

LOCAL FOOD SYSTEMS

Recipes for future proof business models



The FOX project

FOX is a unique collaboration between universities, research institutions, small to medium enterprises, industries and associations, who are extremely grateful for the financial support of seven million Euro from the European Commission's Horizon 2020 Research and Innovation programme. The project lasts for 4,5 years (2019–2023).

FOX stimulates short food supply chains for fruit and vegetables by applying small innovative mild processing technologies. The approach creates business opportunities for regional hubs and provides qualitative processed foods to be indulged by the local community.

www.fox-foodprocessinginabox.eu

The FOX partners

Deutsches Institut für Lebensmitteltechnik / Stichting Wageningen Research / Katholieke Universiteit Leuven / Fraunhofer Institute for Systems and Innovation Research ISI / Aarhus Universitet / Ainia / Výzkumný Ústav Potravinářský Praha / Szkoła Główna Gospodarstwa Wiejskiego / Inštitut za nutricionistiko / Stichting EFFoST / Elea Vertriebs- und Vermarktungsgesellschaft mbH / European Food Information Council / Centre Technique De La Conservation Des Produits Agricoles*CTCPA / Kompetenzzentrum Obstbau-Bodensee / Stichting Food Tech Park Brainport / Falkenstein Projektmanagement GmbH / Linpac Packaging Pravia, S.A. / Terra I Xufa Societat Limitada / Ochsen, Tomáš Ignác Fénix / Agrární komora České republiky / Cedrus spółka z ograniczoną odpowiedzialnością spółka komandytowa / Společnost mladých agrárníků České republiky, z.s. / Sady Tucharaz spol.s.r.o. / van Rijsingeningredients B.V. / Hutten Catering B.V.



LOCAL FOOD SYSTEMS

Recipes for future proof business models

Case studies on how innovative food processing technologies can be used economically to boost local food value chains.

Main Authors

Björn Moller, Lorenzo Giacomella, Anna Kirstgen

Introduction

Welcome to “LOCAL FOOD SYSTEMS – Recipes for future proof business models,” a comprehensive brochure exploring innovative food processing technologies and their economic impact on local food value chains. In today’s rapidly changing landscape of digital technologies, regulations, and markets, the robustness of business models is paramount. This brochure delves into the evaluation of business model components and introduces an effective approach, which we call business model robustness test.

Drawing upon concepts from business model (BM) innovation and scenario planning, our proposed method provides a structured framework to assess the robustness of business model components. We address crucial questions such as how to describe business models, identify relevant changes in the environment to test against, evaluate the impact on business model components, and leverage the results to strengthen the overall model.

Our approach facilitates the testing of individual business model components as well as their inter-relationships, visualizing potential challenges and suggesting strategies to enhance their robustness. It proves particularly valuable during the experimental phase of business model development, aiding companies in choosing between alternative models and successfully implementing their chosen approach.

Within the robustness check, a vital component is the creation of a “Heat Map.” This Heat Map takes the form of a BM canvas. Through a carefully designed coloring scheme, the Heat Map visually represents the impact of the scenarios on each BM component: A red color indicates that the outcome of the stress factor renders a BM component no longer feasible. This signifies that the stress factor has the potential to become a significant obstacle, potentially derailing the entire business model. An orange color signifies that the outcome of the stress factor makes a BM component no longer viable. Adjustments may be necessary to ensure the continued viability of the overall business model. A green color denotes that the outcome of the stress factor even strengthens the feasibility or viability of the BM component.

Embark on a journey through this brochure, where we explore the transformative potential of innovative food processing technologies and mobile units and their economic implications for local food systems. Discover how robustness testing business models can unlock new avenues for growth and resilience in an ever-changing landscape. Let us empower you with the knowledge and tools needed to shape future-proof business models and thrive in the face of uncertainty.

FOX – Food processing in a Box – is a project in which more than 25 European partners aim to transform large-scale technologies for the processing of fruits and vegetables, to small, flexible and mobile units in your neighbourhood. FOX is all about health and sustainability – and how technologies can support and promote these goals. The innovative processing solutions are therefore flexible, resource-efficient, and based on seasonality and demand. It considers the expectations of farmers and small food businesses, looks at the technical and economic feasibility, and takes into account the needs of consumers and the food chain. The latter will be actively involved in the development of new products and new business options for sustainable consumption. This allows for transparency and trust in the food chain. FOX stimulates short food supply chains; transitioning from a more centralised industry, to local production hubs. So-called food-circles are the European regions in which the FOX technologies will be demonstrated to be integrated into the entire food production chain.

Content

7 Approach

FOX Business Models
Three scenarios for Europe's food sector in 2035
Business Model robustness check – Methodology

1

20 Food Circle 1: Low-oxygen extraction and mild preservation

Concept of Food Circle 1
Innovative Technologies in Food Circle 1
FC1 Business Model: a farmer adopts the FOX mobile unit
Food Circle 1 robustness check

2

28 Food Circle 2: Low-temperature drying

Concept of Food Circle 2
Innovative Technologies in Food Circle 2
FC2 Business Model: a farmer adopts the FOX mobile unit
Food Circle 2 robustness check

3

36 Food Circle 3: Innovative Quality Analysis and Packaging for Fresh Fruit and Vegetables

Concept of Food Circle 3
Innovative Technologies in Food Circle 3
FC3 Business Model: a cooperative of farmers adopts the FOX mobile unit
Food Circle 3 robustness check

45 Conclusion

47 Literature

48 Imprint

Approach

FOX Business Models

The Business Model Canvas

A business model “describes the rationale of how an organization creates, deliver, and capture value”. Differently from the concept of strategy planning, which compares business models with the aim of better positioning a company against competitors, business modelling analyses the fundamental operational elements of how a business can be run, created, or improved. Hence, business modelling requires economic assumptions and purposes to be tested. A strategic modelling of a business investigates, on the one hand, the activities required to create a product or service; on the other hand, the activities associated with reaching the customers with such a product or service, in other words: selling (Magretta, 2002). Amongst the benefits of a strategic modelling of businesses, is the possibility to test assumptions and numbers before the actual implementation.

The Business Model Canvas (BMC), see page 8 below, is a visualisation tool used to explore and develop the structure of a business model idea. The BMC gives a management template which documents the pillars and determining elements of a business model. It helps to shape and visualise the business model (Osterwalder et al., 2010).

A BMC consists of nine building blocks which test the activities associated with making and selling the company's proposal to customers. On one side the customer segments, channels, and customer relationships explore how the value proposition is expected to be sold or delivered. On the other side, the creation process – how the product or service is physically made – is described by the key resources, activities, and partnerships. Finally, cost structure and revenue streams are organised and estimated in order to validate the economic rationality of the present, or expected, business model. According to Osterwalder et al. (2010), the nine blocks cover four main areas of business: customers, offer, infrastructure, and financial viability.



Figure 1: Business Model Canvas: nine business model building blocks (Osterwalder et al., 2010)

Value Proposition

Value proposition, also referred to as customer value proposition, is a crucial element for the success of a new business model or for innovating existing ones. The value proposition represents the way the company plans to solve a customer problems or address customer needs in a given situation (Johnson et al., 2008). In fact, the value proposition is typically analysed concurrently with customer segments to gain a comprehensive understanding of the pains and gains that customers encounter when trying to fulfil their requirements. This analysis allows to determine how the company' products and services can effectively enhance customer experience.

In other words, the value proposition captures how the company's products or services can generate benefits to consumer, and how these benefits are delivered, experienced, or acquired.

Customer Segments

Together with a solid value proposition, customers are key to the success of a company. They are the final users of the company' products and services and are willing to pay for them – even though there are instances where consumers may not directly pay for the product or service but still derive value from it, as in the case of social media. Hence, it is fundamental for an entrepreneur to define appropriate customer target groups and make sure their needs match with the value proposition features. In an iterative approach, the exploration of the value proposition helps to identify the right customer segments and vice versa, until the most efficient match is reached.

To decide on effective customer segmentation, an entrepreneur needs to think of both the current and future needs of the relevant customer groups, that is often the end-consumer. However, the term customer is broader, since it is the next supply chain actor to whom the company sells the products and/or services (Sijtsema et al., 2018); they can be represented both by other businesses

(B2B) or final consumers (B2C). According to Osterwalder et al. (2010) various customer segments can be targeted:

- **Mass Market:** the product and/or service is relevant for the general population and has a wide pool of potential customers.
- **Niche Market:** a unique and highly specific need is fulfilled by the product and/or service.
- **Segmented Market:** the customer population is in this case further divided through small variations, for example, the customer demographics or needs.
- **Diversified Market:** the company has flexible products and/or services that are easy to tweak and alter to the customer's needs or traits.
- **Multi-sided Market:** two or more customer groups are linked through the company's products and/or services, but without that product or service, there would be no connection.

Channels

The Channels building block plays a crucial role in a company's communication and delivery of the value proposition to its customer segments. Owned and partner channels encompass the mediums through which the company sells, distributes, and connects with its customers.

Owned channels refer to the communication and distribution channels that are directly controlled and managed by the company. These channels can include the company's physical stores, e-commerce websites, mobile apps, direct sales teams, or any other platforms owned and operated by the company itself. With owned channels, the company has full control over the customer experience and can tailor it according to its brand strategy and customer preferences.

On the other hand, partner channels involve collaborating with external entities to reach and serve customers. These partners can be distributors, retailers, wholesalers, affiliates, or other businesses that have an established customer base or complementary products/services. By leveraging partner channels, a company can tap into existing networks, expand its reach, and benefit from the expertise and resources of its partners. This can help increase market penetration, access new customer segments, and improve overall customer satisfaction.

Furthermore, owned and partner channels are further classified per typology and per phase in which the communication with customers take place. Respectively, channel types are recognised in sales force, web sale, and own stores; while partner channels can be distinguished in partner stores and wholesalers. Finally, the channel phases refer to different stages or moments in which communication and information exchange occur between the company and its customers. These phases are influenced by factors such as the customer's buying journey, the product lifecycle, and the marketing strategy employed by the company. The company should use each phases to appropriately deliver the most relevant communication, as raising awareness and allow consumers to evaluate the consumers value proposition during the pre-purchase phase, allow consumers to purchase or use the company' product or service, delivering it, and provide post-purchase customer support (Lauwers & Goyens, 2019). Below, Table 1 summarises channel types and phases.

Chanel Phases	Channel Types				
	Owned			Partner	
	Sales force	Web sale	Own stores	Partner stores	Wholesaler
Awarenes	Raise awareness about company product and services				
Evaluation	Evaluate organization's value proposition				
Purchases	Allow customers to purchase or use the company products and services				
Delivery	Deliver value proposition				
After Sales	Provide post-purchase customer support				

Table 1: Channel types and phases

Customer Relationships

To ensure the survival and success of any business, companies must identify the type of relationship they want to create with their customer segments. This element addresses how the business will acquire new customers, how the business will keep customers purchasing or using its services and how the business will grow its revenue from its current customers.

Many kinds of relationships can fit the value proposition, the customer segments and the channels selected by the company. According to Osterwalder et al. (2010), for example, the company can interact directly with customers by guaranteeing assistance that fits personal requirements. This is also the case for dedicated personal assistance, which occurs when the company has an assigned/dedicated representative to a set of clients who closely interact with them and who is responsible for the entire customer experience. Moreover, self service and automated services can also be used if the company wants to make customers able to serve themselves by utilizing specific tools (e.g., automatic distributors). Finally, community and co-creation are often used to explain particular relationships the company has at its disposal to interact with its customers. In the first case, the company can easily communicate with a large group of customers and unravel their concerns by allowing them to share their experiences and come up with challenges and solutions. In the latter case, customers have a direct hand, and responsibility, in the solution the company provides.

Customer relationship is very important in the food industry. Trust is key. Direct sales and personal contact result in close and strong relationships. However, an entrepreneur should think about the feasibility of the customer relationship. Investing in a relationship can be time intensive. Therefore, one should make sure that it can be combined with daily tasks and other obligations (Lauwers & Goyens, 2019). Customer relationships are established and maintained with each customer segment.

Revenue Streams

The revenue stream represents the way how the business generates revenue with its products and/or services. There are various ways to achieve this goal, and the following examples illustrate some possibilities: These approaches include Asset Sales, where ownership of goods is transferred for payment, and Usage Fees, where customers pay based on their specific usage. Subscriptions offer regular, consistent access to products or services, fostering customer loyalty. Lending/Leasing/Renting allows temporary usage, charging accordingly. Licensing involves fees for using intellectual property like patents or copyrights. Brokerage Fees apply when companies act as intermediaries between parties, charging for their services. Advertising generates revenue by allowing other businesses to advertise on their platforms. A characteristic of the agricultural sector is that significant cost expenditures are made long before the revenue is received: e.g. expenses arise in spring, while the business only obtains the benefits during the harvest season. In this case, a financial buffer is needed, or to opt for a business model in which customers invest from the beginning (Lauwers & Goyens, 2019).

Key Resources

To create and promote the value proposition, establish relationships, and sell products or services, businesses require various resources. These resources can be categorized into four main groups: human, physical, intellectual, and financial. Businesses can own, purchase, or lease these resources according to economic rationality. By identifying the necessary resources, business owners can better understand the dependencies of their value proposition and lay the foundations for the analysis of costs.

In the case of an agricultural business, there are essential resources that must be available. These include buildings, land, machinery for production, processing, logistics, and sales, as well as resources required for crop cultivation (such as fertilizers and seeds) or livestock rearing (such as animal nutrition). Additionally, farmers need management resources, such as work schedules, quality manuals, databases containing customer information, and lists of relevant partners and suppliers. Therefore, running an agricultural business demands a diverse range of competencies and skills. In addition to crop cultivation, farmers must also manage financial accounts, employees, tools, and machinery.

Key resources can include people, technology and products, equipment, information, brands, channels and partnerships (Johnson et al., 2008). However, it is important to highlight those channels and partnerships should be also explicitly addressed as their own pillars within the business model.

Key Activities

The Key Activities building block “describes the most important things a company must do to make its business model work” (Osterwalder et al., 2010). In other words, key activities identify the main actions a company must take to operate successfully. While key activities vary depending on the company’ unique business model type and configuration, the most important revolve around creating and delivering the value proposition, reaching customers, establishing positive customer relationships, and generating revenues.

In case of product-oriented business models, for example, key activities usually include designing, manufacturing, and packaging of products. In a service-oriented business model, activities might involve developing service offerings, training staff, and delivering the service to customers. However, regardless of the business model, particular attention should always be given to offering and developing the value proposition and reaching customers by creating a positive relationship. Ultimately, key activities should align with revenue generation, developing pricing strategies, structuring sales, negotiating, and collecting payments.

In the agricultural sector, farmer’s primary activities are aimed at growing and harvesting raw materials aimed for processing to get food. By executing ancillary activities, such as developing new products or processing fresh fruits and vegetables into added value products a farmer can exploit new economic opportunities and distinguish his/her company from competitors. However, these extra activities must be implemented carefully, to avoid any negative repercussion on the core farming activities. Continuous training may be essential to stay competitive.

Key Partnerships

The key partners encompass both suppliers and partners who complement the company in creating its products and/or services. It is important to determine which activities the company will handle internally and which will be outsourced. While outsourcing can mitigate risks and lead to cost savings when the company lacks the necessary personnel, knowledge, or resources, it also reduces the company ’autonomy and vulnerability to exogenous events. For this reason, decisions about outsourcing should always be supported by an economic ratio and a careful analysis of expected costs and benefits. Interesting partners can include governmental institutions that provide permits and subsidies, as well as knowledge institutions that offer valuable insights for the business. Partnerships can be categorised in the following four categories (Osterwalder et al., 2010): First, Strategic alliances between non-competitors followed by coopetition (partnership with competitors) as well as Joint ventures (to develop new businesses) and finally buyer-supplier relationships (to assure reliable supplies).

Partnerships can be used to optimize the allocation of resources and activities, or to reach economies of scale and reduce costs. Also, partnerships can be useful to reduce risks and uncertainty of the business activities as in the case of assets investments which are more often postponed in favour of outsourcing.

Cost Structure

The cost structure bundles all the necessary costs for running a business, from creating the value proposition to delivering and maintaining customer relationships. A business model can be categorised as cost-driven, when it focuses on minimising costs, or value-driven, when the emphasis is on delivering maximum value to the customer. In the first case, lot of attention is given to optimise operational efficiencies and reduce expenses along the several business activities. In the latter, a value-driven business model places a lot of efforts in sourcing high quality inputs and in providing unique experiences for consumers - potentially at the expense of reducing costs or necessitating price increases for their products and services.

Whether a company adopts a cost-driven or value-driven approach, understanding and managing costs effectively is essential for achieving economic sustainability while meeting customer expectations. In this regards, two main cost structure are considered in business model development. Fixed Costs on the one hand, are the expenses that are independent of any specific business activity, which means that the cost does not change when the produced amount of goods and/or services is increased or decreased. Examples of fixed costs are insurances, rental lease payments, property taxes, interest expenses, weekly payroll. Variable Costs on the other hand are expenses that vary according to the produced amount of goods and/or services. Examples of variable costs are direct labour costs, cost of raw materials used in production, utility cost.

As mentioned above, in the agricultural sector, it is often the case for a farmer to face with significant costs long before the revenues are received. This requires a scrupulous cash planning to avoid unbalanced cash flows and to guarantee an appropriate reserve of financial resources against unforeseen or unexpected events. As emphasised by Lauwers & Goyens (2019), an agricultural entrepreneur should make sure to include a margin of 10% on their investment and exploitation costs.

Three scenarios for Europe's food sector in 2035

How have we proceeded to project the development in the European food sector into the year 2035? We have developed detailed, consistent and pointed "pictures of the future". The focus was on alternative developments for the food sector along its entire value chain, from production and processing to packaging and logistics as far as sales and consumption.

The meticulously crafted scenarios for the European food sector serve as a robust framework to evaluate business models within a broader and future oriented context. Developed for 2035, they provide a holistic view of the entire value chain. This scenario-based approach facilitates a structured examination of developments, empowering stakeholders to embrace a future-oriented mindset. Scenario creation is a widely-used method in foresight, aiding the understanding of complex systems and uncertainty management. Our qualitative approach focuses on plausibility and connections among factors and assumptions. Through a trend analysis, key factors influencing the food sector were identified. From these driving forces, future assumptions were derived for 2035 as possibilities for development of the key factors. These assumptions were then consolidated into consistent and plausible descriptions of alternative futures.

In the following, the three scenarios are presented to assist in understanding the impact on different BM components in alternative futures.

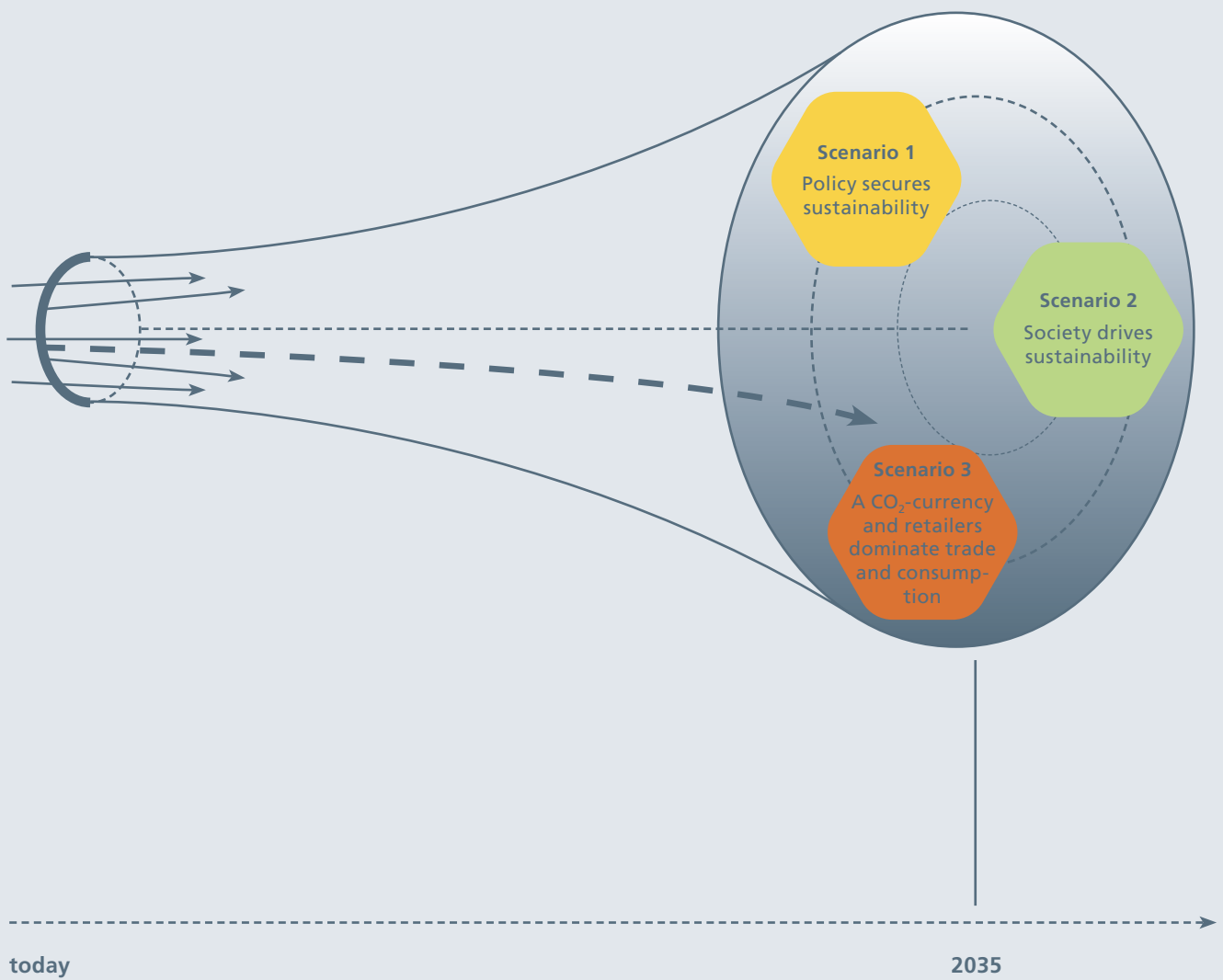
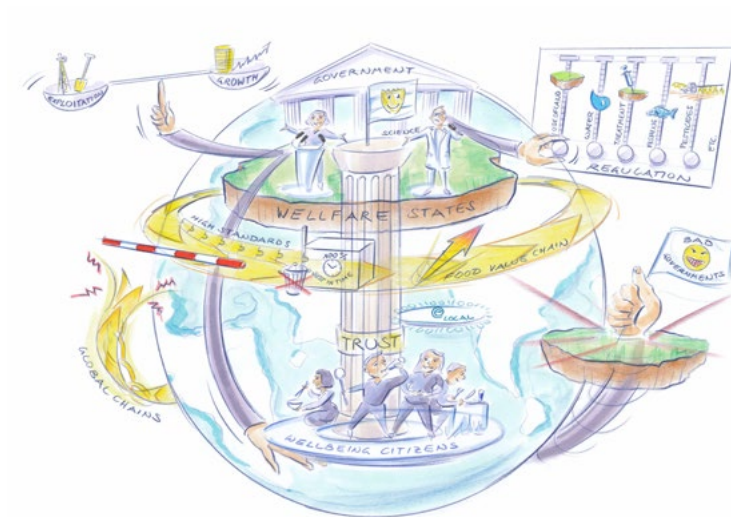


Figure 2: Future funnel: Intersection in 2035 with possible consistent futures. The further away the scenarios are from the centre, the more fundamental the changes are.

Scenario 1

Policy secures sustainability

Welfare states centrally ensure national food security



In this scenario, agriculture becomes increasingly nationalized, prioritizing the common good and meeting the needs of each country or region based on their own rules and natural conditions. Consumers trust their governments to ensure sustainable and nutritious food accessibility. The state intervenes with strict regulations on agricultural production, including land and pesticide use, water consumption, soil treatment, and fishing quotas. Sustainable agriculture is recognized as essential for national food security. To promote sustainable consumption, the government utilizes locally implemented e-commerce platforms and incentivizes citizens toward healthy lifestyles by analyzing their purchase behavior. State platforms focusing on food and health provide consumer profiling and instructions based on e-health data. Food waste is prohibited by law, with effective monitoring and sanctions. While plastic packaging remains, its lifecycle is highly optimized.

Consumers value aspects such as sustainable production, fair trade, traceability, nutritional value, and regionality, but price remains the primary criterion for food choices. Labels play a lesser role as the government emphasizes the provision of high-quality food. Limited resource availability leads to restricted growth, with the state managing all resources such as land, water, and energy. Global tensions arise due to limited food trade and scarce resources for production. High production and food standards create additional trade barriers and reduce food choices. Local climatic conditions heavily influence food diversity, although technological advancements like indoor farming or cultured meat can alleviate this issue. Centralized supply and efficient logistics support the distribution of basic foodstuffs. Digital technologies are utilized to enhance control and efficiency across the entire value chain. As consumers rely on their governments and have limited understanding of food production, the state becomes the main decision-maker regarding the adoption of new technologies in food production. In this scenario, the government plays a central role in ensuring sustainable food systems, resource management, and access to nutritious food.

Scenario 2

Society drives sustainability

Consumers enjoy a green and healthy lifestyle



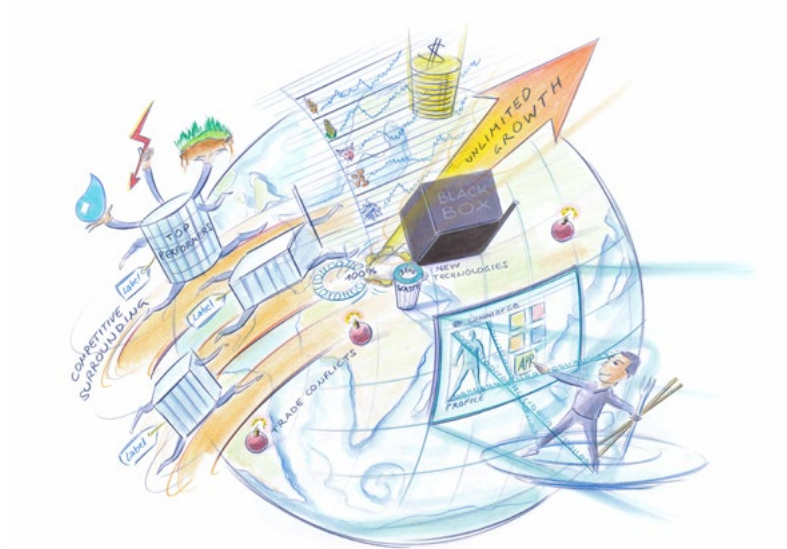
In this scenario, people prefer life in harmony with nature and embracing a healthy lifestyle, valuing sustainability over luxury. Society recognizes excessive economic growth as a problem and embraces a “post-growth” mindset, moving away from consumerism. Sustainable behavior and movements like “Fridays for Future” become mainstream. Food consumption aligns with a sustainable food value chain, positively impacting food security and safety. At the national level, government involvement is limited, but local governments are well-organized and attentive to consumer and producer opinions. Consumers prefer regional products and view global food trade critically due to environmental concerns and lack of production information. Food diversity suffers as a result, but society values activities that minimize resource use. Tax benefits encourage decentralized and privatized energy supply, and consumers accept renewable energy sources like windmills and solar panels. They are willing to pay higher prices for sustainably and socially produced food, with high demand for regional organic products. Growing their own fruits and vegetables is popular, and nutritional value is a priority for consumers.

Agricultural land is widely owned, and local proximity of production builds trust. Consumers prioritize local and global biodiversity conservation in food production. Most fresh food is produced within a short distance from consumers, minimizing food loss. Technologies and data availability help avoid waste, with innovative preservation methods and predictive demand tools. New sustainable food production forms, like urban farming and cultivated meat, gain importance. “Food as a Service” integrates into local food policies, reducing food preparation time through well-organized systems involving all citizens. Sustainable consumption drives retailers to prioritize sustainability, influencing food packaging practices. E-commerce stores and deliveries play a significant role in food purchasing, and retailers handle the entire food logistics as conventional supermarkets transition into logistic centers. Farmers’ markets remain popular for purchasing fresh local food. In this scenario, society actively embraces sustainability, values local and regional food systems, and employs technologies to optimize health and reduce waste.

Scenario 3

CO₂-currency and retailers dominate trade and consumption

In a globalised world, markets and technologies ensure prosperity for top performance



In this scenario, high-specialized global markets dominate, driven by a self-interest mindset that believes individual actions contribute to the common welfare. Dynamic technological progress is seen as the key to addressing global challenges, with unlimited growth and profit maximization as the primary goals. Large retail and sales groups dominate the food industry, leveraging e-commerce for increased sales share. Retailers hold data sovereignty, allowing them to design digitized value chains and offer personalized buying options based on consumer profiling. Efficiency-driven agriculture leads to soil degradation and a loss of biodiversity, as monocultures prevail and only designated areas preserve biodiversity. Global standardization and harmonization of agricultural and processing technologies limit transparency and innovation. Despite a wide variety of foods available through global trade, ensuring safe food becomes challenging due to price pressure and low-quality or unsafe products in the food chain.

Multinationals and supranational organizations hold significant power, overriding the limited authority of national and local governments. Climate protection measures are driven by self-interest rather than intrinsic conviction, with sustainability priced in through CO₂ pricing. Retailers utilize sustainability as a business model and advertising tool, leading to a reduction in labels and minimal food packaging. Industrial processing helps reduce food waste, and a circular economy approach becomes prominent. New technologies, borrowed from efficient industries like automotive, aid in reducing food waste, and AI facilitates demand prediction. Intelligent technologies in households and communities replace traditional waste systems. While technology offers solutions, the dominant focus remains on profit and market competitiveness, with sustainability used strategically by companies to strengthen their core business.

Business Model robustness check – Methodology

The FOX business models underwent a comprehensive discussion with key stakeholders to validate their relevance and appeal in the current market and social conditions. Moreover, an assessment was conducted to evaluate their robustness in the face of future scenarios. To facilitate this process, a two-step approach, inspired by Osterwalder et al. (2014) and Haaker et al. (2017), was implemented, involving storytelling and scenario-guided business model design.

First phase: Storytelling

Storytelling was effectively utilized during the workshops to clearly communicate the value proposition and business model structure of the FOX approach within the context of the food circle of interest. This approach facilitated a better understanding of the practical implications and benefits of the models, while also providing an opportunity for participants to discuss the viability and rationality of the underlying assumptions.

In Food Circle 1 (Germany) and Food Circle 2 (Poland), the discussion focused on a specific business model archetype involving a farmer implementing the FOX approach in conjunction with relevant technology. In Food Circle 3 (France), the case of a cooperative of farmers, adopting the FOX approach was considered, aiming to assess its applicability and advantages within a cooperative framework.

Additionally, the three previously discussed “Scenarios for Europe’s Food Sector in 2035” were introduced to the participants. These scenarios outlined potential future conditions and trends that could affect the food sector and consequently also the BM. During the workshops, specific factors relevant to each food circle were emphasized and analyzed in relation to the respective scenarios. This focused discussion allowed participants to consider the specific contextual factors that could influence the success and adaptability of the FOX approach in each region.

Second phase: Robustness Check

Understanding future conditions is crucial for developing robust business models and anticipating potential positive or negative events. Additionally, analyzing future scenarios provides an opportunity for innovation by identifying upcoming market developments and allowing businesses to stay ahead of their competitors.

Following Haaker et al. (2017), each of the selected scenario factors mentioned earlier were discussed and tested for their potential influences on the business models, both enhancing or limiting. Stakeholders were actively engaged in providing their input on how specific pillars of the BMC would be affected in the three scenarios that were discussed. Participants were presented with questions such as “How would the Value Proposition be affected if consumers shifted their nutritional preferences solely towards snacks and ready-to-eat food?” or “How would stringent regulations on food loss and waste impact costs, profits and partnerships?”. After establishing the causal relationship between the relevant business model pillars and the stress factors identified in the scenarios, stakeholders were asked to judge the effects using a traffic-light system, as depicted on the right.

Finally, a comprehensive discussion took place to explore potential improvements, weaknesses, and other considerations. The primary objective was to support the ongoing development of the business models and fortify their resilience, making the FOX approach more appealing to investors and increasing its viability for real-world implementation.



Green: Represents positive effects, indicating that the particular scenario factor would strengthen or enhance the respective pillar of the business model.

Yellow: Indicates potential challenges or impacts, which might make the business model pillar harder to be viable. In this sense, the factor introduces uncertainties and potential limitations to the business model.

Red: Signifies adverse consequences of the scenario factor to the business model feasibility.

Food Circle 1: Low-oxygen extraction and mild preservation

Partners involved

- DIL German Institute of Food Technologies & DIL Engineering GmbH
- Elea Technology GmbH
- KOB Kompetenzzentrum Obstbau Bodensee
- Falkenstein Projektmanagement GmbH

Fresh,

① The mobile container unit is placed near the farm



② Local producers bring surplus fruits & vegetables to process



local and healthy juice in a mobile container



Figure 3: Food Circle 1

Concept of Food Circle 1

Food Circle 1, situated in the Bodensee Region of Germany, is dedicated to developing a small-scale mobile processing unit for **low oxygen extraction and mild preservation** of fruits and vegetables by adopting Pulsed Electric Field (PEF) post-treatment and vacuum pressing. The project partners involved in Food Circle 1 explore PEF post-treatment to ensure the optimal preservation while maintaining the nutritional integrity of the fruits and vegetables. As a result, sensory qualities and shelf life are improved compared to fresh apple juice. Furthermore, the vacuumed spiral filter press improves the extraction process, ensuring maximum efficiency and purity. The essence and expected functioning of the FOX approach and technology developed in Food Circle 1 are presented in the infographic below (Figure 3).

Food Circle 1 wants to extract and preserve juices and purees from side streams effectively. The aim is to produce top-notch products that enable farmers and other food operators to retain value from the food that is created in excess due to the impossibility to reach the final consumers (e.g., non-conformity to market standards). These are crafted as either mono-varietal or mixed solutions, catering to diverse consumer preferences. Additionally, the FOX mobile unit is intended to be strategically situated in close proximity to the farmers, by selling it to agricultural entrepreneurs and cooperatives, or by establishing dedicated processing hubs where fruit and vegetable surplus and side streams can be processed. As a result, the FOX approach allows for the creation of a diverse range of fresh, local, and healthy products by reducing food waste and maximising the utilisation of available resources, contributing to a more sustainable and circular food system.

Innovative Technologies in Food Circle 1

As mentioned above, at the heart of the FOX innovative processing approach in Food Circle 1, lie two cutting-edge technological advancements: PEF post-treatment and the vacuumed spiral filter press. The spiral filter press is used for gentle low-oxygen juice and puree preparation under vacuum conditions. This technology minimises the contact of freshly pressed product and air, resulting in more intense and authentic colour, aroma and flavour. Additionally, this system ensures better extraction and preservation of valuable compounds, preventing oxidation and reducing the need for additives such as vitamin C, which are commonly used for oxidation-reduction in traditional methods. Compared to the classical heat pasteurization method, PEF offers better qualities to the final products, such as viscosity and nutritional composition.

Finally, the PEF treatment enables the inactivation of spoilage and pathogenic microorganisms in liquid products, such as juices, purees, and smoothies. Remarkably, this treatment minimally alters the fresh character of the products. Compared to classical heat pasteurization methods, PEF offers several advantages, including lower energy consumption, higher efficiency of processing, and preservation of the original colour, flavour, and nutritional composition of juices and purees.

FC1 Business Model: a farmer adopts the FOX mobile unit

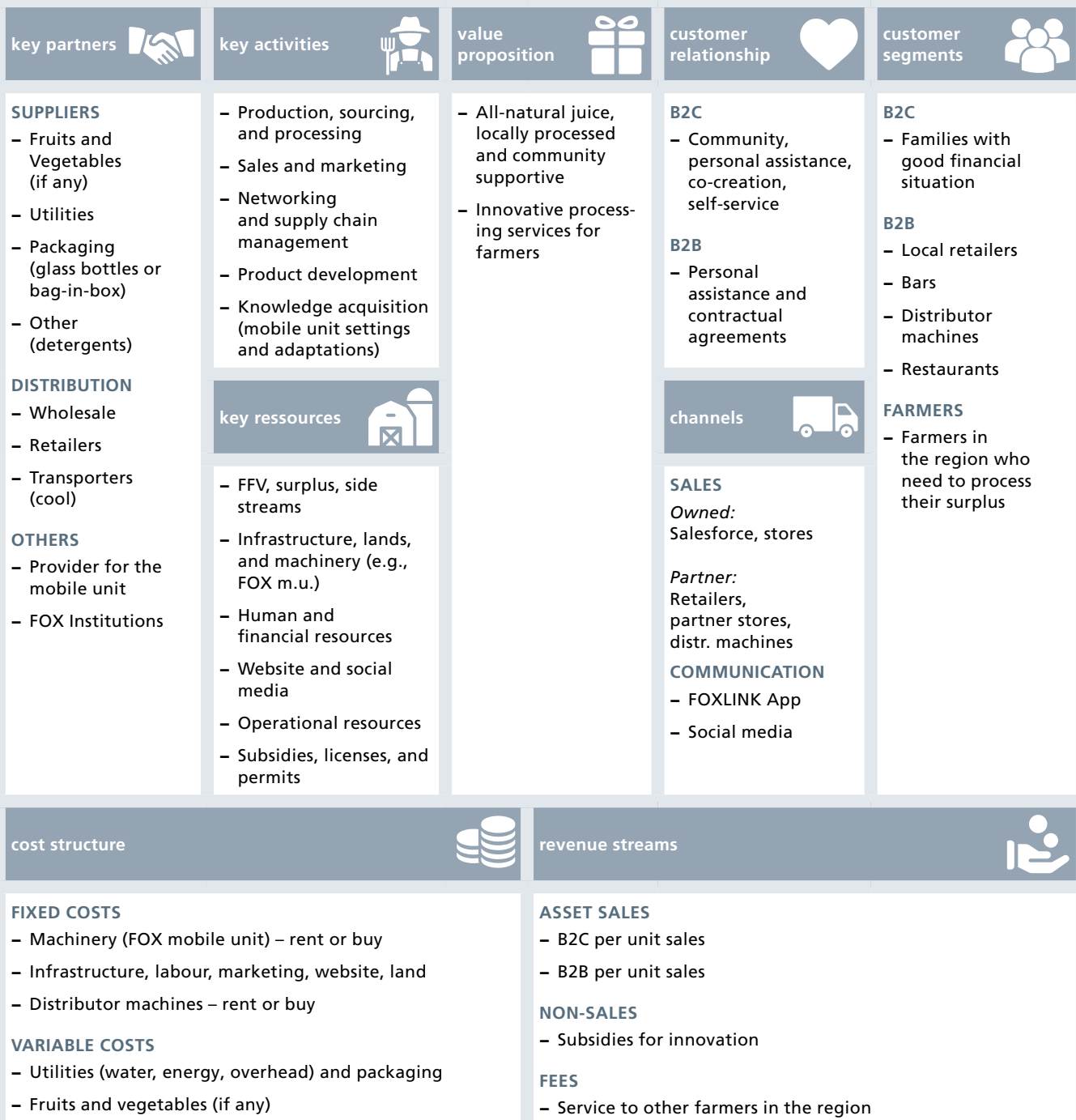


Figure 4: Business Model for Food Circle 1

By applying the FOX approach, a farmer in the Bodensee region diversifies and improve his/her product portfolio with the production and sale of high-quality fruits juices and purees from agricultural production side-streams. While the production is primarily expected to be seasonal, based on the cultivars grown by the farmer, year-round production is also feasible. As a result, the farmer is considering both private ownership of a mobile unit and leasing options. The decision between these two alternatives must be based on an economic analysis and the projected rate of capacity utilization. The economic viability is explored in another task of the FOX project, which examines investment configurations, cost structures and break-even points. This comprehensive exploration can guide the farmer's decision-making process and inform their strategic choices for optimal economic outcomes.

The primary input to the processing unit of Food Circle 1 consists of side streams derived from apple production and surplus agricultural produce. By utilizing these valuable resources that would otherwise go to waste, the farmer is enabled to retain higher value from his/her agricultural activities. This innovative approach can enhance the economic sustainability of farming operations and promotes a circular economy model. Moreover, the farmer could provide a processing service to external farmers who can be interested in processing their own surplus and side-streams with the FOX technologies to external farmers who may be interested in utilizing the FOX technologies to process their own surplus and side streams. This additional revenue stream allows farmers to leverage their expertise and infrastructure, expanding their business reach beyond their own produce. By offering processing services, farmers contribute to the local agricultural community and facilitate the adoption of sustainable practices in the wider farming industry. Hence, the main revenue stream from the FOX approach to the farmer is derived from both the sale of the processed products, such as juices and smoothies, and the provision of processing services to external farmers. These revenue streams form the foundation of the business approach, driving economic viability and growth.

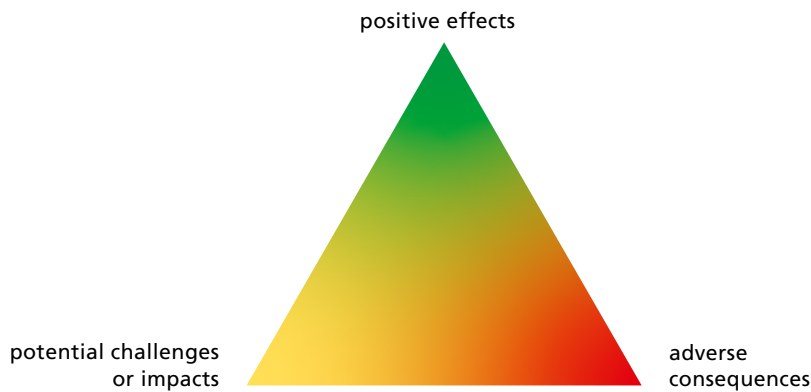
When considering costs, there are two primary factors that determine them: labour costs and the presence or absence of side-stream materials acquired from tertiary parties. Labour costs play a significant role in determining the overall expenses. Depending on whether the mobile unit is operated by external operators or the farmer, the associated labour costs will vary. The decision on who operates the unit should consider factors such as expertise, availability, and cost-effectiveness. The labour cost aspect should be carefully assessed to ensure its alignment with the business's financial objectives. Furthermore, the strategies for acquiring these materials should be based on market prices and the farmer's bargaining power. Analysing market trends, negotiating with suppliers, and exploring alternative sourcing options are essential to make informed decisions and optimize cost efficiency. Throughout the entire season, a flexible approach can be adopted, allowing for a mix of sourcing strategies. This means that the farmers can adjust their sourcing methods based on the availability, quality, and cost-effectiveness of side-stream materials. By incorporating flexibility into the sourcing strategies, the farmer can adapt to market fluctuations and ensure the optimal utilization of resources.

Food Circle 1 robustness check



Figure 5: Heat maps for Business Model of Food Circle 1 in three future Scenarios

In conclusion, a farmer adopting the FOX mobile unit in Food Circle 1 targets both the consumer segment (B2C) and other businesses (B2B) including restaurants, local retailers, vending machine companies. The aim is to deliver products and services through existing distribution and communication channels, leveraging a business-as-usual setting. This approach allows the farmer to tap into established networks and ensure efficient delivery to the market. By emphasizing the specific fruit or vegetable variety used in the production, consumers and businesses can appreciate the distinct flavours, aromas, and characteristics associated with each product. In addition, the processing service provided to farmers is highly appealing as it enables to actively contribute to the diffusion of technological innovation and the distribution of value at a local level. By leveraging these innovative technologies, Food Circle 1 supports farmers in promoting sustainability by valorising food side streams derived from agricultural production.



Based on stakeholders' considerations, the potential impact of future market and societal transformations on the business model involving a farmer in Food Circle 1 can be analyzed within the context of three scenarios. The business model might be positively affected by future transformation towards the conditions described in scenario 1 and 2 while it is important to note that the dominance of retailing may weaken the distinctive values of the FOX approach, as depicted in scenario 3. The summarized results are presented in the three heat maps on the left-hand side.

Scenario 1: In this scenario, the FOX entrepreneur may face challenges in supplying the market and differentiating their products due to reduced consumer interest in ethical and sustainable production, as well as the centralization of food production and distribution. However, there are still opportunities to be leveraged. Supply chain efficiencies, the growth of e-commerce, and the ban on food waste enable the exploitation and commercialization of side streams. This allows for the creation of new income streams, even though profit margins on sales are expected to decrease. Additionally, cost reduction is anticipated through the amortization of the value chain and the central role of the state.

Scenario 2: Within this scenario, there is a strong emphasis on community enhancement and local food circles. Valuation of side streams becomes important, but new product development is required. The trend of self-optimization and the importance of health presents an opportunity for linking the pharmaceutical industry with the food industry. To demonstrate a superior CO₂ footprint compared to other juices, a compelling environmental evaluation, such as a life cycle assessment (LCA), must be performed.

Scenario 3: This scenario is more challenging for the business models in question. While farmers may face a knowledge gap compared to retailers, focusing not only on production but also on processing and product development can open up new opportunities for farmers and local start-ups. The potential for higher sales exists through differentiation from the competing market. The rise of e-commerce and platform economies, exemplified by giants like Amazon or other big companies, may offer small and medium-sized farmers access to economies of scale.

In conclusion, the analysis of these scenarios suggests that the business model involving a farmer in Food Circle 1 may be positively affected by future transformations aligning with the conditions presented in scenarios 1 and 3. However, it is crucial to address the challenges posed by retail dominance and adapt accordingly. By leveraging supply chain efficiencies, e-commerce growth, and the exploitation of surplus and valorized side streams, farmers can explore new income streams. Emphasizing community enhancement, local food circles, and product development can further enhance their position. Furthermore, differentiation from the market and the opportunities presented by rising e-commerce and platform economies can offer potential advantages to small and medium-sized farmers in this evolving landscape.

Food Circle 2: Low-temperature drying

Partners involved

- Warsaw University of Life Sciences
- DIL German Institute of Food Technologies & DIL Engineering GmbH
- VUPP Food Research Institute Prague
- Elea Technology GmbH
- Cedrus Sp. z.o.o. Sp. k
- AK CR Agrarian Chamber of the Czech Republic
- Sady Tucharaz spol. S.r.o.

Local

① The mobile container unit is placed near the farm



and healthy dried snacks in a mobile container

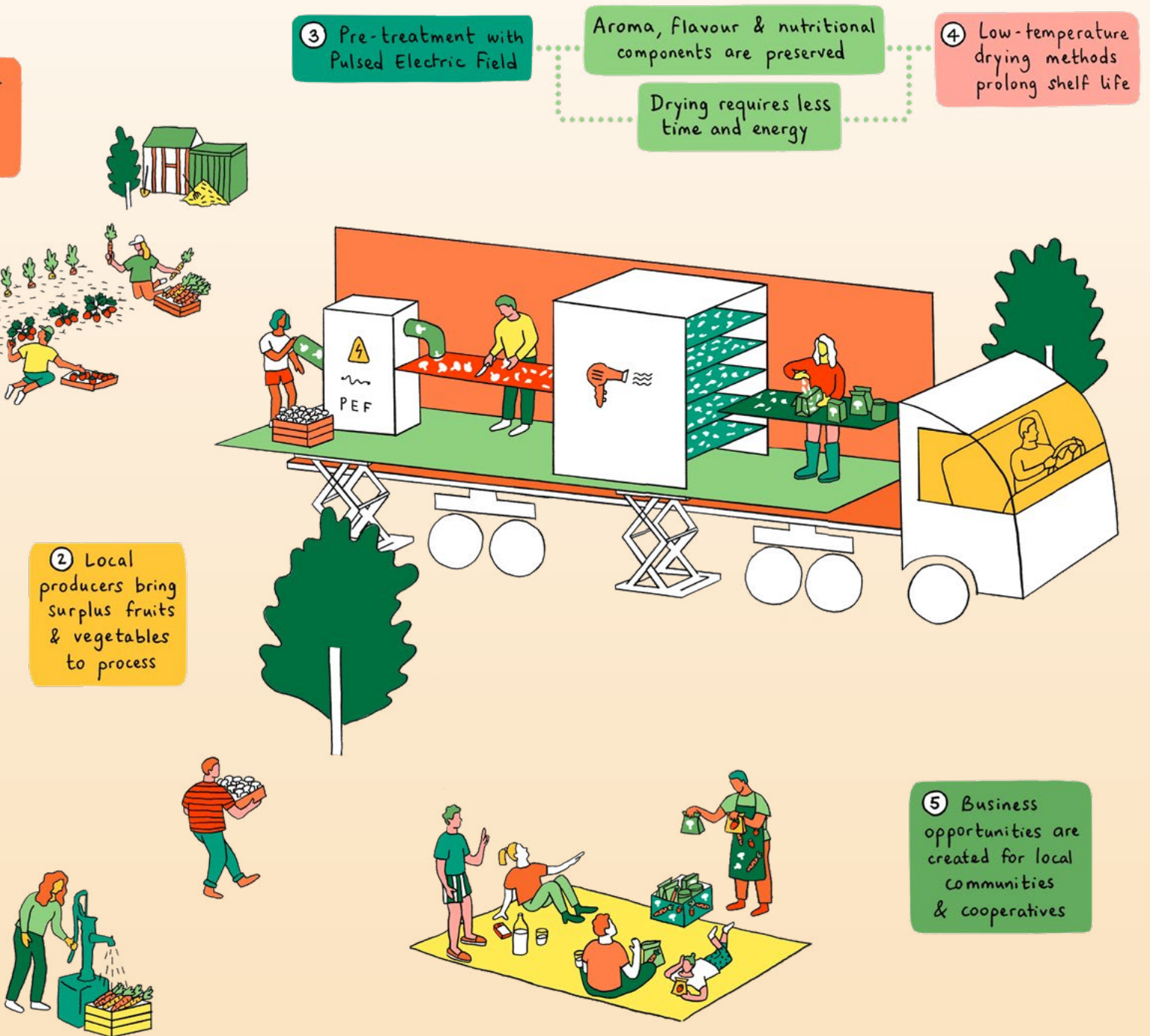


Figure 6: Food Circle 2

Concept of Food Circle 2

Food Circle 2 aims to develop a small-scale mobile processing unit for low temperature drying for fruits and vegetables side streams. The Food Circle brings together partners from the Central Bohemian Region in Czech Republic and the Kuyavian-Pomeranian Voivodeship Region in Poland. In this Food Circle, the aim is to develop products for tertiary businesses and for final consumers from drying fruits and vegetables that cannot be served as fresh ready-to-use food. In this way, regional opportunities are created for farmers and other operators in the food industry, by reducing food waste, valorising side streams, and promoting a circular economy. The FOX mobile unit is strategically designed to be in proximity to farmers, ensuring efficient accessibility. This is achieved through various means such as selling the unit to agricultural entrepreneurs and cooperatives or establishing dedicated processing hubs, as described in Food Circle 1. Also, processing companies can implement the FOX approach and technology to improve their products and differentiate themselves in the market, other than using the FOX processing mobile unit for easier testing and product development.

Innovative Technologies in Food Circle 2

Optimization of the drying process for fruit and vegetables is reachable by disrupting the cellular structure of the biological material. This can be done with pre-treatments that enhance the quality of the final products and improve the efficiency of the drying process by reducing energy requirements and drying time. In the context of the FOX project, various mechanical, thermal, and nonthermal techniques are being tested for pre-treatments and low-temperature drying and conditioning. These techniques take into account attributes such as texture, nutritional composition, and sensory qualities of the product. Consequently, Food Circle 2 explores a matrix of pre-treatment and drying conditioning to process different products like dried mushrooms, carrots, apples, and berries, customizing the treatment configurations based on the specific requirements and characteristics of each food item.

While many combinations are possible, the optimal solution for the FOX mobile unit for Food Circle 2 involves the adoption of a PEF generator for non-thermal pre-treatment, in combination with a downscaled convection dryer with infrared emitters. The entire process is divided into four phases:

1. Non-thermal pre-treatment: The produce undergoes a non-thermal pre-treatment using the PEF generator, which helps to disrupt the cellular structure of the fruits and vegetables.
2. Cutting, spreading the slices on the screens: After pre-treatment, the slices of produce are cut and spread evenly on screens, ensuring uniform drying.
3. Drying and cooling: The produce is then subjected to the drying process, facilitated by the downscaled convection dryer with infrared emitters. This dryer has a wide temperature range of 0-280 degrees Celsius, and its operating power supply can reach up to 45 kW. However, it is estimated that the average power supply required for optimal performance is approximately

FC2 Business Model: a farmer adopts the FOX mobile unit










key partners 	key activities 	value proposition 	customer relationship 	customer segments 
<p>SUPPLIERS</p> <ul style="list-style-type: none"> - Fruits and Vegetables (if any) - Utilities - Packaging (cardboard) - Other (detergents) <p>DISTRIBUTION</p> <ul style="list-style-type: none"> - Wholesale - Retailers - Transporters (cool) <p>OTHERS</p> <ul style="list-style-type: none"> - Provider for the mobile unit - FOX Institutions 	<ul style="list-style-type: none"> - Production, sourcing, and processing - Sales and marketing - Networking and supply chain management - Product development - Knowledge acquisition (mobile unit settings and adaptations) <p>key resources </p> <ul style="list-style-type: none"> - FFV, surplus, side streams - Infrastructure, lands, and machinery (e.g., FOX m.u.) - Human and financial resources - Website and social media - Operational resources - Subsidies, licenses, and permits 	<ul style="list-style-type: none"> - All-natural dried fruits and vegetables, locally processed - High-quality ingredients - Innovative processing services for farmers 	<p>B2C</p> <ul style="list-style-type: none"> - Community, personal assistance, co-creation, self-service <p>B2B</p> <ul style="list-style-type: none"> - Personal assistance and contractual agreements <p>channels </p> <p>SALES</p> <p><i>Owned:</i> Salesforce, stores</p> <p><i>Partner:</i> Retailers, partner stores, distr. machines</p> <p>COMMUNICATION</p> <ul style="list-style-type: none"> - FOXLINK App - Social media 	<p>B2C</p> <ul style="list-style-type: none"> - Families with good financial situation <p>B2B</p> <ul style="list-style-type: none"> - Local retailers - Bars - Distributor machines - Food manufacturing companies (ingredients) - Restaurants (ingredients) <p>FARMERS</p> <ul style="list-style-type: none"> - Farmers in the region who need to process their surplus
<p>cost structure </p>		<p>revenue streams </p>		
<p>FIXED COSTS</p> <ul style="list-style-type: none"> - Machinery (FOX mobile unit) – rent or buy - Infrastructure, labour, marketing, website, land - Distributor machines – rent or buy <p>VARIABLE COSTS</p> <ul style="list-style-type: none"> - Utilities (water, energy, overhead) and packaging - Fruits and vegetables (if any) 		<p>ASSET SALES</p> <ul style="list-style-type: none"> - B2C per unit sales - B2B per unit sales <p>NON-SALES</p> <ul style="list-style-type: none"> - Subsidies for innovation <p>FEES</p> <ul style="list-style-type: none"> - Service to other farmers in the region 		

Figure 7: Business Model for Food Circle 2

30 kW, which is more than standard for small farmers. The inclusion of a rotating platform within the dryer promotes homogeneity of drying throughout the batch.

4. Packaging: Once the desired moisture content is achieved, the dried fruits and vegetables are packaged, ensuring their preservation and market readiness.

As a result, by employing this optimized process flow, the FOX drying unit achieves efficient drying with improved product quality. The combination of treatments ensures effective disruption of cellular structure, reduced energy consumption, and enhanced uniformity in the final dried products. An example of the input/output material for the production of dried apple snack (for final consumers) with a low temperature drying technology is provided below (see Table 8) together with an estimate input costs.

The implementation of the FOX approach presents significant opportunities for farmers in the Central Bohemian Region or other regions of the Czech Republic or the Kuyavian-Pomeranian Voivodeship Region in Poland to enhance their product portfolio and capitalize on new revenue streams from selling healthy snacks from surplus production. The utilization of side streams from agricultural production and surplus produce as the primary inputs for the processing unit creates additional opportunities for value retention. By transforming these side-streams into high-value fruit and vegetable snacks, the farmer can extract maximum value from their agricultural activities and minimize waste. Furthermore, the farmer can expand the value proposition by extending processing services to external farmers who seek to leverage the FOX technologies for their surplus and by-products. This opens up avenues for collaboration and additional revenue streams for the FOX entrepreneur.

By venturing into the production and sale of dried snacks from fresh fruit and vegetables and dried ingredients for processing companies, the farmer can tap into a growing market demand. This expansion offers the potential to increase profitability and exploit of side streams and surplus production in a more efficient way. Note that the possibility to transfer fresh fruits and vegetable into value-added products allows the farmer to consider different options according to market conditions. As an example, dried fruit and vegetable snacks or ingredients can be a valuable alternative for farmers when market prices are not favourable for direct sale of the fresh products.

In terms of sourcing raw materials, the farmer has three possible scenarios to consider. Firstly, self-sourcing all inputs from their own by-products and surplus provides the advantage of cost control and quality assurance. Secondly, partially relying on external farmers in the region for inputs introduces the potential for collaborative partnerships and shared resources. However, it is important to assess the additional costs associated with purchasing external inputs. Lastly, sourcing all inputs externally offers the benefit of convenience and potentially accessing a wider variety of fruits and vegetables for processing. This has direct implication on the timeframe of the business model, from seasonal to year-round production. When the farmer relies on its own supply of fresh fruit and vegetable the production model for dried snacks is expected to be seasonal. However, the option of year-round production opens up the possibility of sustained revenue generation beyond the typical harvest season, adding more flexibility to meet consumer preferences and market trends by sourcing external raw products (fruit and vegetables).

Food Circle 2 robustness check

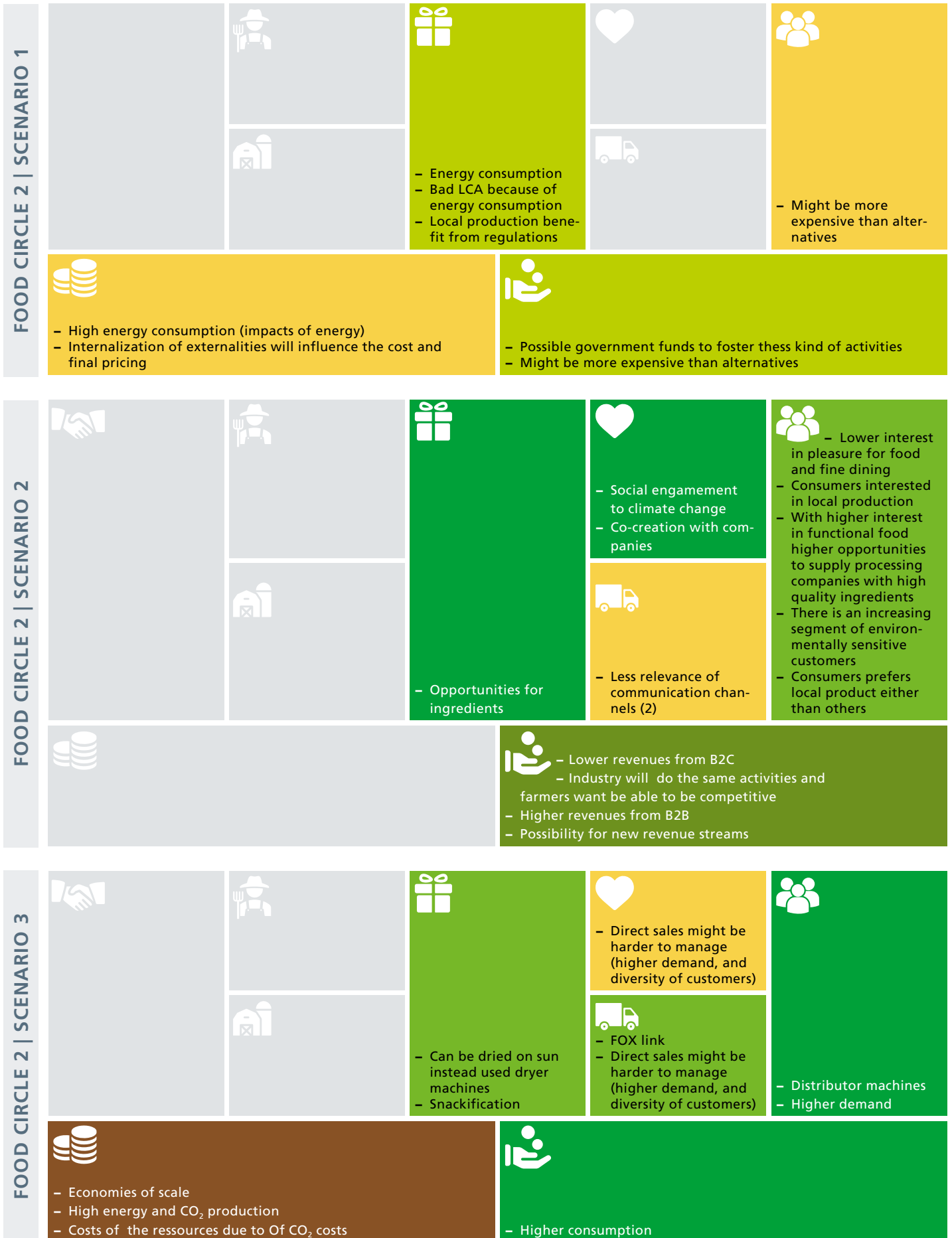
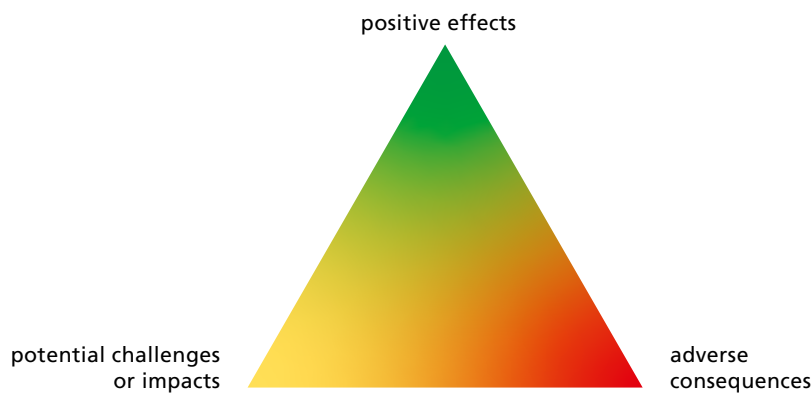


Figure 8: Heat maps for Business Model of Food Circle 2 in three future Scenarios

When considering ownership options for the mobile processing unit, both private ownership and leasing present unique advantages. Private ownership provides the farmer with complete control over the equipment, allowing for customization and operational autonomy. On the other hand, leasing offers the benefits of reduced upfront costs and access innovative equipment without the burden of long-term maintenance and depreciation. The farmer can carefully evaluate the economic implications and capacity utilization rates to make an informed decision that aligns with their specific circumstances and goals. When considering ownership options, the farmer should also consider the ability to cover the larger and more efficient operational profile of the mobile unit over longer period of time based on the availability and costs of input materials.

The diversification of the selling points should encompass both the consumer segment (B2C) and businesses (B2B) such as processing companies and restaurants for dried ingredients, local retailers and vending machine companies for the distribution of snack. By leveraging existing distribution and communication channels, the farmer can efficiently reach their target audience and establish strategic partnerships. Emphasizing the single-origin or mono-varietal identity of the products can further differentiate the products and attract discerning consumers who value traceability and quality.



In summary, the implementation of the FOX approach within the agricultural industry in Czech Republic and Poland have the potential for to expand their product portfolio. Farmers can capitalize on a thriving market and diversify their revenue streams Including high quality and healthy dried fruits and vegetables snack as well as ingredients for the food industry. By optimizing resource utilization, evaluating ownership options, and capitalizing on by-products and surplus produce, farmers can position themselves at the forefront of the industry, driving sustainable growth and profitability.

The Business Model of Food Circle 2 exhibits opportunities across all three future scenarios. The most significant prospects arise in Scenario 2, particularly through the potential for incorporating new ingredients. However, it is important to acknowledge that the statements and conclusions drawn for Food Circle 2 should be interpreted with caution due to the limited number of participants and the constrained timeframe of the workshop.

In scenario 1, there are opportunities for the value proposition of Food Circle 2 as local production stands to benefit from new regulations. However, challenges may arise in terms of energy consumption and the associated low performance in life cycle assessments (LCAs). Additionally, the FOX products may be priced higher than alternative options. The internalization of externalities is expected to influence costs and final pricing, and there is a possibility that government funds may foster activities in this domain.

Scenario 2 presents potential opportunities for Food Circle 2, particularly due to the use as new ingredients. The increasing societal engagement with climate change serves as a supportive factor for local food circles. Co-creation with companies emerges as a new trend within this scenario. However, there may be a lower interest in the pleasure of food and fine dining, which could potentially result in reduced revenues from business-to-consumer (B2C) channels. Furthermore, there is a risk that the industry might engage in similar activities, making it challenging for farmers to remain competitive.

Opportunities in **Scenario 3** are likely to arise from increased demand driven by higher consumption patterns. Trends such as snackification may further support the viability of Food Circle 2's business model. However, challenges persist in terms of high energy demand and the associated carbon footprint.

In summary, the analysis of the three scenarios indicates that the business model of Food Circle 2 presents opportunities for growth and adaptation. The value proposition can benefit from new regulations, local production, and the incorporation of new ingredients. While challenges such as energy consumption, pricing, and competitive pressures from the industry exist, there are still avenues for success. The rising societal engagement with climate change and the trend of co-creation with companies provide additional opportunities for development. It is crucial, however, to address concerns related to pleasure of food and fine dining, potential revenue reductions in B2C channels, and the need to manage energy consumption and carbon footprint. By navigating these challenges and capitalizing on the identified opportunities, Food Circle 2 can position itself for sustainable growth in an evolving market landscape.

Limitations of the methodology

Eventually, the statements for Food Circle 2 can be just a first rough assessment of the business model due to the small number of experts participating in the assessment process.

Food Circle 3: Innovative Quality Analysis and Packaging for Fresh Fruit and Vegetables

Partners involved

- AINIA
- CTCPA – Centre Technique de la Conservation des Produits Agricoles
- KOB Kompetenzzentrum Obstbau Bodensee
- LINPAC Packaging Pravia, S. A.
- Terra i Xufa S.L.

Sustainable p



Packaging of fresh-cut fruits & vegetables in a mobile container

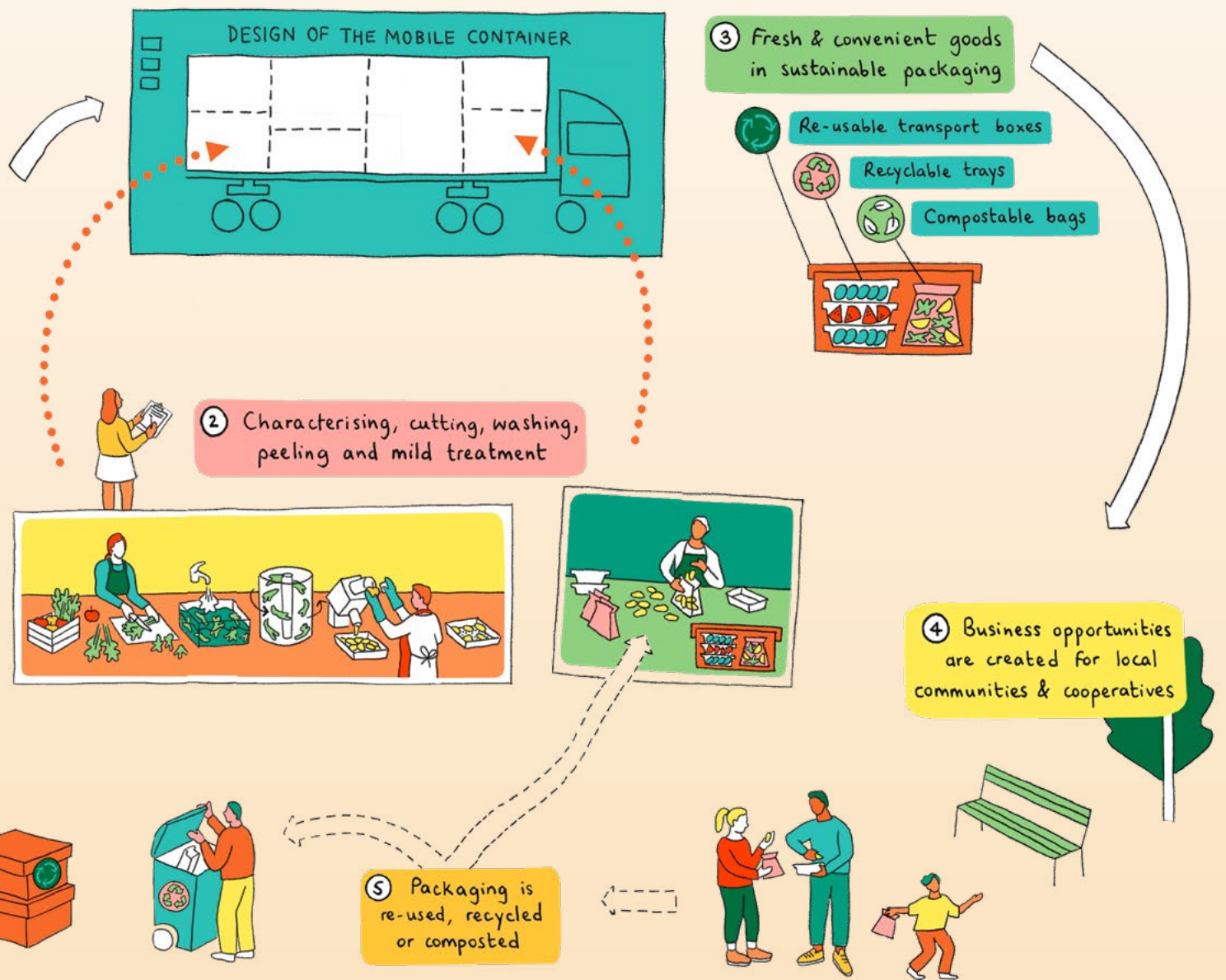


Figure 9: Food Circle 3

Concept of Food Circle 3

Food Circle 3 focuses on designing a processing mobile unit that selects, process, and packages fresh-cut fruit and vegetable products, preferably from surplus production and side streams. Partners are located in Valencia in Spain and in the Alpes Côte d'Azur region in France. The aim of the Food Circle is to develop a sustainable packaging solution to enlarge the shelf-life of fresh-cut fruit and vegetables. The technology will provide fresh-cut fruit and vegetable snacks produced by local producers and will encourage sustainable and healthy consumption. This is possible by placing the FOX processing unit close to farmers, enabling the recovery and valorisation of surplus and side streams of the agricultural production, as well as distributing the product locally.

The essence and expected functioning of the FOX approach and technology developed in Food Circle 3 are presented in the infographic (Figure 9).

Innovative Technologies in Food Circle 3

Fresh-cut fruit and vegetable products require specific packaging and processing in order to extend shelf life and reduce the risk of spoilage and contamination. This can be reached implementing pre- and post-treatments activities, as well as by developing innovative packaging solutions that caters to the specific respiration activity of the products it contains. In this context, Food Circle 3 proposes a three-steps processing mobile unit aiming to produce high-quality fruit mixes from fruit and vegetable surplus of production and side streams. The three steps are: pre-treatments, post-treatments, and packaging. Pre-treatments consist of minimally processing operations for sanitation treatment (e.g. washing), peeling, and cutting. Post-treatments refer to the application of compounds to improve the physic-chemical or microbiological parameters in fruits and vegetables to be packed.

Firstly, sanitation pre-treatments can make use of tap water, peroxyacetic acid, hypochlorite solution, peracetic acid, and chlorine. Secondly, post treatments can rely on natural extract such as acerola, grapefruit seed extract, green tea extract, or calcium chloride. The decision on what compound to rely on is driven by specific product characteristics that need to be investigated by the adopter of the technology. Finally, primary packaging is decided based on the final product to be obtained, such as ready-to-eat or ready-to-prepare fresh fruit and vegetable mixes, as well as the specific respiration rates of biological content. Note that, in order to ensure that packaging does not contribute to environmental issues, it should be designed in accordance with eco-design principles, as well as with the products' requirements for shelf-life improvement.

While different compounds for pre-treatments and post-treatments can be considered, the FOX approach proposes specific packaging solutions. Within the scope of Food Circle 3, the primary packaging, which directly comes into contact with the product, can be either sustainable flexible packaging or sustainable rigid packaging. The two types of packaging aim at promoting sustainability and improving the shelf-life and quality of products. These consist in a rigid tray (or bowl)

FC3 Business Model: a cooperative of farmers adopts the FOX mobile unit

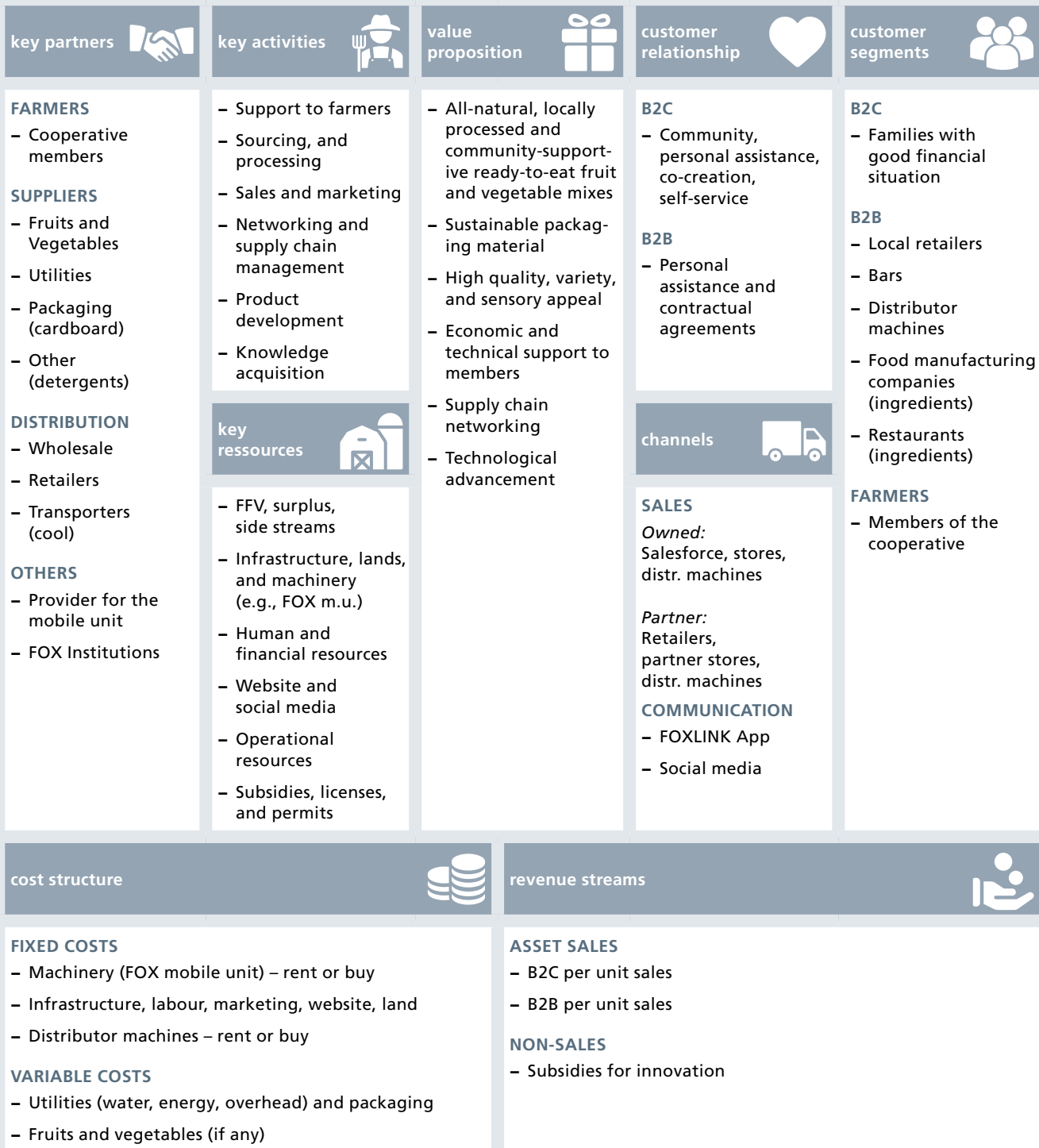


Figure 10: Business Model for Food Circle 3

covered by a thin, resealable, plastic film for fresh fruit and vegetable mixes and a flexible plastic bag for ready-to-prepare smoothies.

Furthermore, innovative secondary packaging is also developed to distribute refrigerated products, for which thermal isolation is of crucial importance. To achieve this, a reusable box made of PHBV and cork is proposed. At the end of its service life, the box is expected to be compostable under industrial conditions. Being reusable, the box will contribute to avoid the recent European tax for non-reusable plastic packaging, as well as reducing the overall environmental footprint over its lifetime.

In conclusion, by implementing specific packaging solutions and processing techniques, the FOX approach ensures the longevity and quality of fresh-cut fruit and vegetable products while minimizing environmental impact, reducing food waste, and valorising food side streams. Such a combination of innovation and sustainability is crucial for meeting consumer demands, reducing waste, and promoting a more environmentally friendly approach in the food industry.

A cooperative of farmers relies on a business model that brings together farmers and agricultural producers to collectively address challenges, enhance productivity, and improve their economic prospects. In this model, farmers pool their resources, knowledge, and efforts to achieve common goals, such as increasing market access, reducing input costs, and promoting sustainable farming practices.

By implementing the FOX approach and technology, a cooperative of farmers in Valencia in Spain or in the Alpes Côte d'Azur region in France, expands its product portfolio with seasonal ready-to-eat and ready-to-process fruit and vegetable mix. Thanks to the application of the FOX approach, it is possible for the cooperative to unlock the potential of food side streams within its members to produce high-quality product to deliver to local markets. At the same time, the cooperative provides its members with access to new technology, which might spur further innovation and product development. Furthermore, the cooperative enables its members to make use of side streams and surplus production without the need to bear the high costs and risks associated to the initial investment for the FOX mobile unit. By effectively utilizing these resources, the cooperative maximizes the value derived from their agricultural activities and reduces waste.

The cooperative has the option to lease or purchase the FOX processing mobile unit according to expected usage rates and market opportunities. This unit is made available to process surplus or side stream production from the cooperative members, benefitting from a diverse supply of inputs and a consequent diversification of products. Additionally, because of the consistent flows of output and the potential resonance on the local market, the cooperative may establish its own quality and sustainability label to differentiate its products in the market and retain a more solid consumer's base. Also, by hiring specialized operators, the cooperative can efficiently operate the processing unit, fully utilize its capacity, and reduce costs per unit. Emphasizing the single-origin or mono-varietal identity of the products can further differentiate them and attract discerning consumers who value traceability and quality.

Food Circle 3 robustness check

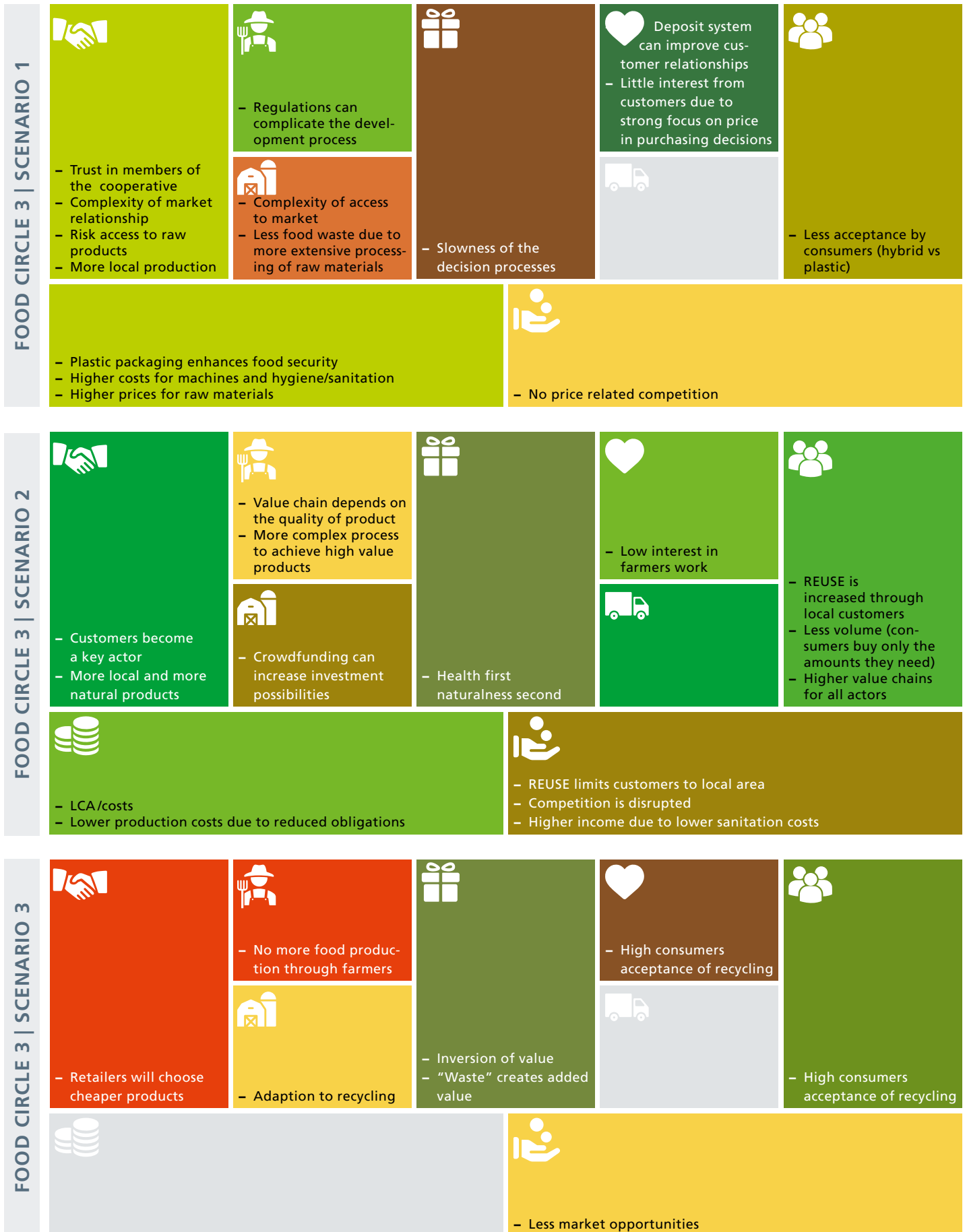
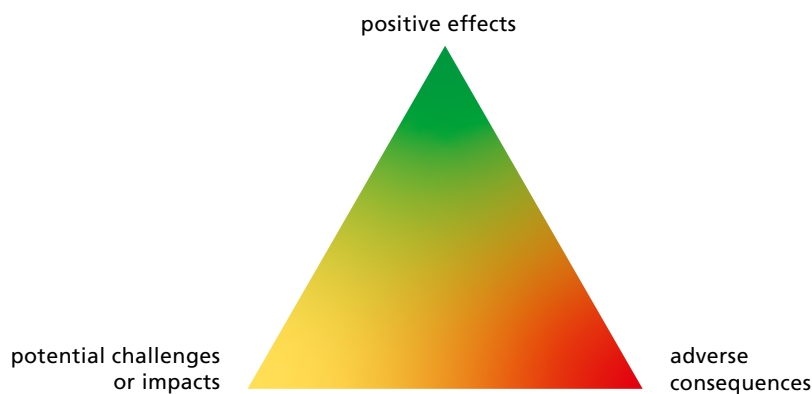


Figure 11: Heat maps for Business Model of Food Circle 3 in three future Scenarios

The key resources, activities, and partners may vary based on the typology of products that are developed by the cooperative with the FOX processing unit. Additionally, these might change during the year according to changes in market demand and diversity in the kind of fruits and vegetable side-streams available to be processed.

In summary, the implementation of the FOX approach within a cooperative setting in Food Circle 3 has the potential to expand the product portfolio of the participating companies/farms. By adopting an innovative approach to pre- and post-processing of fresh fruit and vegetable products and utilizing innovative primary and secondary packaging to preserve shelf life and maintain quality, cooperatives can capitalize on a thriving market and diversify their revenue streams. As a result, the cooperative can position itself as a market leader, which also promotes local development, foster innovation, and drives sustainable growth.



According to the workshop participants, the Business Model of Food Circle 3, which involves a cooperative of farmers adopting the FOX mobile unit, demonstrates relatively high opportunities in Scenario 1 and quite high opportunities in Scenario 2. In scenario 3, certain modifications are necessary to ensure success.

In **Scenario 1**, the discussed aspects include the potential benefits of implementing a deposit system to enhance customer relationships, the role of plastic packaging in enhancing food security, and the importance of trust in the members of the cooperative. However, challenges arise from regulatory complexities, slower decision processes, limited customer interest due to a strong focus on price, and higher costs for machines, hygiene/sanitation, and raw materials.

In **Scenario 2**, positive aspects emerge such as customers becoming key actors, the availability of more local and natural products, and lower production costs resulting from reduced obligations. Additionally, there is an increase in reusing of packaging through local customers, a reduction in volume as consumers purchase only what they need, and potential crowdfunding opportunities to facilitate investment. However, challenges exist in terms of localized customer reach for recycling, disruption of competition, the prioritization of health considerations over naturalness, and the complexity of achieving high-value products.

Moving to **Scenario 3**, challenges arise from retailers opting for cheaper products, a decline in food production by farmers, and limited market opportunities. However, there are opportunities to be found in high consumer acceptance of recycling practices and the potential to create added value from what was previously considered “waste.”

In conclusion, the analysis indicates that the Business Model of Food Circle 3 holds promising opportunities for success. It is essential to address challenges in regulatory compliance, decision-making efficiency, pricing strategies, and cost management. Scenario 2 highlights the importance of active customer engagement, local and natural product offerings, and efficient production processes. While challenges exist in localized reach and competition, emphasis should be placed on health considerations and the creation of high-value products. In Scenario 3, it is crucial to navigate challenges related to market dynamics and prioritize initiatives that align with consumer expectations. By making the necessary modifications and leveraging the identified opportunities, Food Circle 3 can position itself for success across different future scenarios.

Conclusion

Local food systems encompass a variety of business models that support the production, distribution, and consumption of food within a specific region. These business models contribute to the overall resilience, sustainability, and well-being of local food systems, strengthening the ties between producers and consumers and promoting a healthier and more environmentally friendly food culture.

Within the FOX project, business models for the use of mobile unit for food processing have been developed for different case studies – food circles – as a business model canvas. The business model canvas is a strategic management tool that provides a framework for developing, describing, analysing and visualising a business model. All business models in this project have in common, that they stimulate short food supply chains for fruit and vegetables by applying small innovative mild processing technologies. The primary goal of this brochure was to describe how the robustness of the business models has been tested against different scenarios by investigating their possible future potentials.

Scenario methodology plays a prominent role in the canon of foresight methods, as it enables a systematic examination of different future paths. Scenario processes provide relevant and plausible images of the future that prepare us for different developments in the future and allow us to explore different strategy paths. Through the intensive and structured discussion of the characteristics of the key factors influencing the future, an orientation knowledge was created among the participants, which sensitised them for future changes. Against the background of the developed scenarios, various optimisation options for the FOX Food Circles technologies were exchanged and in addition, potentials and possible weaknesses of the business models were openly discussed.

Based on the analysis of the three FOX business models, it is evident that there are promising opportunities for mobile food processing units across all scenarios. However, some adaptations are required in certain areas of the business model canvas, depending on the specific scenario. The value proposition of the FOX approach received highly positive feedback, being considered future-resilient in almost all scenarios and food circles. This indicates that the unique value offered by the mobile food processing units resonates well with customers and is likely to remain relevant in the future. Despite the promising prospects, challenges were identified in the creation process (partnerships, activities, and resources). These challenges are more pronounced in scenario 3. Issues such as lack of knowledge, regulatory hurdles, and pricing pressures were mentioned as contributing factors. Addressing these challenges will be crucial to the successful implementation of the mobile food processing units. Regarding the cost structure, it was noted that some major adjustments might be necessary, however this is not a deal-breaker for the viability of the business models.

In conclusion, the analysis proves the potential for mobile food processing units in the FOX business models across different future scenarios. If challenges in the creation process and optimisation of the cost structure are addressed, mobile units can leverage their promising value proposition to thrive in different use cases and ensure a successful future in local food systems.

Literature

- Almquist, E.; Senior, J. & Bloch, N. (2016):** The elements of value: Measuring – and delivering – what customers really want. *Harvard Business Review* 94 (9): 46–53.
- Béné, C.; Oosterveer, P.; Lamotte, L.; Brouwer, I. D.; de Haan, S.; Prager, S. D. ... & Khoury, C. K. (2019):** When food systems meet sustainability – Current narratives and implications for actions. *World Development*, 113, 116–130.
- Deller, S. C.; Lamie, D. & Stickel, M. (2020):** Local foods systems and community economic development. *Local Food Systems and Community Economic Development*, 4–30.
- Dönitz, E. J. (2009):** Effizientere Szenariotechnik durch teilautomatische Generierung von Konsistenzmatrizen. *Empirie, Konzeption, Fuzzy- und Neuro-Fuzzy-Ansätze*.
- Dönitz, E. J.; & Schirrmeister, E. (2013):** Foresight and scenarios at Fraunhofer ISI. *Problemy Eksploatacji* (4), 15–28.
- European Commission (2020):** Farm to Fork Strategy. For a fair, healthy and environmentally-friendly food system. Available online at https://food.ec.europa.eu/system/files/2020-05/f2f_action-plan_2020_strategy-info_en.pdf
- European Commission (2020):** The European Green Deal. Available online at https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_de
- Food and Agriculture Organization of the United Nations (2013):** The State of Food and Agriculture. *Food Systems for Better Nutrition*.
- Haaker, T. et al. (2017):** Business model stress testing: A practical approach to test the robustness of a business model. *Futures* 89: 14–25.
- Johnson, M.; Christensen C. & Kagermann H. (2008):** Reinventing Your Business Models. *Harvard Business Review*, Dec. 2008, pp. 2–11.
- Jurgilevic, A.; Birge, T.; Kentala-Lethonen, J.; Korhonen-Kurki, K.; Pietikäinen, J.; Saikku, L. & Schösler, H. (2016):** Transition towards Circular Economy in the Food System. In: *Sustainability* 8 (1), 69. DOI: 10.3390/su8010069.
- Lauwers N. en Goyens G. (2019):** Business Model Canvas voor nieuwe starters in land- en tuinbouw. Boerenbond. Leuven.
- Magretta, J. (2002):** Why business models matter, *Harvard Business Review*, May 2002.
- Moller, B.; Voglhuber-Slavinsky, A.; Dönitz, E. J. & Rosa, A. (2019):** 50 Trends influencing Europe's food sector by 2035.
- Moller, B.; Voglhuber-Slavinsky, A. & Dönitz, E. J. (2020):** Three scenarios for Europe's food sector in 2035.
- Osterwalder, A. (2010):** The Business Model Canvas: Instruction manual. Book, 1, 94105.
- Osterwalder, A.; Pigneur, Y.; Bernarda, G. & Smith, A. (2015):** Value proposition design: How to create products and services customers want (Vol. 2). John Wiley & Sons.
- Röös, E.; Bajzelj, B.; Weil, C.; Andersson, E.; Bossio, D. & Gordon, L. J. (2021):** Moving beyond organic – A food system approach to assessing sustainable and resilient farming. *Global Food Security*, 28, 100487.
- Sijtsema, J. J. & Lindenberg, S. M. (2018):** Peer influence in the development of adolescent antisocial behavior: Advances from dynamic social network studies. *Developmental Review*, 50, 140–154.
- UNICEF (2021):** The state of food security and nutrition in the world 2021.

Imprint

Contact

Björn Moller
Phone +49 721 6809-427
bjoern.moller@isi.fraunhofer.de

Fraunhofer Institute for
Systems and Innovation Research ISI
Breslauer Strasse 48 | 76139 Karlsruhe
Germany

www.isi.fraunhofer.de

Karlsruhe, September 2023

Authors

Björn Moller¹, Lorenzo Giacomella², Anna Kirstgen¹,
Kerstin Pasch³, Kemal Aganovic³, Ewa Dönitz¹,
Ariane Voglhuber-Slavinsky¹,

¹ Fraunhofer Institute for Systems and
Innovation Research ISI

² KU Leuven

³ DIL German Institut of Food Technologies

Coordination of the FOX-project

Kerstin Pasch, Project coordinator,
DIL German Institut of Food Technologies

Ariette Matser, Scientific coordinator,
Wageningen University & Research

Support

Workshop Food Circle 1

Milena Zdravkovic
DIL German Institut of Food Technologies
Haibo Xuan
KOB Kompetenzzentrum Obstbau Bodensee

Workshop Food Circle 2

Małgorzata Nowacka, Warsaw University of Life Sciences
Milan Houška, VUPP Food Research Institute Prague

Workshop Food Circle 3

Stéphane George, David Allain
CTCPA – Centre Technique De La Conservation
Des Produits Agricoles

Graphic Design

Jeanette Braun, Renata Sas

Illustration

Cover, Food Circle: Fanny Monier
Scenario Illustration: Heyko Stöber

Credits

European Food Information Council

This brochure is the third brochure produced as part of the Foresight process in the FOX project. There are already published:



50 trends influencing Europe's food sector by 2035



Three scenarios for Europe's food sector in 2035



LOCAL FOOD SYSTEMS
Recipes for future proof business models

