

Holistic sustainability assessment of FunTomP approach

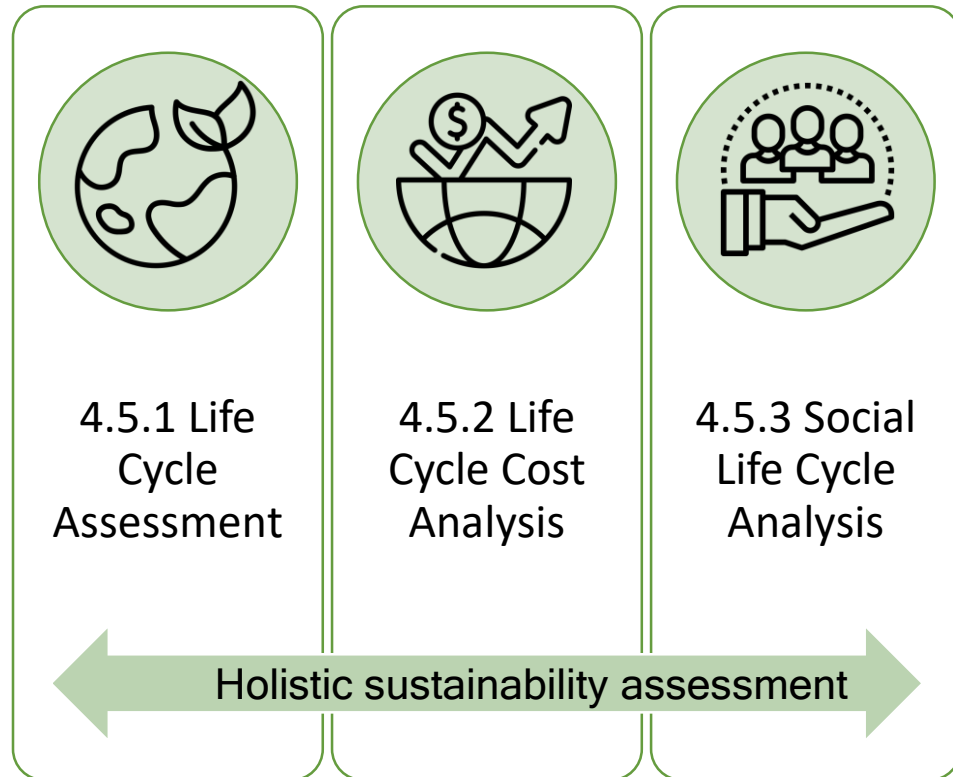
WP4 – Task 4.5



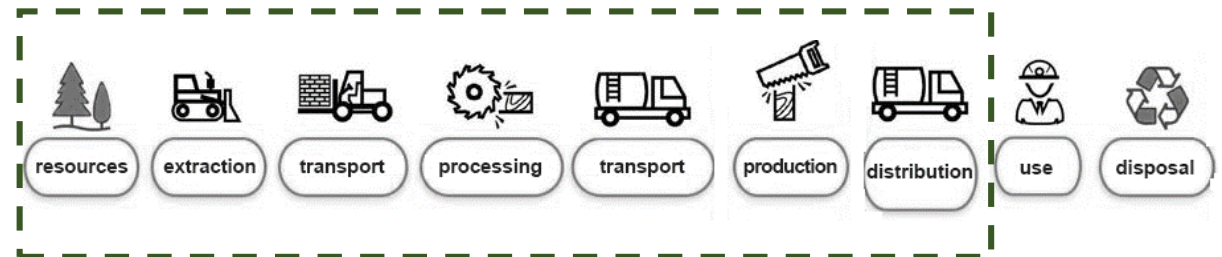
This project has received funding
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programme under grant agreement
No 2032



FunTomP sustainability assessment



FunTomP concept **life cycle thinking** will evaluate the environmental, economic, and social impacts of the proposed products beyond the production or consumption from a '**cradle-to-consumer**' system boundary.



FunTomP sustainability assessment

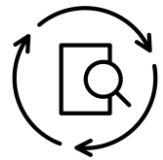


DATA COLLECTION STATUS

Julio 2023	M27								
FunctionalizedTomatoProducts									
PROCESS	TASK	DESCRIPTION	DURAT ION	PARTNER	INPUT (TASK)	OUTPUT (TASK)	DEADLINES FOR LCA/LCC/SLCA DATA DELIVERY		
							INPUTS/OUTPUTS IDENTIFIED (materials, energy sources, waste)	INPUTS/OUTPUTS QUANTIFIED AT LAB/PILOT SCALE	INPUTS/OUTPUTS QUANTIFIED/ESTIMATED AT INDUSTRIAL SCALE
Extraction of the proteins from SBL.	Task 2.2	- Sugar beet leaves are provided by Kaysen Sugar Company (M7). - Processes optimization at EgU and METU. - Processes for protein extraction (FBM 17/22): • Alkali liquor (18). • Homogenization (2000 rpm, 3min). • Extraction (50°C, 30min). • Filtration. • Centrifugation (6000rpm, 20min). • Isoelectric precipitation (pH:3.5). • Centrifugation (6000rpm, 30min). • Dialysis. • Freeze drying. • In study: EAE (Pectinex Ultra SPL) and/or USAE. • To ask for HPH.	M1 - M24	EgU Dr Seda Ezuz (sedaerus@gmail.com) Ayga Akjuiz (akguzayga@gmail.com)	- Fresh sugar beet leaves. - pH 9.2 carbonate-bicarbonate buffer - Electricity - 5 N HCl - Pectinex Ultra SP-L - pH 7 dipotassium phosphate-mono potassium phosphate buffer	- Concentrated SBL protein powder. (to task 3.2 and task 4.2) - By-products: Remaining pulp and Green pellet. (To task 6.1/6.2/6.3)	Inputs: - Fresh sugar beet leaves. - pH 9.2 carbonate-bicarbonate buffer - Electricity - 5 N HCl - Pectinex Ultra SP-L - pH 7 dipotassium phosphate-mono potassium phosphate buffer Outputs: - Concentrated SBL protein powder - By-products: Remaining pulp and green pellet.	Inputs: - Fresh sugar beet leaves (35 g/each production). - pH 9.2 carbonate-bicarbonate buffer (280 mL) - Electricity (Annee-1) - 5 N HCl (approximately 10 mL) - Pectinex Ultra SP-L (20.3 mL) - pH 7 dipotassium phosphate-mono potassium phosphate buffer (280 mL) Outputs: - Concentrated SBL protein powder (depending on the process the quantity may change between 0.35 and 2.5 g) - By-products: Remaining pulp and green pellet (depending on the process the quantity may change between 10 and 15 g)	Inputs: - Fresh sugar beet leaves (100 kg). - pH 9.2 carbonate-bicarbonate buffer (800 L) - Electricity - 5 N HCl - Pectinex Ultra SP-L (70 L) - pH 7 dipotassium phosphate-mono potassium phosphate buffer (800 L) Outputs: - Concentrated SBL protein powder (depending on the process the quantity may change between 1 and 7 kg) - By-products: Remaining pulp and green pellet (depending on the process the quantity may change between 30 and 45 kg)
	Task 2.5	- Pilot scale: 50 times larger than the current lab scale.	M25 - M30	METU, EgU and KSC					
Production of olive powder	Task 3.1	- Olives are provided from Greece, Spain, Italy, and Turkey. - Steps for powder production: • Mix with water • HPH. • Microwave Vacuum dried + freeze-dried. • Grinding.	M3 - M13	METU Dr Mert Dr Alev ince (alevince@gmail.com)	- Fresh olives.	- Olive powder (to task 3.2 and task 4.2)	Inputs: - green olives - water - high pressure homogenizer - freeze dryer - grinder Outputs: - olive powder May 2023		
Production of dried tomato products	Task 3.2	- Tomatoes provided by AF. - Leather and snack bar: tomato puree + protein + olive powder + salt and spices. - Snack bars: pouring and drying. - Powder mixes: pouring, drying and grounding. - Leather process: • Tomatoes from AF. • Washing and blanching. • Peeling and sieving. • Mixing: tomatoes, pectin, olive powder, salt. • Pouring into trays. • Drying. • To ask for HPH.	M14 - M32	METU Dr Alev ince (alevince@gmail.com) Dr Sumnu SELUZ	- Tomatoes - SBL protein. (from task 2.2) - Olive powder (from task 3.1). - Salt and spices. - Pectin HMF (for leather). - Energy for processes.	- Leather - Snack bar - Powder mix - By-products: tomato skin (to task 6.1/6.2/6.3), tomato seeds.	Inputs: - Tomatoes - Olive powder - Spices (mint&thyme) - Starch - Pectin - Sugar - Salt - Pea protein/Aqualaba/Rubisco - High speed mixer - High pressure homogenizer (for leather production) - Microwave vacuum dryer (for		

- ✓ Proteins from SBL
- ✓ Olive powder
- ✓ Tomato snack bar
- ✓ Tomato leather
- Tomato juice
- Tomato sauce
- ✓ Bioactive subproducts
- Packaging

FunTomP sustainability assessment



LCA: SBL PROTEIN

Last updated :Aug-2023

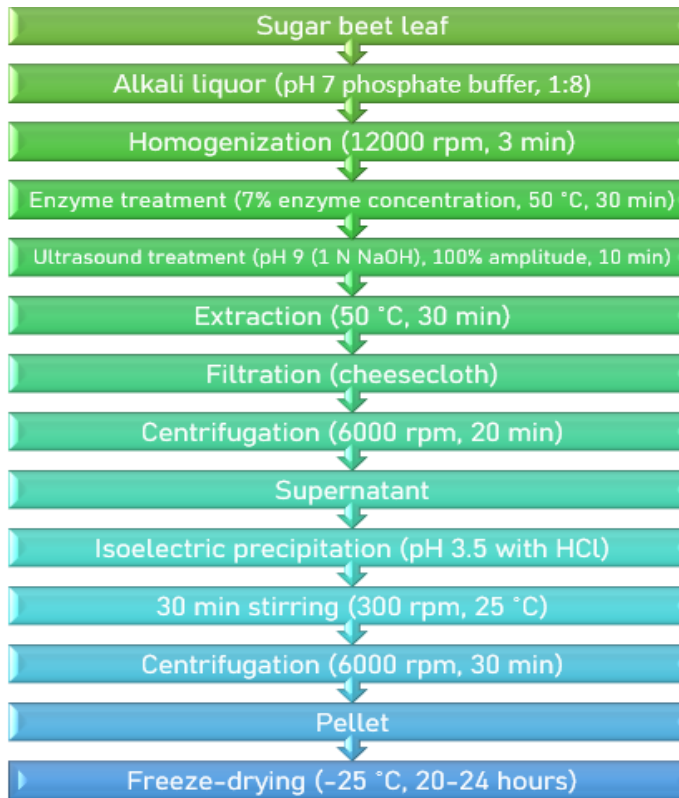
Data source :EgU

Dr Seda Ezus

Ayça Akyüz

Data detail :Laboratory scale

FU :Input of 35 g of
Fresh sugar beet
leaves



Considerations

- Pectinex® modelled as generic enzyme from Ecoinvent® database (7% concentration).
- Energy generation mix average for EU
- Early froze storage not included in the inventory.
- Freeze dryer capacity 110 kg and used at total storage capacity. FU assumed 1%.

FunTomP sustainability assessment



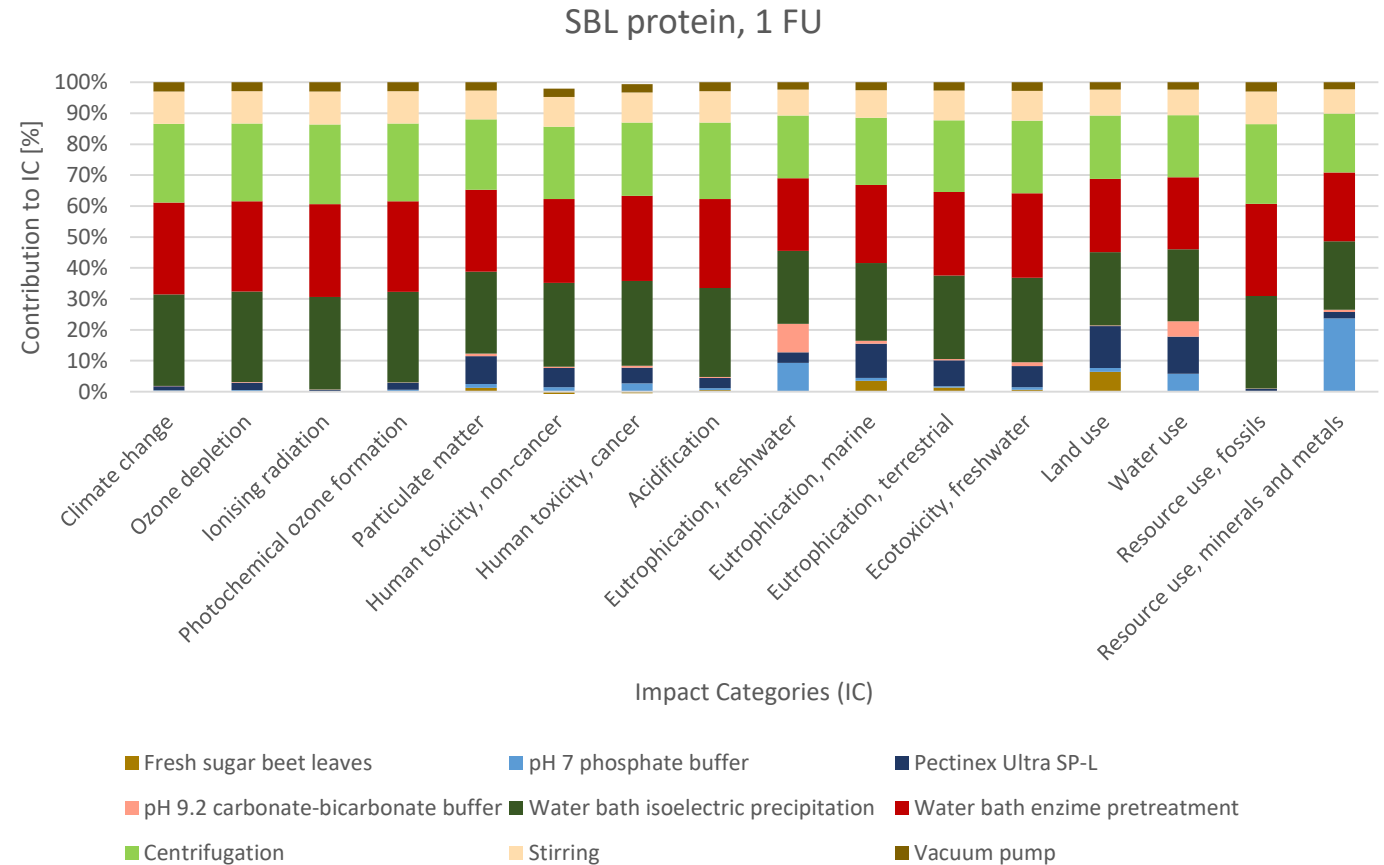
LCA: SBL PROTEIN

Energy consumption related to processes is the main contributor to the IC (74-99%):

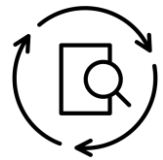
- Isoelectric precipitation (21-29%)
- Enzyme pretreatment (21-29%)
- Centrifugation (18-25%)

Next steps

- To review energy mix modelling and compare it with total renewables.
- Data collection at pilot scale.
- Costs inventory for LCA and S-LCA.
- Comparison with baseline (pea protein available on Ecoinvent)



FunTomP sustainability assessment



LCA: OLIVE POWDER

Last updated :Aug-2023

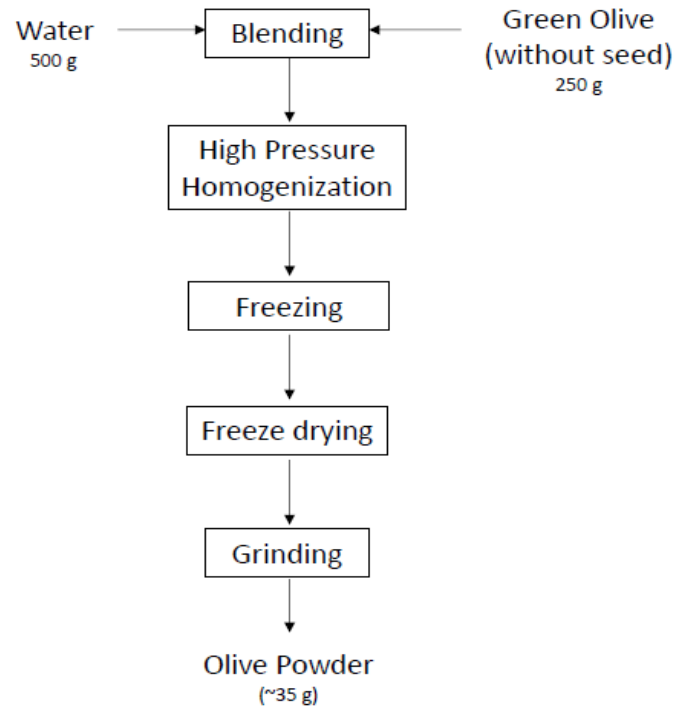
Data source :METU

Dr Alev İnce

Dr Behic Mert

Data detail :Laboratory scale

FU :Input of 250 gr of olives



Considerations

- Olive production from the general database.
- Energy generation mix average for EU
- Transport of raw materials was not included.
- Freeze dryer capacity 110 kg and used at total storage capacity.

FunTomP sustainability assessment



LCA: OLIVE POWDER

Olive's production is the main contributor to IC.

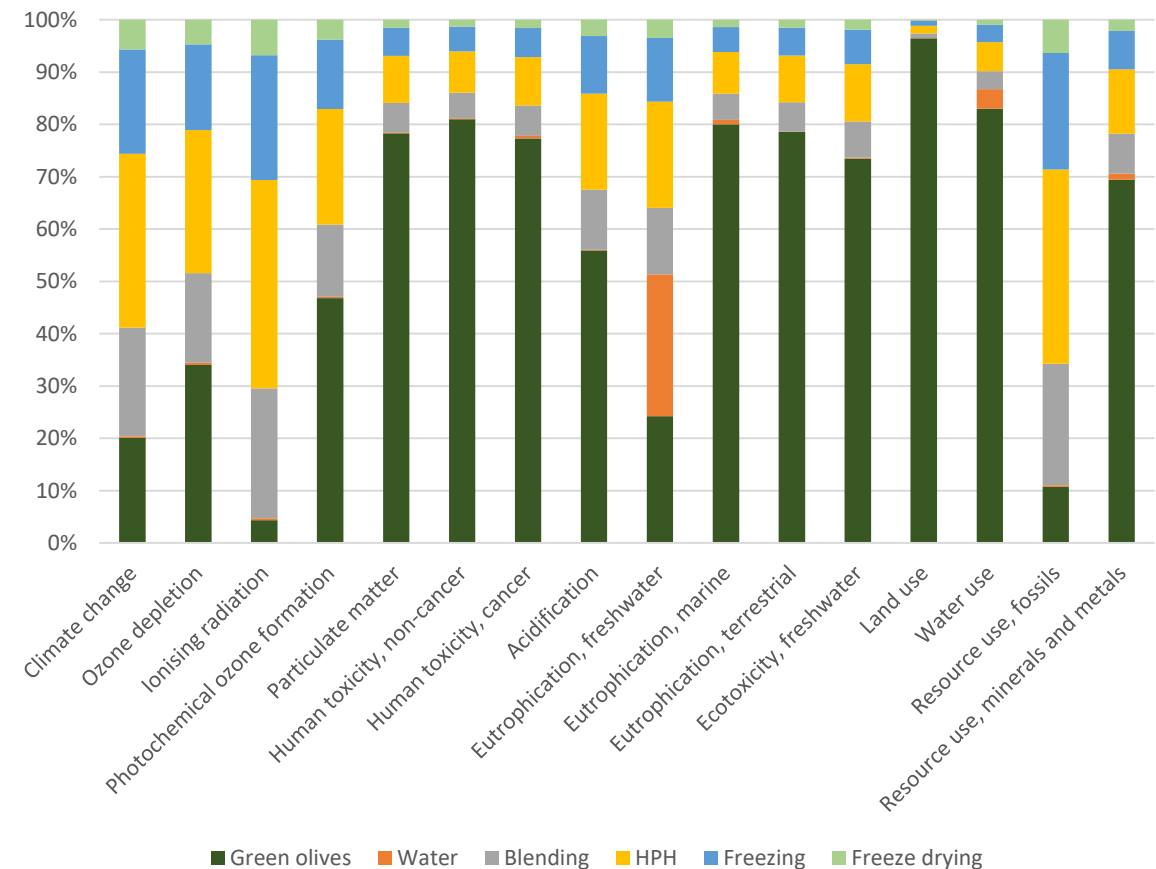
Energy consumption from processes (33% HPH, 21% Blending, and 20% Freezing) is the primary cause of climate change.

Next steps

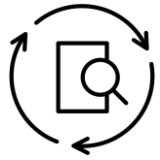
- To review energy mix modelling and compare it with total renewables.
- Data collection at pilot scale.
- Costs inventory for LCA and S-LCA.



Olive Powder, 1 FU



FunTomP sustainability assessment



LCA: TOMATO SNACK BAR

Last updated :May-2023

Data source :METU

Dr Alev Ince

Data detail :Laboratory scale

FU :9 samples

5g each

Aw<065

100 g tomato juice (hot break applied)
+
2 g pectin (low methoxylated pectin)
+
10 g pea protein isolate
+
2 g salt
↓
ULTRATURRAX (8000 rpm for 5 min) **0.5 kW**
+
12 g tomato powder
+
2 g olive powder
+
1 g thyme
+
1 g mint
+
1 g red pepper
↓
ULTRATURRAX (8000 rpm for 2 min) **0.5 kW**
↓
Put into plastic molds and keep at 4°C for 1 h
↓
MICROWAVE-VACUUM OVEN (75% power level for 8 min) **7.25 kW**
↓
Cool down for 15 min

Considerations

- Still missing a proxy for “pectin”.
- Energy generation mix average for EU
- Cold moulding not included in the inventory.
- Ice bath and frozen storage of tomato juice not considered.



FunTomP sustainability assessment

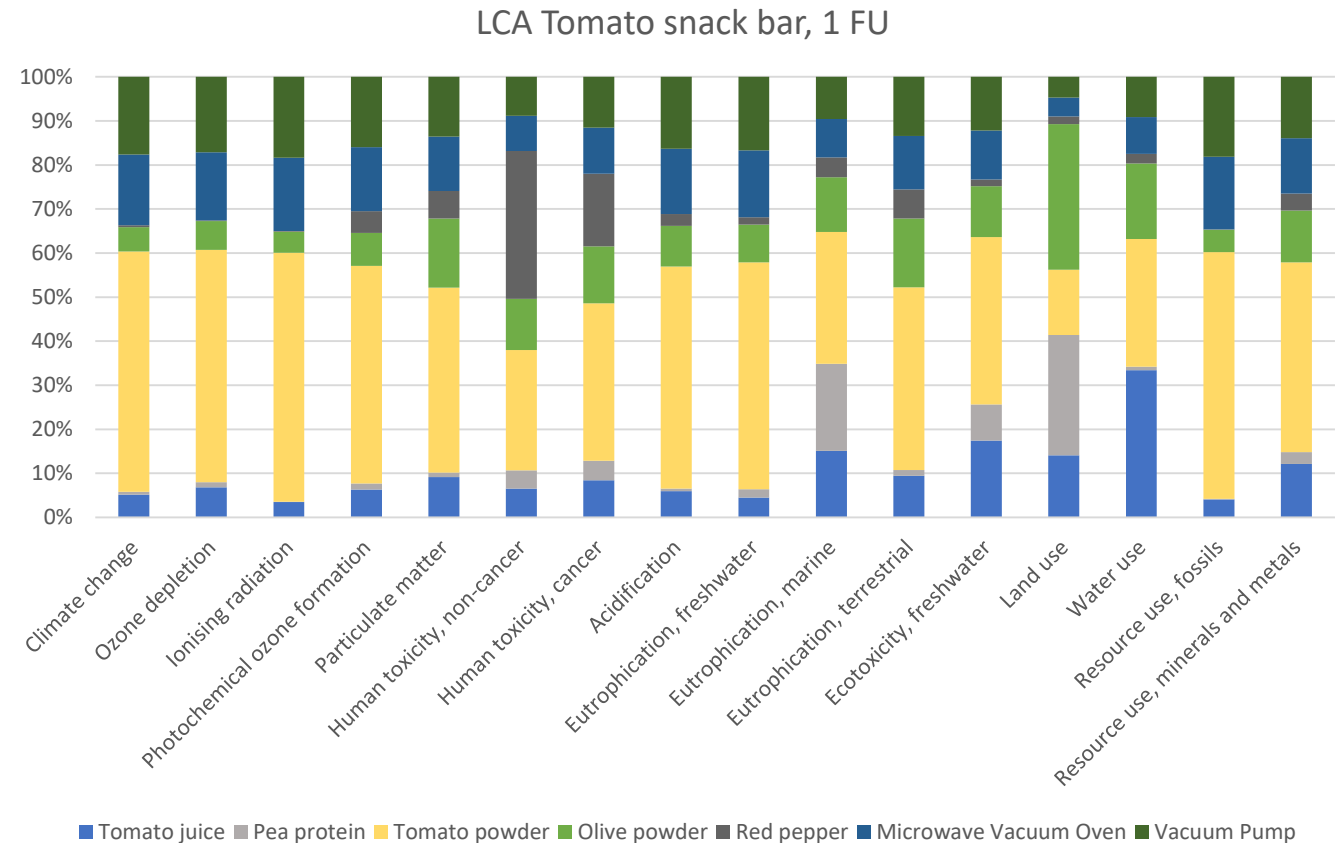


LCA: TOMATO SNACK BAR

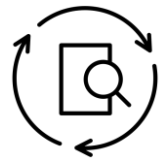
Energy represents 10-38% of IC. When including energy from tomato powder and tomato juice, it can reach up to 99%.

Next steps

- To review energy mix.
- Data collection at pilot scale.
- Costs inventory for LCA and S-LCA.
- To define a baseline to compare with.



FunTomP sustainability assessment



LCA: TOMATO LEATHER

Last updated :May-2023

Data source :METU

Dr Alev Ince

Data detail :Laboratory scale

FU :17g of tomato
leather
(aw < 0.4)

200 g Tomato juice (hot break applied)

+

1 g olive powder

+

1 g pea protein isolate

+

1 g salt



ULTRATURRAX (13800 rpm for 5 min)



HPH (at 500 bar for 2 cycles)



Put into frames (12 cm × 20 cm)



Tray dryer (60°C, 10% RH, for 5.5 h)

Considerations

- Energy generation mix average for EU



FunTomP

FunTomP sustainability assessment

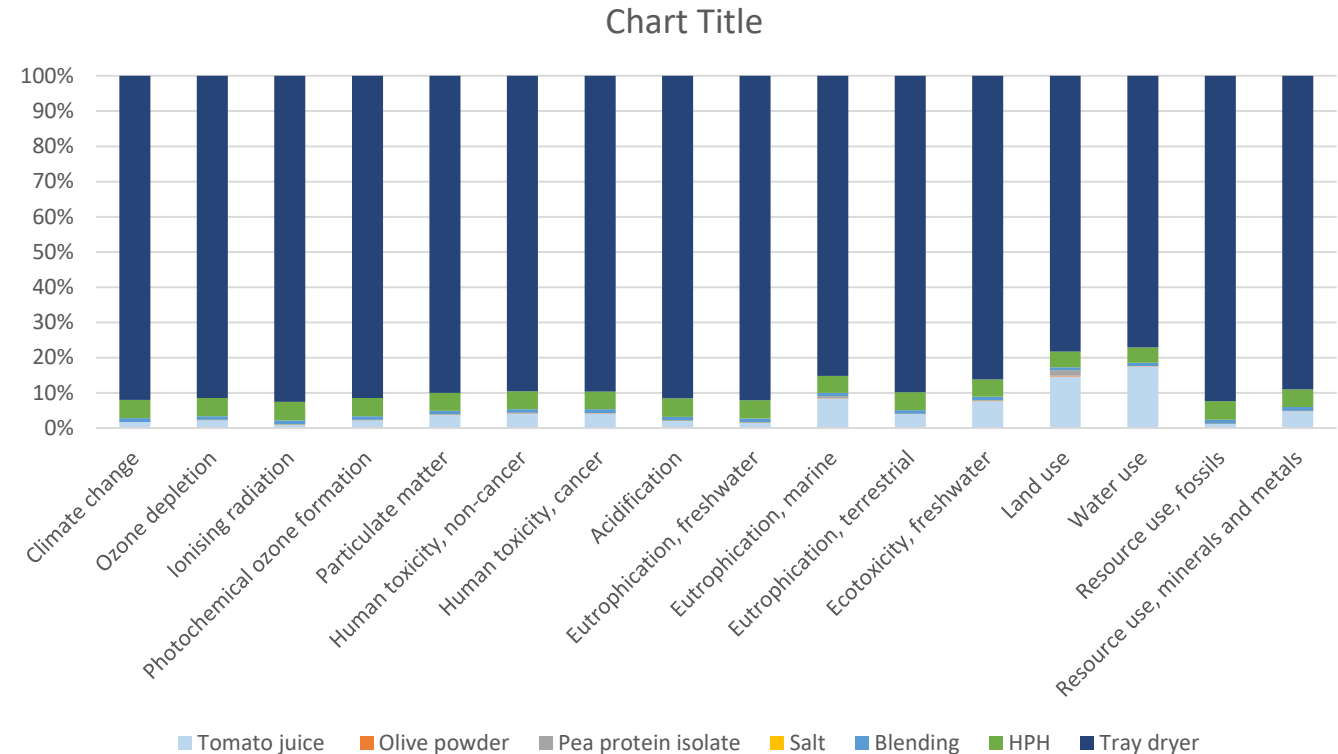


LCA: TOMATO LEATHER

Energy consumption linked to the tray dryer is the main contributor to the IC (77-92%)

Next steps

- To review energy mix.
- Data collection at pilot scale.
- Costs inventory for LCA and S-LCA.
- To define a baseline to compare with.



FunTomP sustainability assessment

- Energy consumption represents, on average, the main contributor to impact categories.
- Opportunities for efficiency improvements when scaling up.
- Renewable energy sources and heat waste management might be considered.

NEXT STEPS

- To review energy mix modelling and compare it with total renewables.
- Data collection at pilot scale.
- Costs inventory for LCA and S-LCA.
- To inventory liquid products and packaging.



Certification roadmap

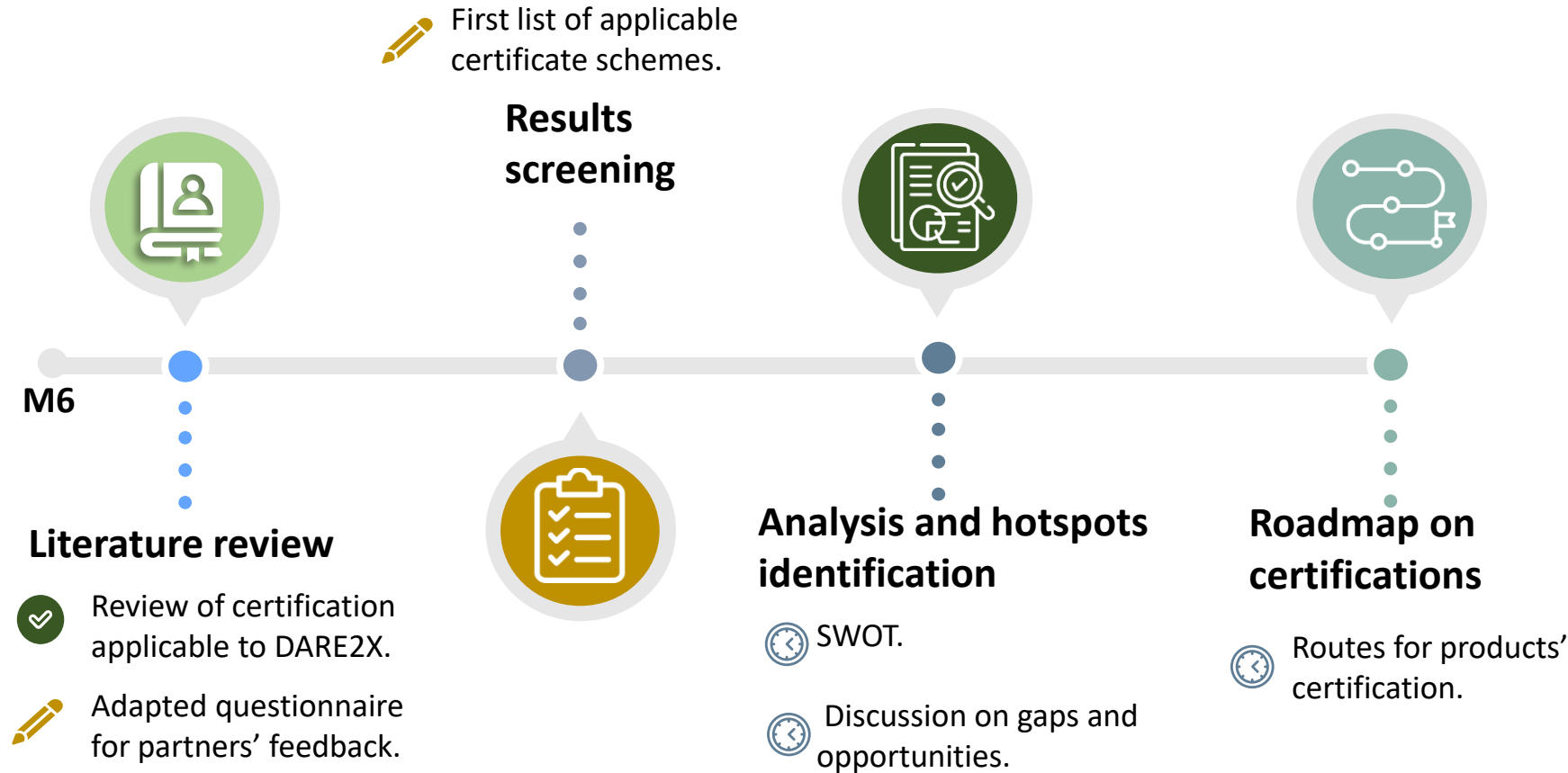
WP4 – Task 4.6



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FunTomP certification roadmap



FunTomP certification roadmap

Certification	Responsible Organization	Topic
FOSHU	Ministry of Health, Labour and Welfare of Japan	Functional Food
UN	UN-FAO	
WHO	WHO	Focused on overweight and healthy food
OECD	OECD	Food safety recommendations
ISO-22000 ISO-22500 ISO-22002-4 ISO-9001 ISO-22000-34	ISO	Certification of several aptitudes for food and food-related processes: Food Safety, Traceability, Manufacturing, Quality, Allergens Management.
Integrated Pest Management (IPM)	Eu	Sustainable and non-depending on chemical fertilizers crops-