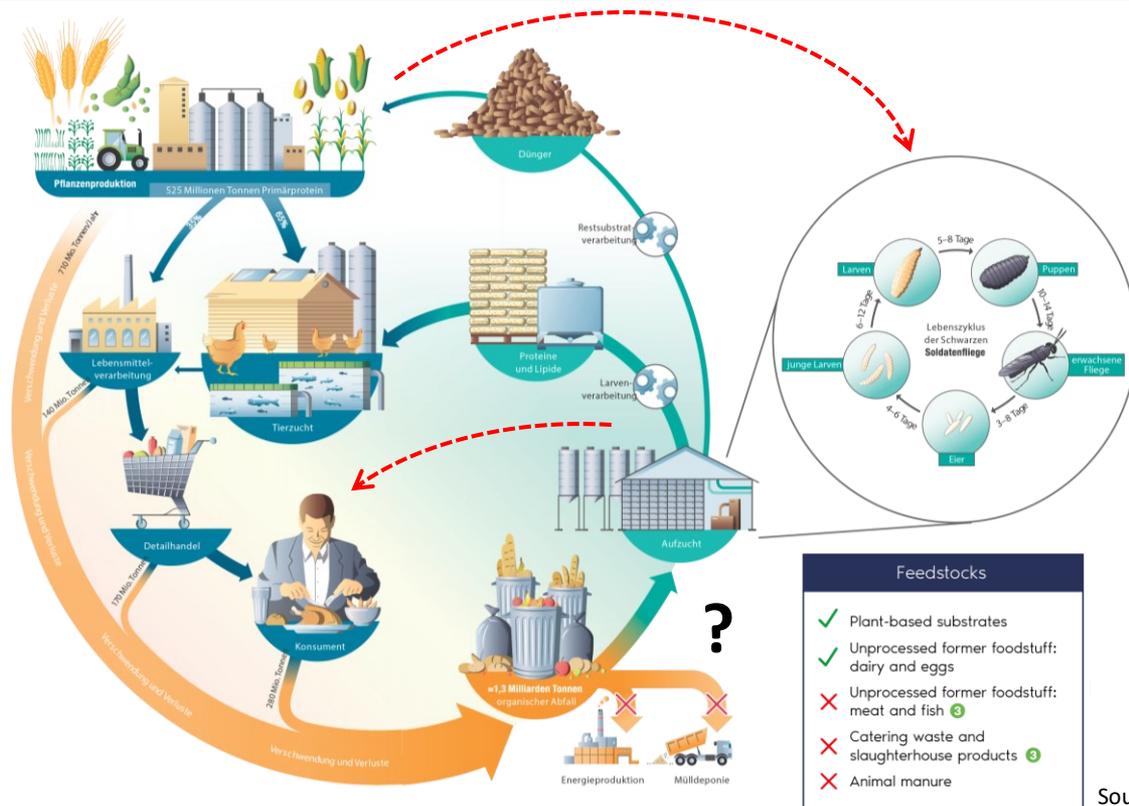
PEF

European Commission

More efficient, less
harmful and less
resource consuming
products



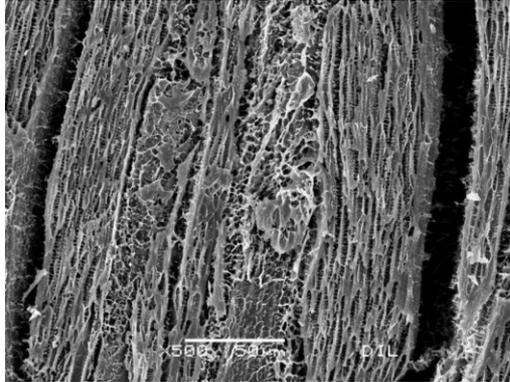
INSECTS COULD BE A SOLUTION (MAYBE PARTIALLY)



Source: IPIFF, 2019

EXTRUDED PRODUCTS AND MEAT SUBSTITUTES

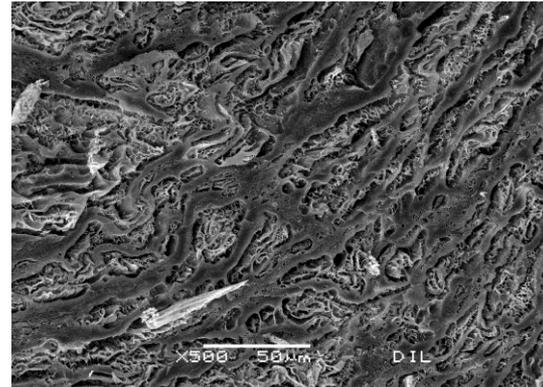
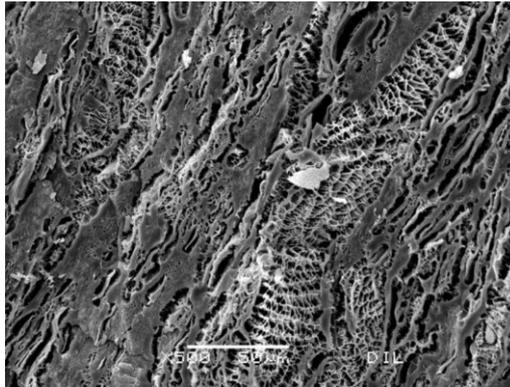
Meat



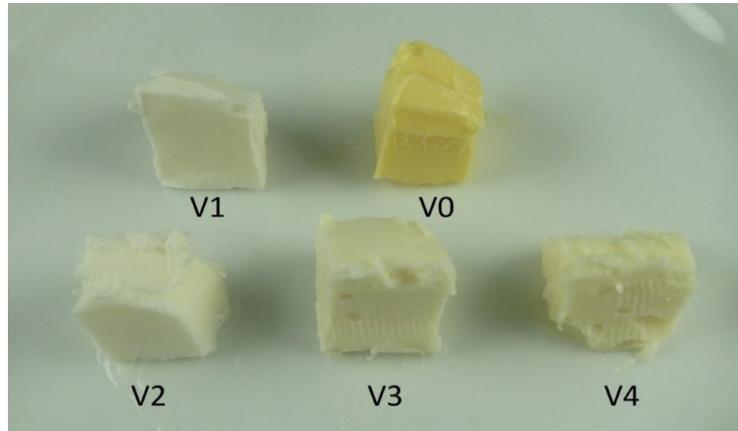
Extruded soy protein



Extruded soy + *T. molitor*



LIPIDS – CRUCIAL COMPONENT OF FOOD PRODUCTS



Smetana, S., Leonhardt, L., Kauppi, S. M., Pajic, A., & Heinz, V. (2020). Insect margarine: Processing, sustainability and design. *Journal of Cleaner Production*, 264, 121670.)

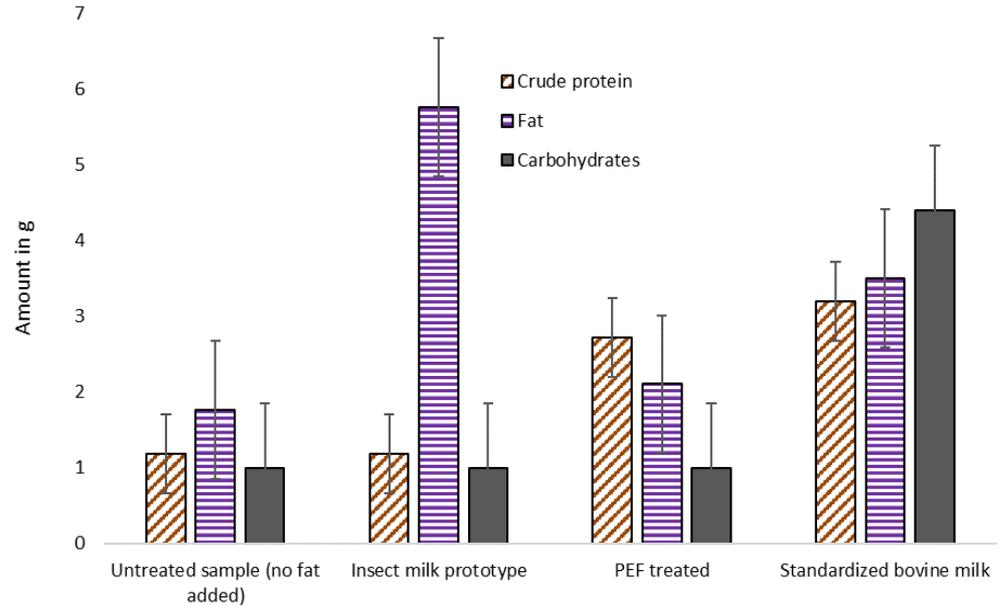
INSECT MILK



(A)

(B)

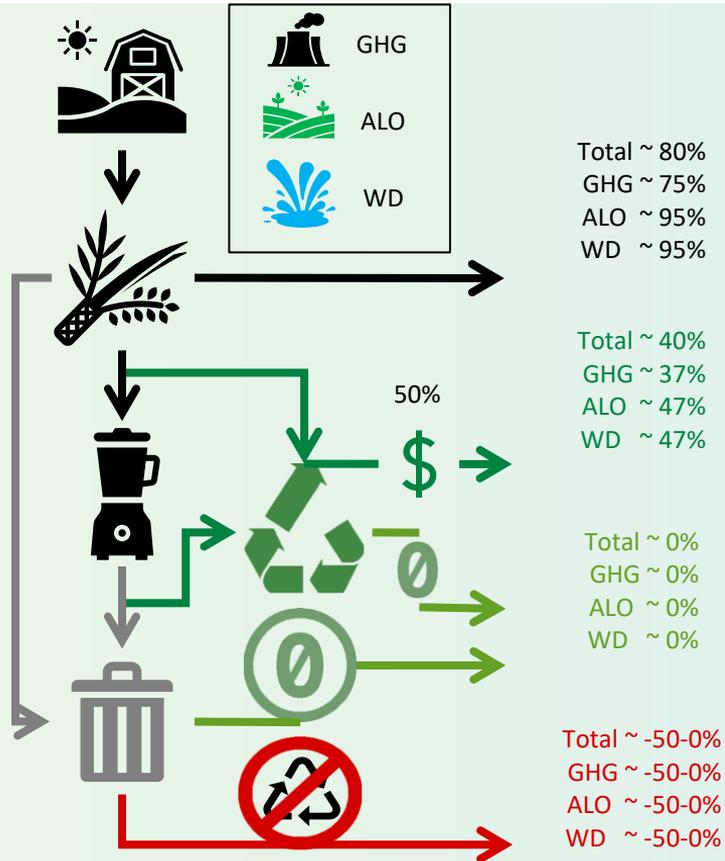
insect milk (A) and bovine milk (B)



Comparison of main nutrients in developed prototypes (dry matter basis) in 100 g

ENVIRONMENTAL HOTSPOTS

Feed conversion efficiency (DM/DM)



<i>H. illucens</i>	<i>T. molitor</i>	<i>A. domesticus</i>	<i>M. domestica</i>
0.05-0.25	0.05-0.26	0.03-0.2	0.37?
0.03-0.36	0.024-0.19	0.03-0.2	0.02-0.1
0.02-0.5	0.024-0.19	0.03-0.2	0.025-0.11
0.02-0.5	0.04-0.15	0.05-0.2?	0.018-0.11

ENVIRONMENTAL HOTSPOTS

Development times (days) -> Energy use

Environmental impact, 1 kg DW



<i>H. illucens</i>	<i>T. molitor</i>	<i>A. domesticus</i>	<i>M. domestica</i>
13-34	91-151	48?	9-12



<i>H. illucens</i>	<i>T. molitor</i>	<i>A. domesticus</i>	<i>M. domestica</i>
GHG 1.4-15 ALO 0.01-94.7 WD 1.26	GHG 9-10.3 ALO 12 WD 1.8-8.7	GHG 7.7-8.7 ALO 27-180 WD 1.4-2.7	GHG 20 ALO 16.7 WD 1.3



15-42	83-227	55-167	4-11
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GHG 0.3-5 ALO 0-4.9 WD 0.8-2	GHG 3-10.3 ALO 5.3- 17 WD 0.1-0.2	GHG 5-27 ALO 12-79 WD 0.1-0.2	GHG 0.8-12 ALO 0.03-61 WD 8.5-11
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12-42	83-227	55-167	4-12
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GHG -6.42÷3.5 ALO -16.8÷4.9 WD 0.8-1.1	GHG 0.6-1.2 ALO 0.1-0.3 WD 0.4-1.7	GHG 1.3-2 ALO 0.5-1 WD 0.4-0.7	GHG 5.9-9.7 ALO 4.4-7.7 WD 114-188
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ENVIRONMENTAL HOTSPOTS

Development times (days) -> Energy use

Environmental impact, 1 kg DW



<i>H. illucens</i>	<i>T. molitor</i>	<i>A. domesticus</i>	<i>M. domestica</i>
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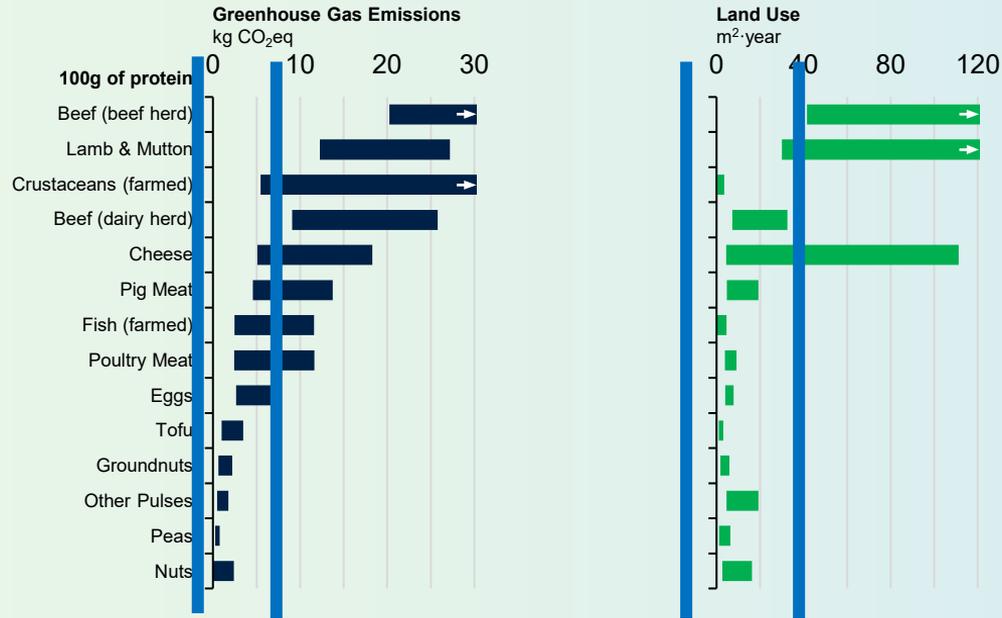


12-42	83-227	55-167	4-12
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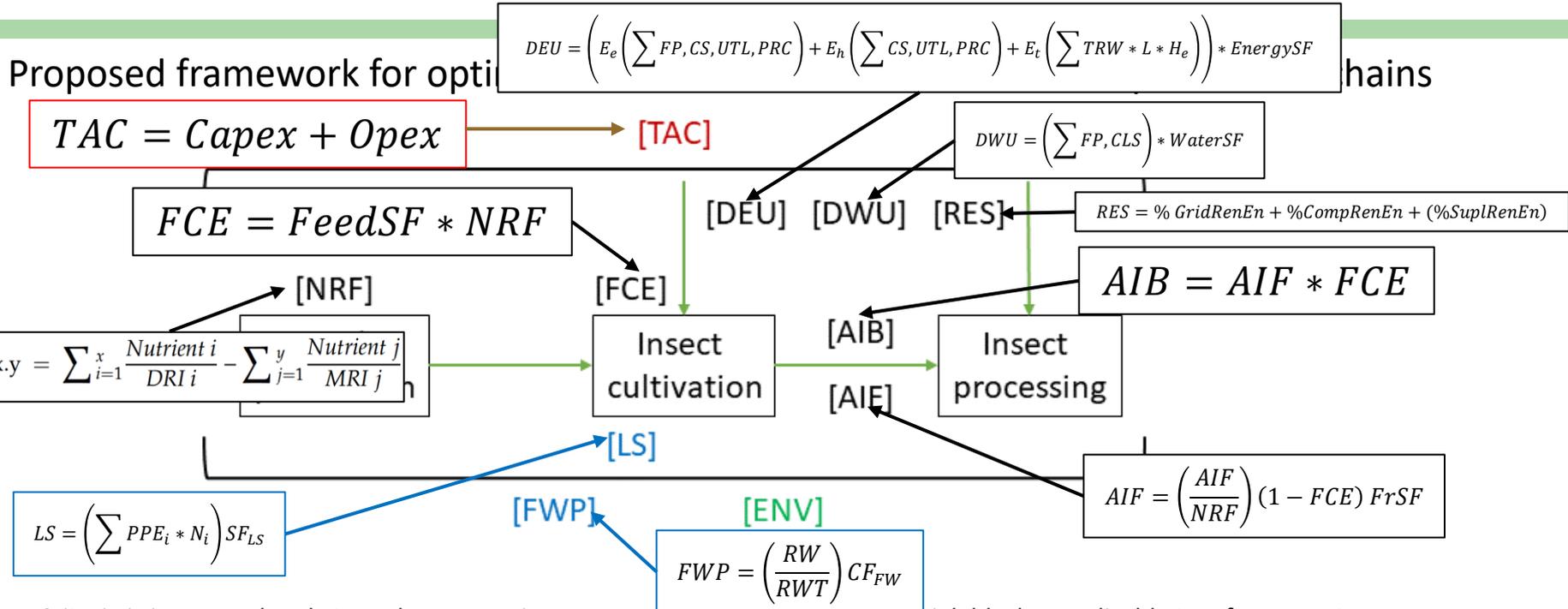


GHG -6.42÷3.5 ALO -16.8÷4.9 WD 0.8-1.1	GHG 0.6-1.2 ALO 0.1-0.3 WD 0.4-1.7	GHG 1.3-2 ALO 0.5-1 WD 0.4-0.7	GHG 5.9-9.7 ALO 4.4-7.7 WD 114-188
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CONVENTIONAL SOURCES OF PROTEINS



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

INTEGRATED EQUATION

$$EI = \left[\sum_{i=1}^n EI_{feed} i f_i S F_i \right] K [] - ASf$$

Environmental impact

Feed EI

FCR

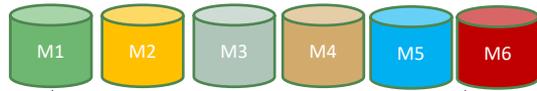
Scaling factor

Coefficient of product concentration

Allocation/substitution factor

MULTI-OBJECTIVE INTEGRATED DECISION SUPPORT SYSTEM (DSS)

LCI modules



Scenario LCI Database 1

	Natural gas	Market for electricity
A) Electricity natural gas	1	-1
a) CO2 (kg)	0.3	0

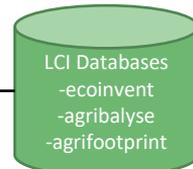
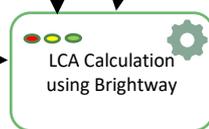
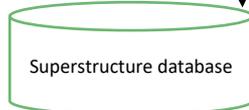
Scenario Database 2

	Natural gas	Wind turbine
A) Electricity natural gas	1	0.5
a) CO2 (kg)	1.5	0

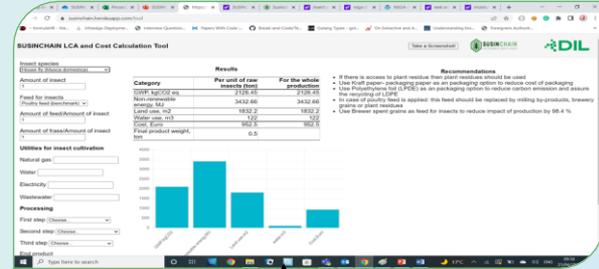
Intermediate flows
1->A:1
Elementary flows:
1->a:2

Intermediate flows
1->A:1
Elementary flows:
1->a:2

Brightway₃



Multi-objective decision support tool



LCA results

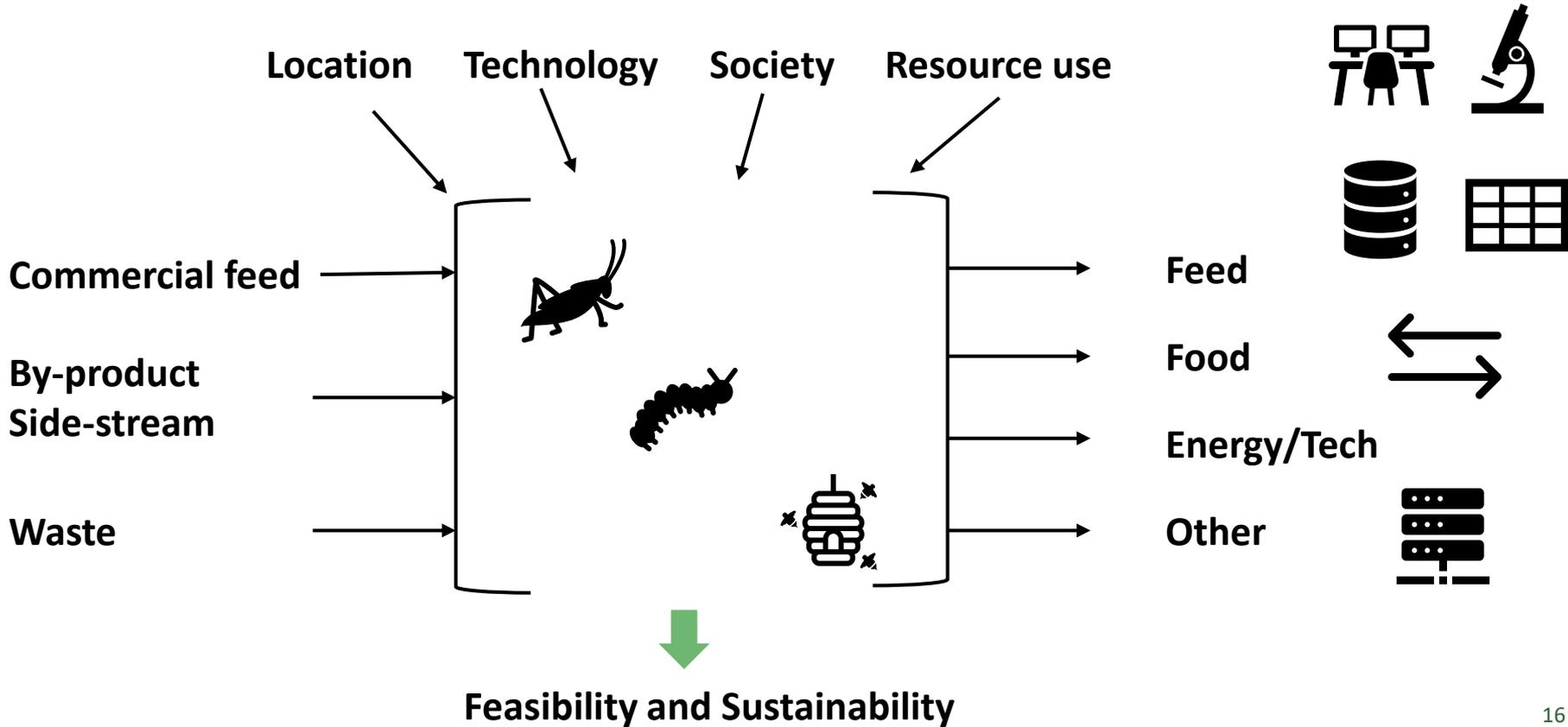
MOO results

Multi-Objective optimization (NSGA-II)

Feasibility check

Multi-criteria analysis (AHP)

CONCLUDING POINTS



ACKNOWLEDGMENTS

Project **SUSINCHAIN** H2020 n° 861976



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WP7 partners



Food
Data
Group



SUSINCHAIN partners



Thank you for for your attention!

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