How to encourage putting technological innovations for food producers and food SMEs into practise : The experience of the EU-FAIRCHAIN project

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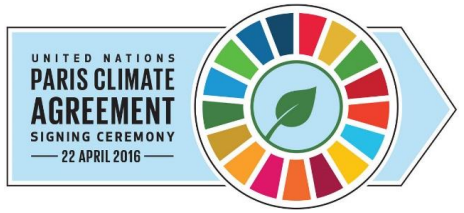
Context



- Dominant agri-food systems are based on **long supply chains**
  - Mass production, lower prices, economies of scale, resources efficiency … ☑
  - Globalised, concentration of profit, high-tech processing ☒
    → economic, social, environmental issues
- **Short food value chains** involve a limited number of actors (no more than one intermediary)
  - Greater social cohesion, fairer price for farmers, creation of jobs at local level, … ☑
  - Insufficient production volumes, higher prices, limited distribution, difficulties on treating and valorizing small volumes of co-products, effluents … ☒

→ **Mismatch** between **demand** of the citizen for local, affordable and nutritious food produced in a fair and sustainable way and **supply** of such food by actors of the food value chains

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Context

→ Enable small and mid-sized farmers and food producers to scale up and expand production of nutritious food through sustainable food value chains

- 99,1 % of all EU food companies are SMEs (2.8 Mio workers)
- 70% of SMEs do not engage in any formal R&D activities
- 20% of SMEs are « technology-adopting enterprises »
- 10% of SMEs are carrying out innovative and research-fuelled activities

(FoodDrinkEurope, 2016)

EU-FAIRCHAIN Project (2020-2024)

- **Objective** : Test, pilot and demonstrate **technological, organisational and social innovations** that have the potential to support the scaling up and expansion of small and mid-sized farmers and food producers

Acronym	FAIRCHAIN
Title	**Innovative technological, organisational and social solutions for FAIRer dairy and fruit and vegetable value CHAINs**
Topic RUR-06-2020	Innovative agri-food value chains : boosting sustainability-oriented competitiveness under the programme SC 2 “Food security, sustainable agriculture and forestry, marine, maritime and inland water research and the bioeconomy” → Innovation Action
Budget & funding	Overall budget: 8 036 566 € EU contribution: 6 996 636 €
Duration	1 November 2020 – 31 October 2024 (48 months)
Consortium	A total of 22 partners from 8 countries

Objectives of this talk

- Present the **methodology** put in place in the FAIRCHAIN project to ensure the successful implementation of innovations in selected value chains

- Present **technological innovations**
  devoted to SMEs and producers,
  developped, demonstrated and implemented in the FAIRCHAIN project

- Discuss
  Challenges in adopting these innovations
  Supporting and hindering factors for putting innovations into practice
  Possible solutions for their successful implementation

- Formulate **recommandations** to encourage the adoption of technological innovations by SMEs

Issues & Innovations at the start of FAIRCHAIN

Main issues	List of anticipated Innovations		
	Technological Innovations	**Organisational innovations**	**Social Innovations**
Better use of co/by-products	Fermented whey-based drink, **CS-Fra** Alternative cleaning agent (vinegar), **CS-Swi**		
Improve packaging and distribution of fresh food liquids	Flexible filling machine using sustainable packaging materials and designed to fulfil hygienic requirements, **CS-Bel**	Distribution with reduction of packaging consumption, **CS-Fra**	
Improve trustworthly traceability and information sharing	Blockchain, **CS-Gre**		
Bring high technology usage to small size actors	Blockchain, **CS-Gre** ICT tool for berry tracking , **CS-Swe**	Sharing of processing equipment, **CS-Bel** and/or infrastructure, **CS-Swi**	Food Innovation Incubator, **CS-Aut**
Developp innovative funding systems			Funding system based on philanthropic income streams, **CS-Bel**
Build networking & better innovation awareness			Food Innovation Incubator, **CS-Aut**

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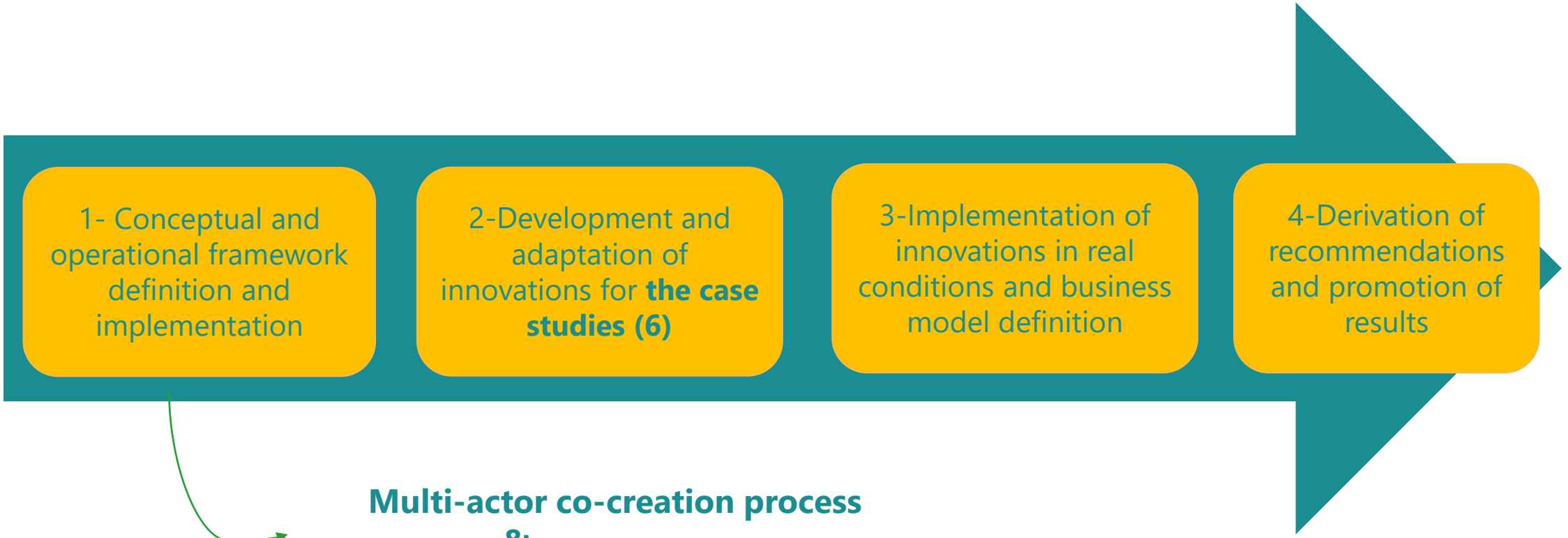
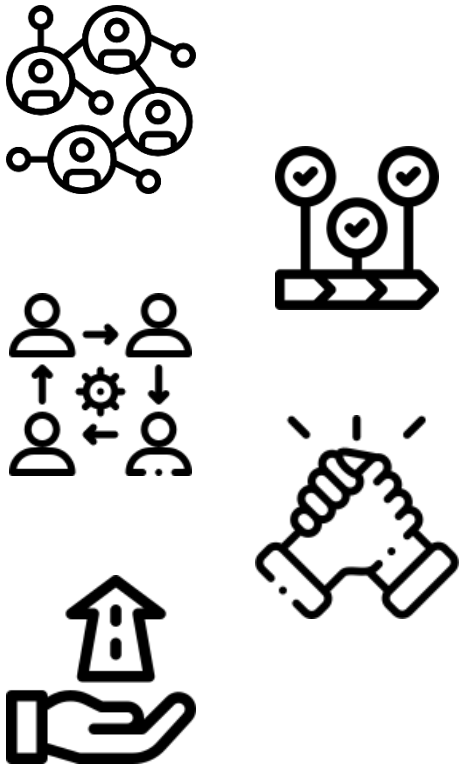
Developp innovative funding systems	
Build networking & better innovation awareness	

- Lack of time to carry out innovation activities
- Difficulties of getting access to finance for innovation activities
- Lack of business and management skills
- Lack of knwledge of legal frameworks
- Fear of losing customers
- Cultural and language barriers

FAIRCHAIN's methodology



Multi-actor Co-Creation Approach: Goals



- Integrate **expertise** from different stakeholders
- Include and address stakeholders and actors across the **entire value chain**
- Generate **new perspectives** on each of the case studies
- Ensure **fair(er) distribution** of benefits and risks along the value chains
- Design the new/reconfigured value chains in each case study
- Foster **collaboration** and partnerships among stakeholders that can thrive and grow **beyond the duration of the project**.
- Foster **exchange between** the different FAIRCHAIN **case studies** to provide new insights from other areas of expertise and can lead to spill-overs.

The FAIRCHAIN Co-creation process

WS#1:
Goal-defining workshops
Concept development, test and training workshop

CASE STUDY

WS#2:
Implementation workshops
Concept development, test and training workshop

CASE STUDY

WS#3:
Mid-term review workshop

Concept development and moderation for all case studies

CASE STUDY Austria
CASE STUDY France
CASE STUDY Sweden
CASE STUDY Belgium
CASE STUDY Greece
CASE STUDY Switzerland

WS#4:
Final review workshops
Concept development, test und training workshop

CASE STUDY

The workshops in the case studies are carried out by the project partners

Expert in co-creation methodology
- Concept for FAIRCHAIN co-creation approach
- Guidance for practical implementation
- Cross-case study outcome analysis

Goals — *Implementation* — *Mid-term* — Final review

Have we achieved our goal ?

Which steps, actions and competencies are required by which actor to achieve the goals and implement the innovation?

What do you want the case study to achieve?
What are the most pressing concerns for the respective case study?

Key aspects/challenges for a successful co-creation

- **No default co-creation process**; must be tailored specifically to case study setting and stakeholder resources
- **Representativity**: Stakeholder identification and involvement according to PESTEL, affectedness and influence, covering all stages of the value chain
- **Early involvement:** influence/ give stakeholders the opportunity to shape (parts of) the case study
- Openness for **different kinds of innovation** (technological, organizational, social)
- Task definition, influence, transparency: very **clear communication** of co-creation workshop goals, what is negotiable, what not
- **Fair and transparent** decision-making and conflict-solving processes

Specific effort to involve SMEs or small producers

Important steps: identify stakeholder, facilitate dialogue and knowledge sharing, incentivise stakeholders, build long-lasting cooperations

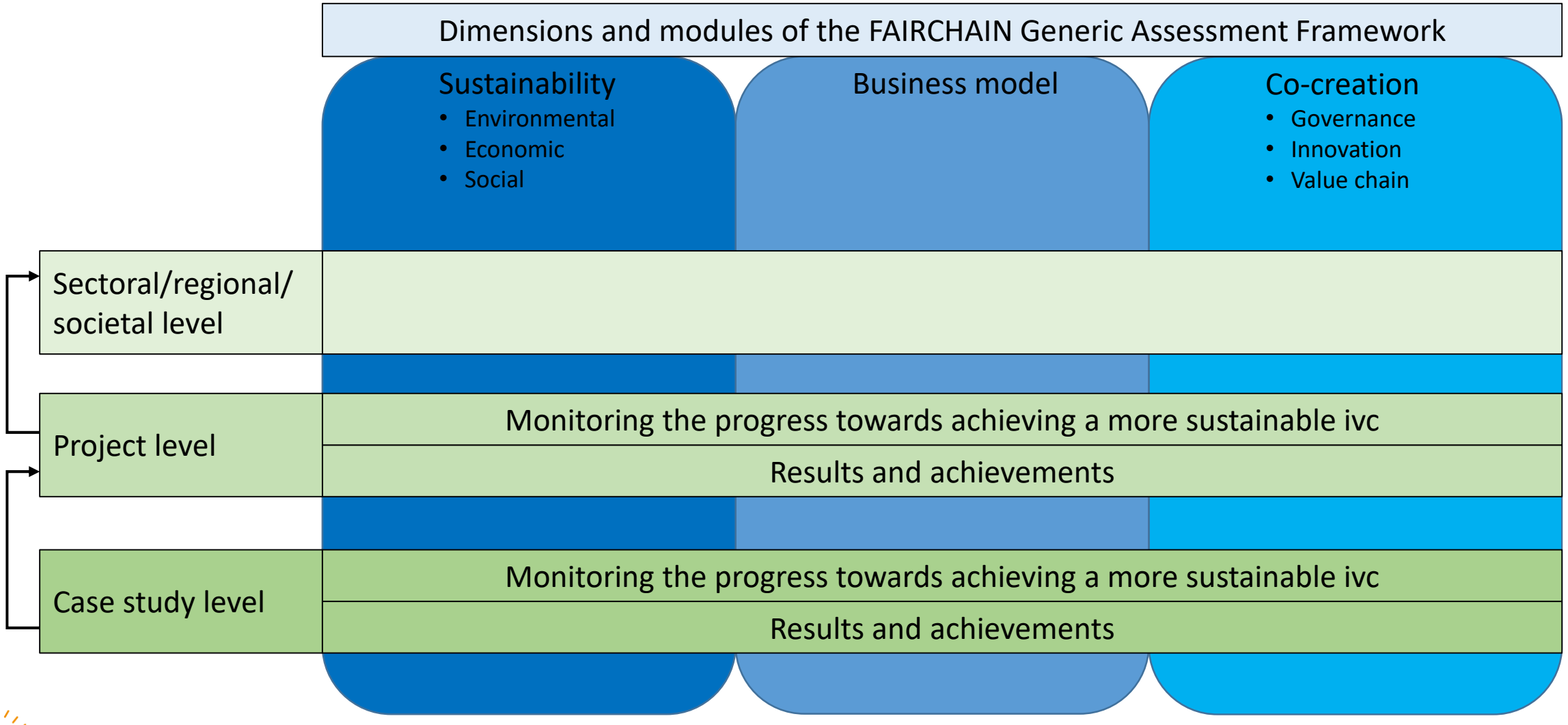
Assessment framework : Goals

- High-quality case study execution
  - integrate stakeholder perspectives, sustainability and business model development right from the start of the innovation process
  - ensure that sustainability hot spots are addressed
  - ensure that suitable business models are developed
  - provide guidance between different options
  - compare before – after and monitor progress towards goals

- Project achievements must be more than the sum of the case study achievements
  - unifying function of the methodology
  - allows cross-case study analysis

- Team-building function in the consortium
  - close interactions between project partners when elaborating and applying the methodology
  - inducing mutual learning processes

Structure of the FAIRCHAIN Assessment Framework




Innovative fermented whey-based drinks

Current situation versus aim

Whey

Curd
(Cheese)

Vevy

The Vevy cheese dairy

Processing 1

Pressing

Slightly acidified whey

Sweet whey

Sweet whey

Preconcentrator plant

Drying plant

Long dominant value chain

Processing 2

Molding & maturing

Slightly acidified whey

Wastewater treatment plant

Comté

PDO (Protected Designation of Origin) cheeses

Tomme

Raclette

Morbier

Current situation versus aim

→ Find a new route adapted to small and mid-sized actors at a regional level for upgrading value of whey by developing innovative fermented whey-based drink

The Vevy cheese dairy

Processing 1

Pressing

Sweet whey

Sweet whey

Processing 2

Molding & maturing

Comté

PDO (Protected Designation of Origin) cheeses

Slightly acidified whey

Preconcentrator plant

Drying plant

Slightly acidified whey

Wastewater treatment plant

Fermentation
+ « zero waste » distribution mode
(Reusable bottles / Bulk distribution)

Tomme

Raclette

Morbier

The technological innovation
Development of the fermented whey-based drinks

- Determine heat-treatment conditions to stabilize wheys (lab-scale → pilot)

  Obj: Remove native cheese whey micro-organisms with minimal impairment of whey organoleptic properties

- Screen and select the micro-organisms on wheys alone
  - Screening of > 125 lactic acid bacteria (or consortia of yeasts + lactic acid bacteria) on ≠ wheys to identify the strains with the best acidification and sensorial properties

    →Selection of 20 promising strains on Comté acid whey and 32 strains on Morbier sweet whey

- Carry out fermentation assays on wheys mixed with fruits/vegetables/herbs
  - → Over 15 flavours (fruit juice or herb) were tested,
  - → Selection of **4 bacteria strains** (/ whey type) working well in association with (at least) one flavour
  - → Some of the best prototypes were tasted and validated by CS-Fra team

→ Many options / degrees of freedom (flavours, texture, … conditions of storage, type of packaging …)

Main learnings from the co-creation process

- **Support and reassurance to be on the right track → New stakeholders** are prone to actively participate

  (ex: The Franche-Comté region, Ademe (French agency for the Environment and Energy Management), « J'aime Mes bouteilles » …)

- **Need for higher consumer and demand orientation → Definition of consumer expectations / innovative drinks**

  →Need to emphasis of the 'story-telling' of the innovative drinks & identify the targeted consumers to better define the drink features

  →Need to co-develop the drink with the consumer at an early stage

  → Re-organisation of activities, planning, budget

  → Extra consumer studies → 2 main « drink concepts » that best suit consumers **validated by stakeholders :**

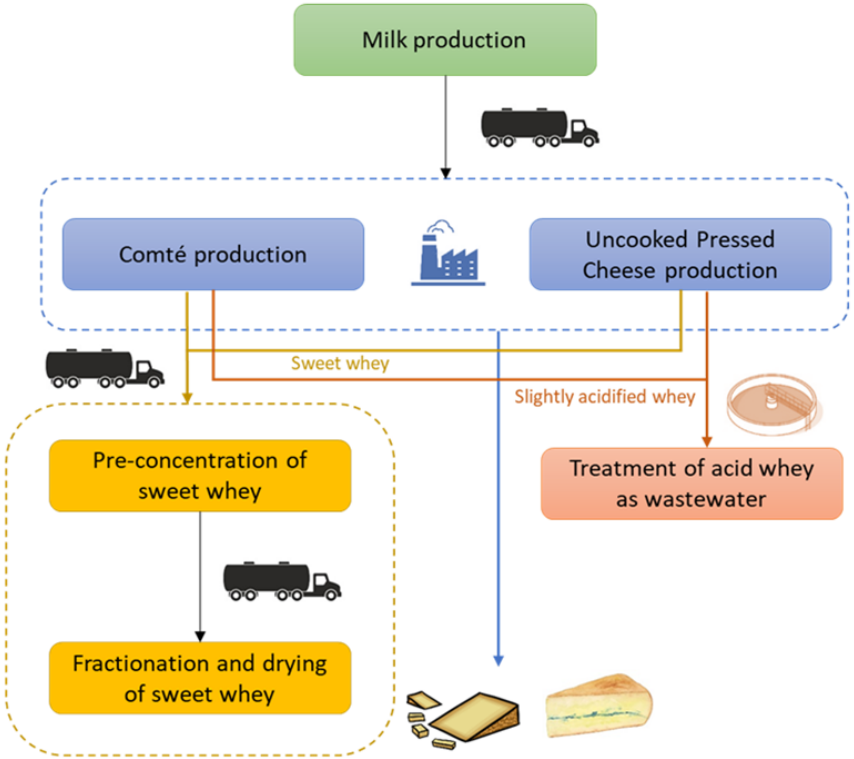
  "Whey-based Kefir"; "Fruit whey-based drink";

  → Priorization of technological development → 6 drinks (association of strains/ whey/ flavours) were selected

- **Emergence of new ideas and/or barriers that need to be investigated**
  - Constraints in the development of the new business models : low volume of whey to be collected, high cost of collection, storage, and production/distribution; constraints imposed by the protected designations of origin (PDO) regulation of cheeses, …
  - Weak know-how of the cheese makers regarding fermentation ; lack of equipment in the current cheese dairies;
  - Definition of a specific brand for the drink

Main learnings from the assessment baseline

From an environmental perspective



			Milk production	At cheese factory	Whey valorization	Transports	Wastewater treatment
Climate change (CC)	1,53E+07	kg CO2 eq					
Ozone depletion (OD)	4,66E-01	kg CFC11 eq					
Ionising radiation (IR)	1,29E+06	kBq U-235 eq					
Photochemical ozone formation (POF)	2,07E+04	kg NMVOC eq					
Particulate matter (PM)	1,09E+00	disease inc.					
Acidification (Acid)	1,59E+05	mol H+ eq					
Eutrophication, freshwater (Eutro-F)	8,38E+02	kg P eq					
Eutrophication, marine (Eutro-M)	2,74E+04	kg N eq					
Eutrophication, terrestrial (Eutro-T)	6,97E+05	mol N eq					
Land use (LU)	8,78E+08	Pt					
Water use (WU)	3,10E+06	m3 depriv.					
Resource use, fossils (Res-F)	6,07E+07	MJ					
Resource use, minerals and metals (Res-M)	1,52E+01	kg Sb eq					

Functional unit: “one-year cheeses production and whey ends-of-life at Monts & Terroirs Vevy production site”

Main learnings from the assessment baseline

From an environmental perspective

- The management of whey is not a hotspot (milk production and whey drying);
- Transport of whey from cheese dairies to valorization sites is not negligible → Production of the innovative drinks as close as possible to the cheese dairy + Transport of the drink at ambient temperature
- Life Cycle assessment → support the eco-design of the beverage / comparison of the beverage with others

Main learnings from the assessment baseline

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From a social point of view

- Generation of more jobs and reinforcement of the regional workforce.
- More stability and independence on the costs of current markets → Reinforcement of the independence of the regional players facing international market (whey) prices, which fluctuate according to world market demand (infant milk with Asia) or socio-political situations (like the war in Ukraine)

From an economical point of view

- More benefit for producers and processors, being part of the SODIAAL cooperative. They would benefit directly from the margin profit.
- The business model needs to consider the constraints imposed by PDO regulation and be defined by considering the volume, the cost of collected whey, storage conditions, and production/distribution modes and the different implementation schemes of the distribution reuse loop, including cleaning and packaging machine.

The main challenges of this technological innovation are related to **the economic sustainability of the innovative drink**, including its acceptability by the consumers/citizens and the business models including the "zero waste" distribution mode

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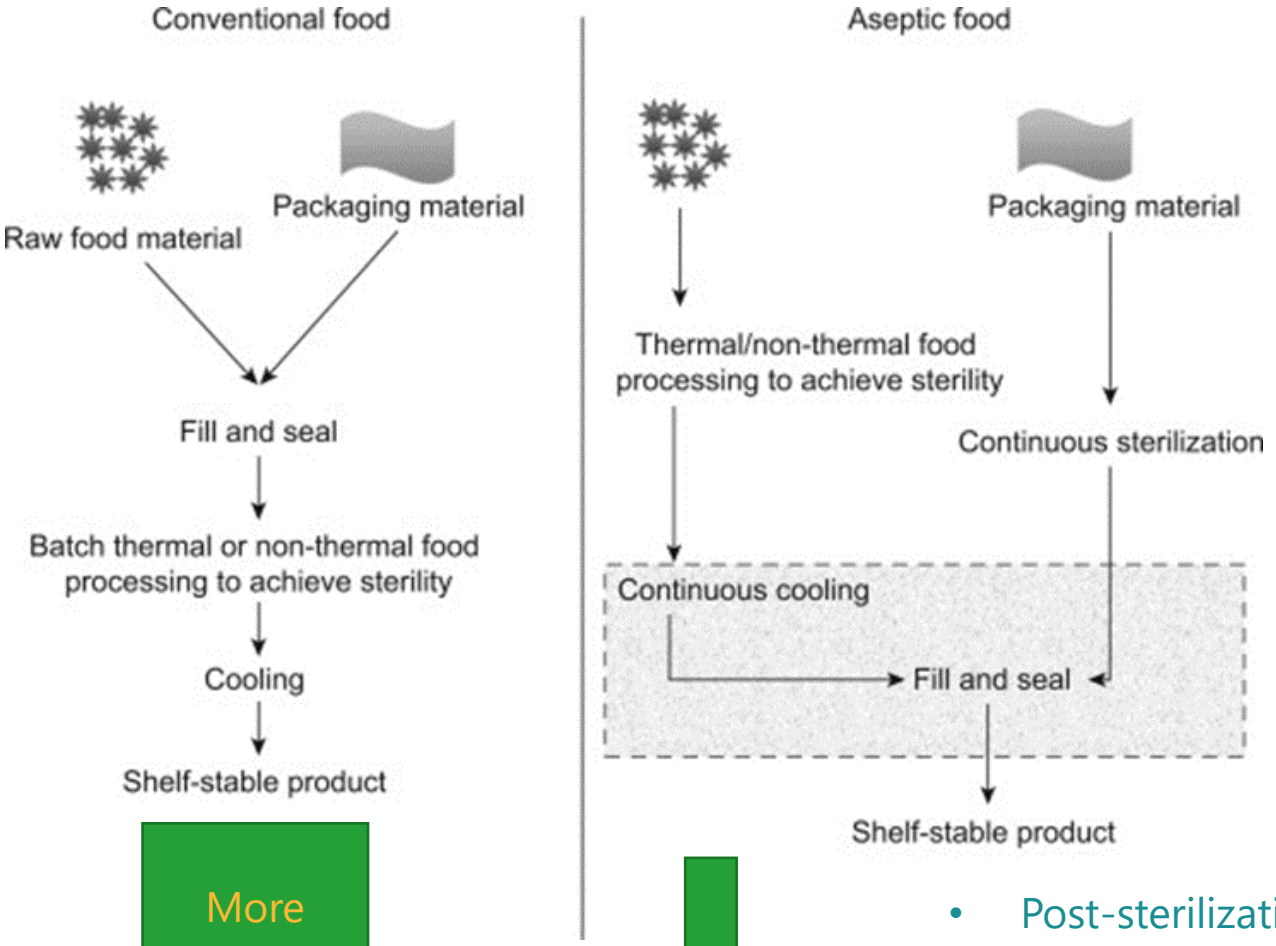
Innovative aseptic filling machine

Current situation versus aim



Fruit juice

- Up-scaling: Access; design and/or business models needed for small scale producers/farmers
- Down-scaling (process steps) big producers

Vegetable juice/soupe

Whey based drink

More energy and water use

- Post-sterilization is not needed resulting in less dropout
- Less energy may be expected
- Packaging material could also be less resistant allowing the use of different (biobased) materials
- …

The technological innovation

Development of small-scale aseptic filling machine + reusable packaging

- Establisment of the requirements for the new sustainable pouches
  - Collect data on the testing of the efficiency and desinfection of the packaging material
- Development of the requested packaging machine
  - Evaluate existing machines' design & Select the best machine options related to the objectives
  - Implement some important hygienic design principles
  - Select the air filter systems to render the machine aseptic
  - Select the additional equipment necessary to install around the machine (heat treatment, cleaning in place, desinfection of the arriving pouches before the filling areas)
- Measurement of the air quality around and in the machines of several companies

  Obj : Have an idea of the current air quality in the companies, to serve as input for the hygiene guidelines
  - Size of companies (farmer, SME producer, large producer)
  - Type of product

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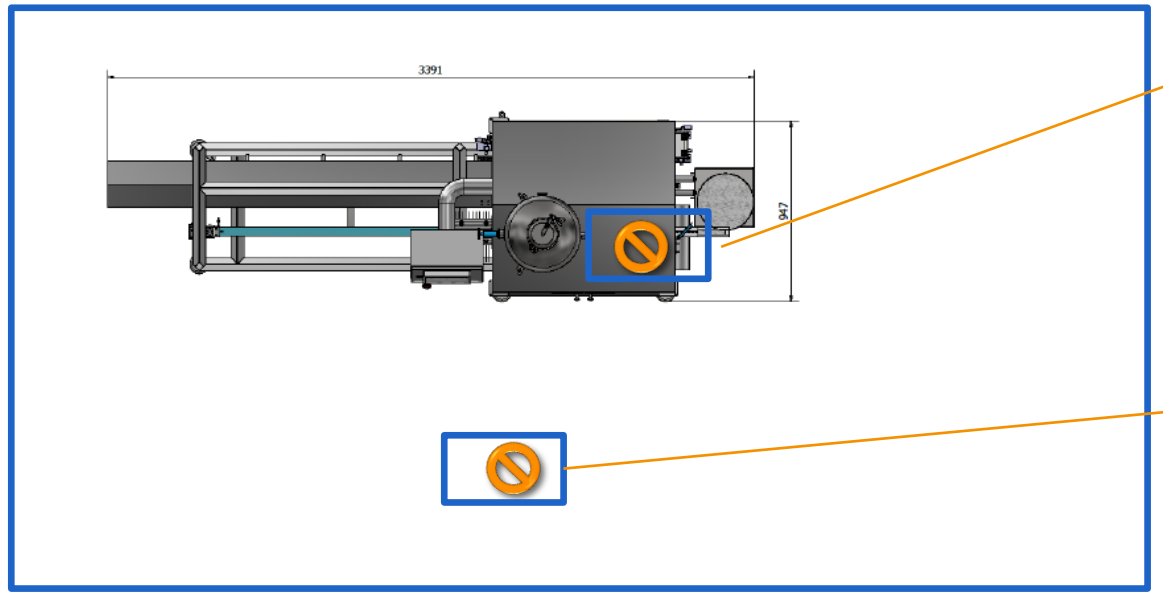
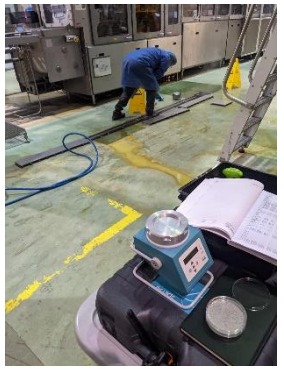
Hygienic design: e.g. air quality toward new guidelines

Measure air where packaging enters the machine following the method of Pasquerella, 2000 (1 meter from the machine, 1 meter height, for 1 hour).

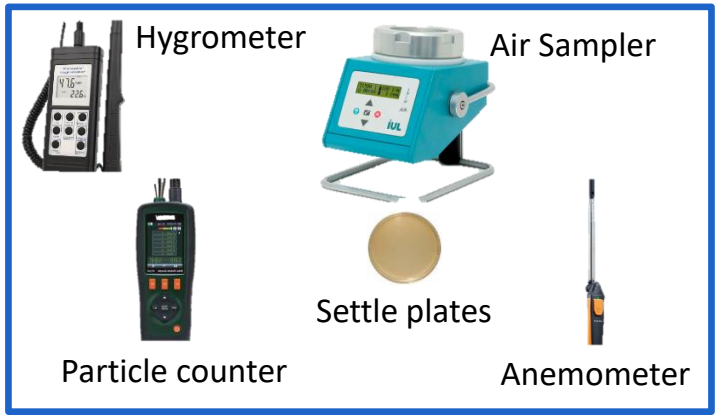


Inside Machine

Outside Machine



Air Sample Point



- Passive (Settle plates)
- Active (Air Sampler)
- Temperature (Hygrometer)
- Relative humidity (Hygrometer)
- Air Velocity (Anemometer)
- Particles/diameter (Particle counter)

Sampling campaign in Food Industry (Belgium)

Factory	TVC, Total Viable Count (Active)		
	n	$\bar{x}$ (CFU/m^3)	std
Dairy 1	24	**1.36**	0.46
Dairy 2	24	**2.25**	0.68
Dairy 3	12	**3.42**	0.16
RTE1	24	**1.99**	0.38
RTE 2	24	**2.07**	0.39
RTE 3	12	**2.30**	0.18
RTE 4	24	**1.68**	0.52
Sauces 1	18	**2.03**	0.33
Sauces 2	18	**2.83**	0.27
Sauces 3	18	**2.37**	0.14
Other 1	24	**2.72**	0.21
Other 2	12	**3.21**	0.18
Other 3	6	**2.83**	0.09
Other 4	24	**1.35**	0.65

*n – number of samples, $\bar{x}$ - mean in CFU/m^3, std - standard deviation

Preliminary results show:

- Significant differences between factories for airborne contamination of TVC and Yeast/Mould ($p<0.01$) for active and passive measurements

- No correlation between relative humidity and active/passive counts
- No correlation between temperature and active/passive counts
- The most decisive influencing factor appears to be the type of ventilation system.

The air quality of the food company is influenced by a combination of various factors, and it is this collective influence that determines the risk of airborne contamination.

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Main learnings from the co-creation process

- **Support on the development of the machine and reassurance to be on the right track**
  → Identification of the requirements for the machine to be developped in terms of hygienic design, cleanability, efficiency, and ease of use (especially for small actors)
    - Ex Efficiency: Ability to fill small volumes, multi-format machine, flow-rate to be treated (1000-5000L/h); ability to package fibrous products

- **Need to focus on two machines**

  Reasons : complexity to reach the air quality of the food company / high investment of the machine
    - A « light-version » machine (not necessarily aseptic) for not fragile product, with packing at high temperature (ex: pasteurisation)
    - A « high-version » machine, aseptic, for fragile product with packing at low temperature

- **Need to focus on suitable business models**

  Reasons : high investment of the machine / seasonal use / flexibility of the machine

  → identification of 3 different suitable business models for the 2 machines

General perceptions of the solutions for users

Business models (BM)

BM1 Mobile packaging machine	+ Save time in transportation + No need to consider maintenance - Cost of the service for users and place needed	**Users with seasonal/punctual productions**
BM2 Individual ownership with open access	+ Areas already complying hygienic norms + No need for considering maintenance - Cost of the service, potential variability	**Users starting a new processing activity or with non-regular production**
BM3 Sharing in cooperative	+ Shared investment AND skills, workforce, and other resources + Being part of the governance - Higher administrative charge	**Users with similar needs and more regular productions**

Business models in the form of "shared workshops" or "food hubs" seems appropriate to small and mid-sized actors (compatible with BM2 and BM3).

The business models imply technological adaptations

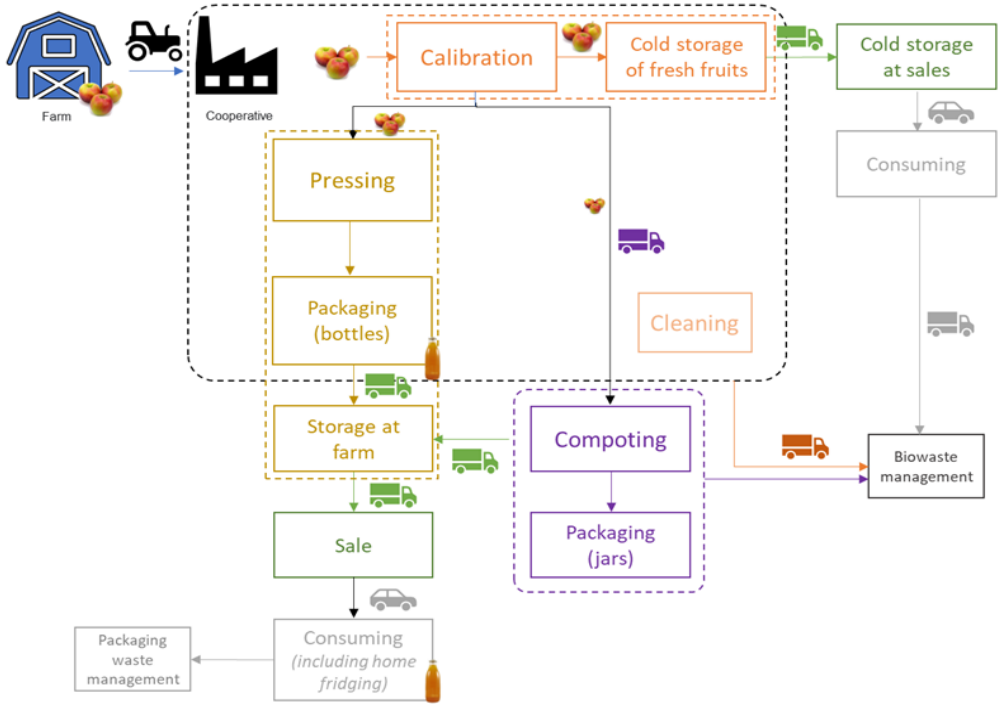
Two common aspects to the 3 Business Models (BM):

➔ The question of the cross-contamination (allergen, plant-based vs. animal products, organic vs. conventional)

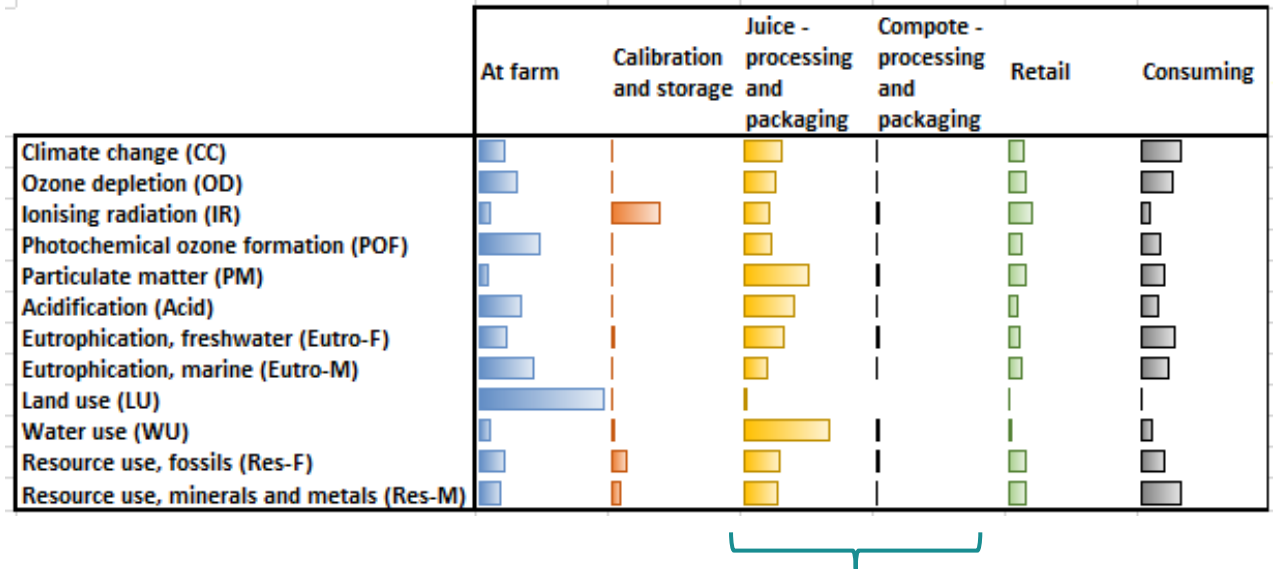
➔ The need for associating the packaging machine to other processing machines to consider the whole process

Main learnings from the assessment baseline

From an environmental perspective



Functional unit: « one year production of fresh apples, juice and compote delivered to the consumer »



From 3% to 73% of the total impacts related to the processing and packaging of juice and compote

Apple production in French Flandres

- Small producer: 3 ha
- Transformations: juice and compote (made off-farm)
- Packaging: glass bottles and jars
- Limited finance and workforce

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Main learnings from the assessment baseline

From an environmental perspective

- Environmental impacts are mainly due to 3 stages : the apple production, the juice processing and packaging, the consuming
- (The farmer is already very good at producing apples so its manœuvre is elsewhere)
- The innovation will modify the juice processing and packaging so could have a direct benefit

Main learnings from the assessment baseline

From an environmental perspective

- Environmental impacts are mainly due to 3 stages : the apple production, the juice processing and packaging, the consuming
- (The farmer is already very good at producing apples so its manœuvre is elsewhere)
- The innovation will modify the juice processing and packaging so could have a direct benefit

From a social point of view

- At the level of the farmer : More security and job creation, due to an increase in the range of products thanks to new processing possibilities
- At the level of small-scale processing : Development of protected jobs in adapted structures (return to work after a long period of unemployment, disabled workers)
- Involvement of the general public in the modification of the food system → Development of crowd funding

From an economical point of view

- Expansion of the market with upscaling
- Les running costs due to less water and energy use
- Better product shelf life and safety due to the hygienic design of the machine
- The selected business models need to take into account the expectations of the users (producers / processors).

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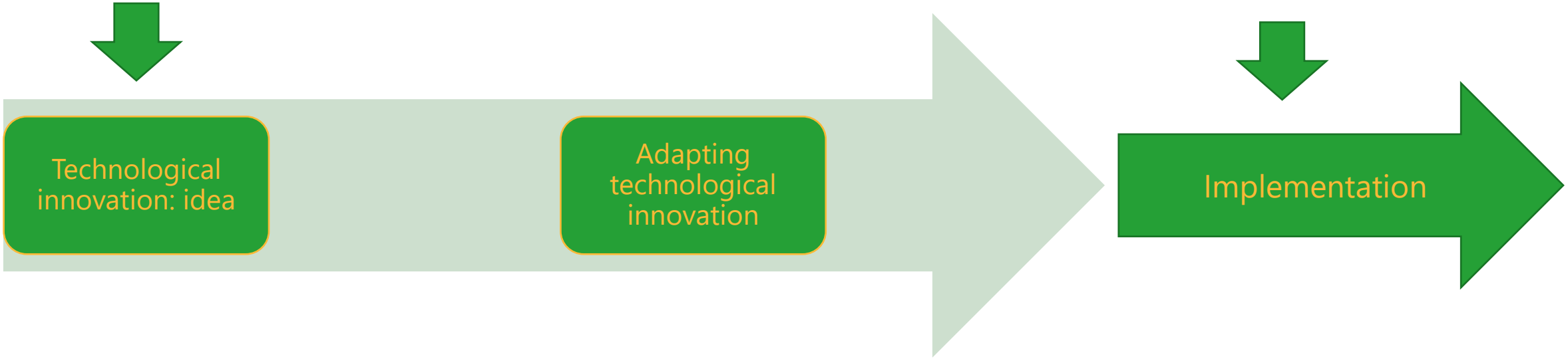
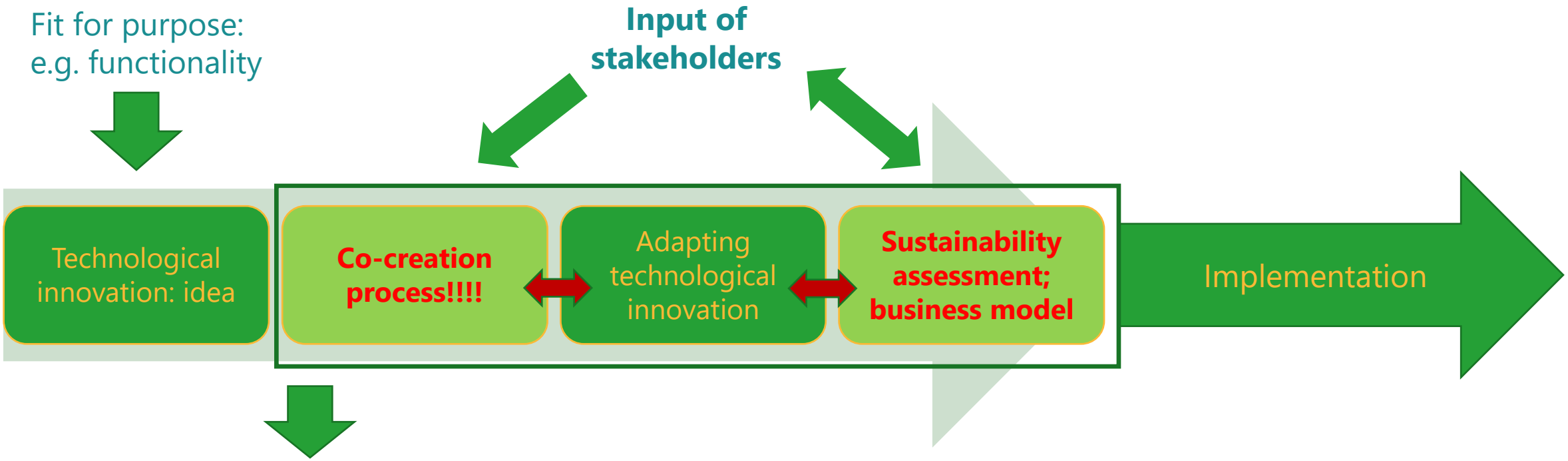
Take home messages, recommendations

Fit for purpose:
e.g. functionality

Input of stakeholders



Take home messages, recommendations



→ Co-creation multi-actor approach is a pre-requisite to achieve successful implementation of (technological) innovations

→ The sustainability and business models assessment are required to provide guidance between different options and assess the progress made

Take home messages, recommendations

- **Customer / Consumer knowledge**
  → be well aware of needs and wants of their customer and end-consumer base

- **Networking and collaborations**
  → Establish collaboration with institutions (universities, research centers, …) or industry technical centers for sharing knowledge

- **Facilities, tools and services**
  → Design equipment with simplicity, clarity and compatibility in mind,and/ or have the option to be done in a service-type mode
  → Use of experimental and testing facilities of prototypes of new solutions and tools

Take home messages, recommandations

Building of projects aiming at implementing technological innovations

- **Choose a "good consortium“**
  - a small number of multidisciplinary academic partners (expert in food technology, process engineering, ... co-creation, assessment, business models, ...)
  - private partners with complementary skills and knowledge with a strong motivation and open mindedness

- **Plan to set up co-creation approaches from the beginning of the project**

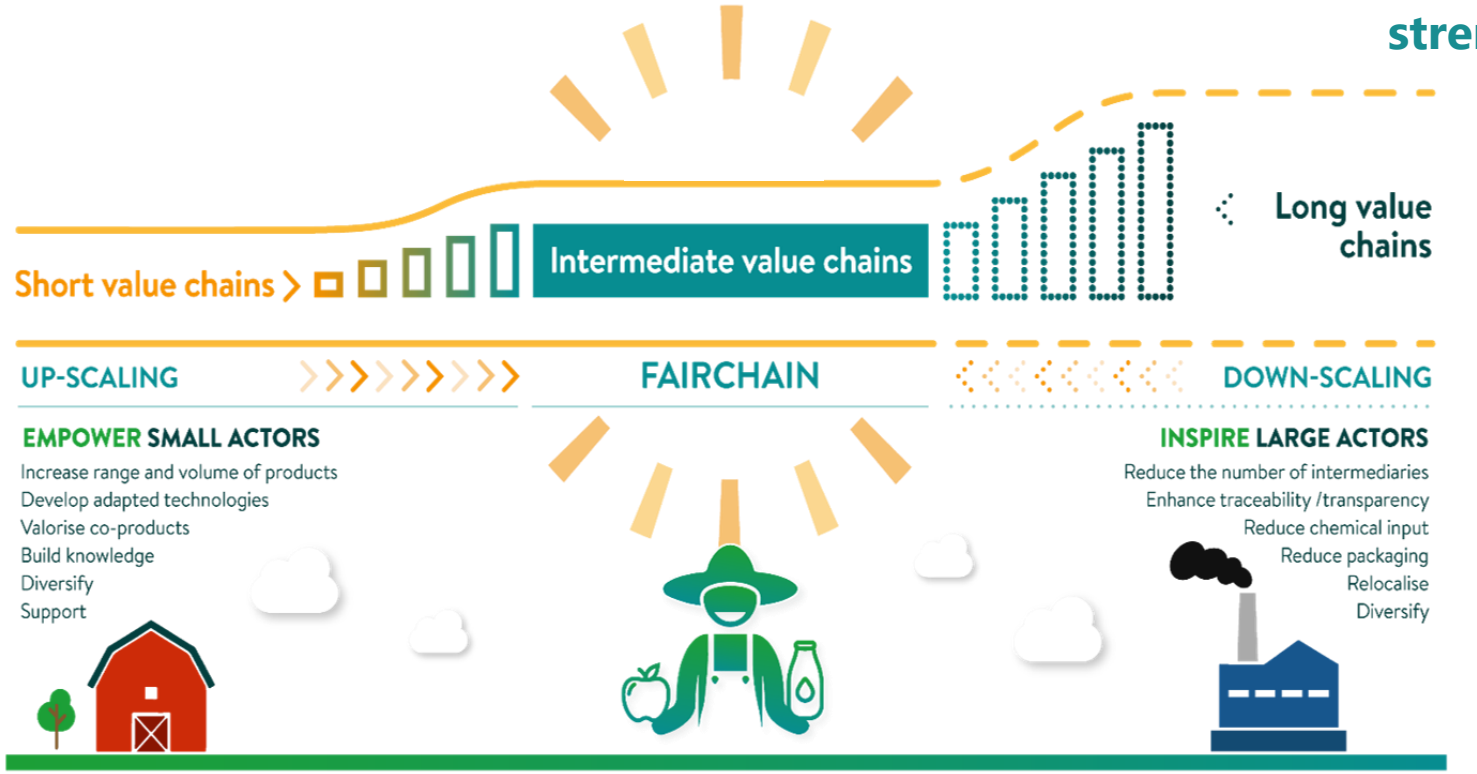
- **Foresee a financial contribution** to involve stakeholders (non-partner) in the project

- **Be flexible** (time (schedule of the tasks) and budget (new tasks, new innovations ...) !

FAIRCHAIN

Innovative technological, organisational and social solutions for FAIRer dairy and fruit and vegetable value CHAINs

Goal : Enable small and mid-sized farmers and food producers to scale up and expand production of nutritious food through **competitive intermediate value chains** at the regional level



Focus on postharvest steps in dairy and fruits & vegetables sectors

Intermediate value chains combine the strengths of both short and long chains while avoiding their weaknesses

They are characterized by

- **cooperation of mainly small and mid-sized actors on a network or strategic alliance;**
- **trusted and transparent relationships** and a **fair distribution** of value created among the involved actors (win-win situations)
- implementation of **common values** through **collective organisation**.

They supply **sustainable and high-quality food products** to consumers beyond the local market **in greater quantities** - often on a regional level- with facilitated access for consumers.

Objectives

Main Objective

Test, pilot and demonstrate **technological, organisational, social innovations** that have the potential to support intermediate value chains and address some of their issues

Specific Objectives

Deliver a **set of innovations** at technology readiness level (TRL) 7, fostering the emergence of competitive intermediate value chains

Develop **business models** associated to these innovations and carry out environmental, social and economic impact assessment

Formulate **recommendations,** create **tools and guidance documents,** promote the results to ensure uptake and replicability of value chains developed within FAIRCHAIN

Case studies and innovations at the start of FAIRCHAIN

CS-Aut

Food Innovation Incubator

Food Innovation Incubator

CS-Bel

Innovative packaging machine for small and mid-sized actors

Flexible filling machine

Sharing of processing equipment and/or infrastructure

Funding system based on philanthropic income streams

CS-Fra

Production and distribution of innovative dairy drinks based on co-products of cheese

Fermented whey-based drink

Distribution with reduction of packaging consumption

CS-Gre

Traceability and reliable information sharing in local dairy production

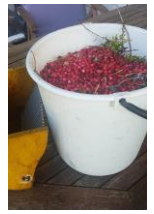
Blockchain

CS-Swi

Fruit co-product valorisation for SMEs and regional stakeholders

Alternative cleaning agent

Sharing of processing equipment and/or infrastructure



CS-Swe

Developing wild berry business to boost local economy and social cohesion

ICT tool for berry picking

Technological	Organisational	Social

Innovations

Consortium

A multidisciplinary partnership including **22 organisations** in **8 countries**

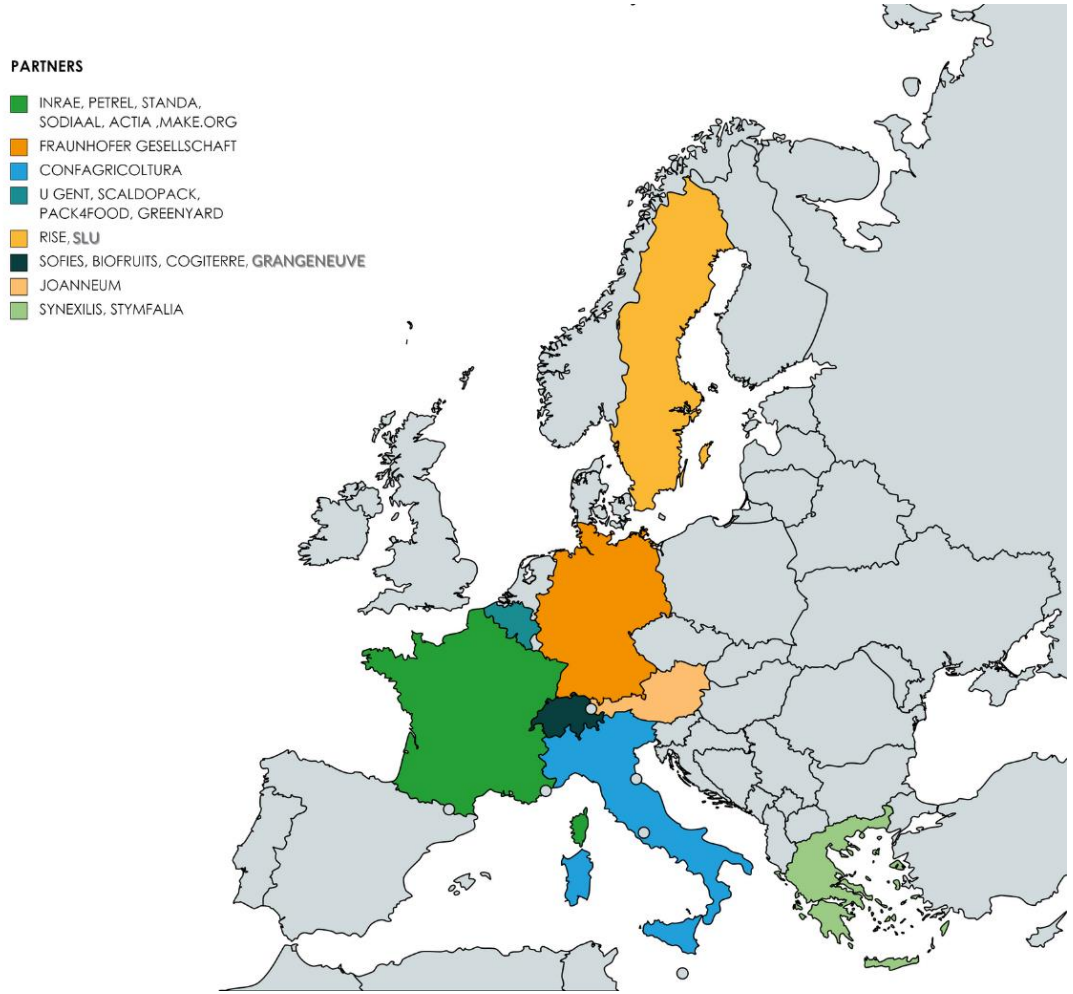
(process engineering, environmental science, supply chain management, logistics, economy, marketing, social science, sensory and consumer science, information and communication technology, technology transfer…)

Research (5+2)
INRAE, RISE, FH JOANNEUM, Fraunhofer-Gesellschaft-ISI, Universiteit Gent, GRANGENEUVE, SLU

SMEs (8)
Scaldopack, Petrel, Laboratoires Standa, DSS (ex Sofies), Biofruits, Cogiterre, Synexilis, Stymfalia
(end-users, processors and associated farmers, equipment providers, distributor, etc)

Industry
Pack4Food, Greenyard, Sodiaal

NGOs
ACTIA, Confagricoltura, ISEKI-Food, Make.org foundation



Consortium

INRAE

RI. SE

FH | JOANNEUM
University of Applied Sciences

GHENT UNIVERSITY

Fraunhofer ISI

ACTIA

Pack4Food

Confagricoltura

PETREL
COMMERCE CIRCULAIRE

scaldopack

dss+
sofies
leading sustainability

SYNELIXIS

Bi fruits

Cogiterre

Stymfalia

ISEKI Food Association

MAKE. ORG FOUNDATION

SODIAAL INTERNATIONAL

ETAT DE FRIBOURG
STAAT FREIBURG
Grangeneuve

SLU Swedish University of Agricultural Sciences

GREENYARD

FAIRCHAIN

Linked third parties

itab
l'Institut de l'agriculture et de l'alimentation biologiques

ACTALIA

MONTS & TERROIRS
De merveilleux fromages

Keep in touch with FAIRCHAIN!

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FairchainEU

How to encourage putting technological innovations for food producers and food SMEs into practise : The experience of the EU-FAIRCHAIN project

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