

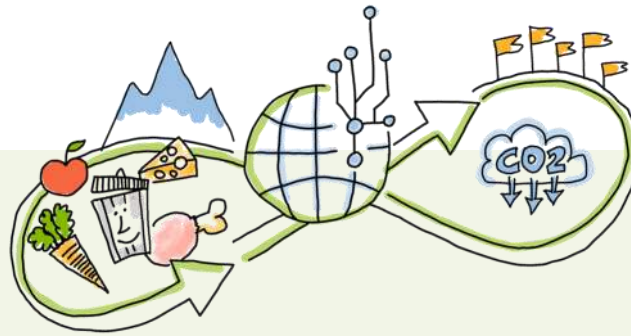
Interreg



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CEFoodCycle

Alpine Space



Blueprint for an emerging sustainable circular future in the food sector

Output 1.2



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- Salzburg University of Applied Sciences (AT)
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- Cluster of Environmental Technologies Bavaria (GER)

Layout & graphic design: Anna Schliesselberger

Illustrations: Sophie Wehmeyer - www.sophiewehmeyer.com

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Introduction

On a global scale, one-third of food goes to waste. To foster the shift towards a Circular Economy in the agri-food sector, it is necessary to show **food waste conversion pathways** and related trade-offs and opportunities (Santagata et al., 2021). Food waste remains a critical issue in Europe, with staggering amounts of edible food being discarded at various stages of the supply chain (European Commission, 2019a). One priority of the European research and innovation policy framework is the **Food 2030**. Its focus is to establish circular and resource-efficient food systems. This goal involves creating sustainable and resource-effective food systems to address the global issue of 1.3 billion tons of annual food loss and waste. Key challenges in this endeavour include eliminating food waste entirely throughout the food supply chain, addressing waste from primary production, improving the recycling of food waste, reimagining food packaging to incorporate eco-friendly, biodegradable options that reduce microplastic pollution, and responding to the growing demand for customised and locally-sourced food. Furthermore, in addition to supporting the new Farm to Fork strategy, this priority aims to provide solutions that align with the modernization of the Common Agricultural Policy, the Common Fisheries Policy, the EU Bioeconomy Strategy, the EU Circular Economy Package (including the Waste Directive), as well as Climate Action policies and the relevant targets of Sustainable Development Goals 2, 8 and 12 (European Commission, 2020).

At the consumption level alone, European households discard approximately 47 million tons of food annually, equating to roughly 95 kg per person. The magnitude of this waste is particularly concerning given that around 8% of European citizens suffer from food insecurity. This highlights the inequitable distribution of resources. In terms of sectors, the hospitality and food service industries contribute signi-

ficantly to food waste. Also, these sectors account for 14% of the total food waste generated within the EU, totaling around 14 million tons per year (United Nations Environment Programme, 2021). The environmental impact of this waste is substantial. The unnecessary disposal of food results in the emission of 170 million tons of CO₂ equivalents, contributing to climate change. Additionally, precious resources like water and land are squandered, exacerbating the strain on the environment. To combat this issue, the European Union has set ambitious targets to halve food waste by 2030 as part of the Farm to Fork Strategy. This includes measures to improve food labelling, encourage food donation, and promote a Circular Economy approach to bioeconomy (Schebesta & Candel, 2020). The EU is committed to meeting the aim to halve per capita global food waste at the retail and consumer level by 2030, and reduce food losses along the agri-food production sector and supply chains (WWF-WRAP, 2020). Efforts to minimise food waste and losses play a crucial role in achieving Sustainable Development Goals (SDGs) to fight and address climate change. This is underscored by the footprint and environmental impact of food waste, which produces approximately 16% of the total Greenhouse Gas emissions within the EU's food system (World Resources Institute, 2020). Despite these efforts, food waste remains a complex challenge, necessitating collective action from governments, businesses, and consumers.

While there has been some advancement in protecting vulnerable socio-ecological habitats, there is a significant urgency to integrate Circular Economy (CE) initiatives into regional development policies. To this end, the CE-FoodCycle Project informs how the Alpine environment can appropriately be safeguarded and commercially exploited to become a driver of a transition towards a circular and resource efficient economy in peripheral and

urban mountain areas.

The overall objective is the implementation of Circular Food Hubs in five alpine pilot regions - Austria, Germany, France, Italy, Slovenia - to identify potentials for food waste and CO2 reduction. Activities are aimed at stakeholders in the food production value chain such as manufacturing companies across industries, gastronomy and food retailers, the hotel industry, but also energy providers and other cross-sector manufacturers. Stakeholders benefit from know-how transfer, networking as well as the use of a digital, intelligent decision support system based on Life-Cycle-Assessment (LCA) indicators. The decision support system aims to facilitate the identification and evaluation of potential collaborations between various stakeholders; it enables these parties to connect with each other and assess their matchmaking initiatives, considering both resource utilisation and CO2 savings. This will contribute to closing circular loops and enhance sustainable, circular economic competitiveness in the Alps.

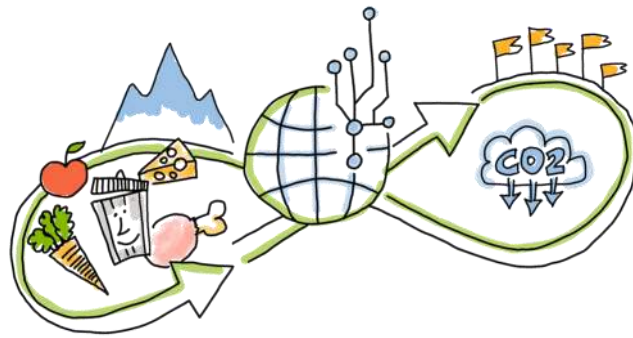
Aim of the brochure

This brochure is written with the intent to convey key insights into strategies to minimise food waste and to understand the key stakeholders in the food value stream in the participating countries. Based on a desk research phase between January and November 2023, some key figures are presented regarding the food market structure in the Alpine Region. Furthermore, best practices of companies that use food waste as a resource are presented and circular food hubs shortly introduced.

This brochure targets those interested in the process of how to minimise food waste, best practices of companies that are able to monetise food waste and those that aim to learn about circular food hubs. This includes stakeholder groups consisting of food related companies or those that use food waste as a resource, NGOs, funding organisations, networking organisations, incubation centres and researchers.

The brochure is organised in four sections that should carve out the importance of Circular Economy in the food sector defined (Section I), from Where We Started (Section II), to explaining What we found - Best practices (Section III), to Where we are going: Circular Food Hubs (Section IV) and Section V: Invitation to Stakeholders - Get in Touch.





Section I

Circular Economy in the food sector defined



The concept of a Circular Economy has gained significant attention in recent years as a sustainable alternative to the traditional linear "take-make-dispose" economic model (EllenMcArthurFoundation 2023; European Parliament 2023a). At its core, Circular Economy principles seek to decouple economic growth from the consumption of finite resources by emphasising resource efficiency, waste reduction, and closed-loop systems.

“

The Circular Economy is a model of production and consumption, which involves sharing, leasing, reusing, repairing, refurbishing and recycling existing materials and products as long as possible. In this way, the life cycle of products is extended.

In practice, it implies reducing waste to a minimum. When a product reaches the end of its life, its materials are kept within the economy wherever possible thanks to recycling. These can be productively used again and again, thereby creating further value.

European Parliament (2023)

”

This paradigm shift is particularly crucial in the food sector, where resource depletion, environmental degradation, and food waste are pressing challenges. The Circular Economy concept offers a promising framework to address these issues while ensuring a resilient and sustainable food system. This entails reimagining the entire food supply chain, from production processing and transformation to distribution, consumption, and waste management. Furthermore, the potential of food waste, with its diverse functionalized chemical components is aligned with opportunities for higher value applications and the principles of bioeconomy. Establishing a circular bioeconomy that reintegrates resource materials into the economic cycle while reducing wastage is a pivotal step towards steering the global food system onto a more sustainable path (Feodorov et al., 2022).

The Circular Economy is based on three prin-

ciples, driven by design, i.e. (EllenMcArthurFoundation 2023):

- **Eliminate waste and pollution,**
- **Circulate products and materials** (at their highest value) and
- **Regenerate nature.**

Ways to reduce food waste

Incorporating insights from Teigiserova et al. (2020), Papargyropoulou et al. (2014), UNEP (2014), and the European Commission Joint Research Center the [European Commission's Knowledge Centre for Bioeconomy \(2020\)](#) provides a **hierarchy for prioritisation of food surplus, by-products and food waste (FW)**, as well as prevention strategies (see Fig. 1). Embedded within the hierarchy are prevention strategies that encompass a spectrum of interventions. These include enhanced production planning, improved inventory management, optimised packaging design, and consumer awareness initiatives. The hierarchy for prioritisation offers a comprehensive roadmap to guide stakeholders in making informed decisions and implementing effective strategies. Ultimately, the framework aligns with broader sustainability objectives by underscoring the importance of source reduction, efficient resource utilisation, and prevention measures to address the global challenge of food waste (see Fig. 1 on the next page)

Comprising five distinct levels, the hierarchy first emphasises food waste **prevention and reduction** at the source, addressing the core causes of surplus and waste. This involves better harvesting practices, improved storage and transportation methods, and innovative packaging to extend the shelf life of products.

Also, this step relates to emphasising the role of consumers in making sustainable choices. Educating consumers about the environmental impact of their food choices and encouraging mindful consumption can drive positive change, including digital devices that enable consumer conscious purchasing of food, providing recipes for meal preparation with leftovers and smart refrigerator management. Redirecting surplus for human consumption ser-

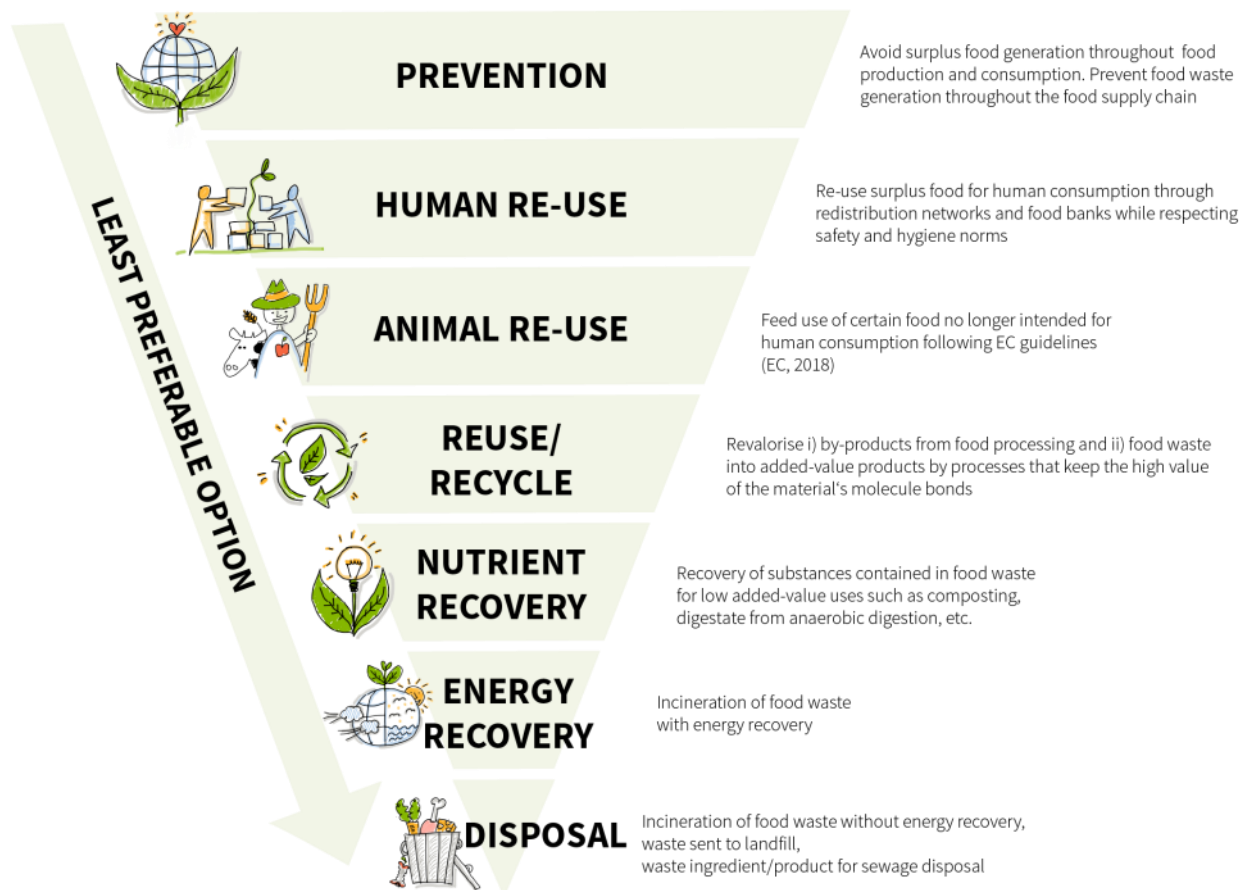


Fig. 1: Hierarchy for prioritisation of food surplus, by-products and food waste (FW) prevention strategies (Sanchez Lopez et al., 2020; Papargyropoulou et al., 2014)

ves to exemplify the practice of repurposing for direct **human consumption**, with Papargyropoulou et al. (2014) particularly highlighting the economic, environmental, and social benefits of reusing food waste, by-products, and surplus through avenues like food banks or donation programs.

Further down the hierarchy is food **re-use for animal feed**, i.e. feed use of certain food that is no longer intended for human consumption. Alpine farms have a long tradition of utilising food leftovers to feed animals, such as chickens or pigs. Animals, like cattle, have historically played a pivotal role in maximising the value of grassland and generating organic fertilisers for crop cultivation through grazing. Their presence has been instrumental in the resilience of human settlements in challenging environments. As the food sector became more industrialised and the foods more refined with additives, the challenges changed in na-

ture. Modern challenges arises due to the EU regulations that govern the use of food waste for animal feed EU No 575/2011, that limit what can be safely fed to animals and what not. Also, there are policy and legal efforts under way to promote insects for human consumption ([EUR-Lex, 2023](#)). The International Platform of Insects for Food and Feed ([IPIFF, 2023](#)) lobbying for the adaptation of regulations to make this solution more applicable in the EU.

Another intervention involves **revaluing by-products** from food processing food waste into added-value products by transforming them into added-value products. This entails the conversion of by-products generated during the food processing stage and food waste into valuable and beneficial products. Methods that retain the inherent value of the molecular bonds within the material are used, i.e. it is aimed to extract maximum utility from

these materials, preserving their original molecular structures through innovative processes. Doing so enhances the economic and environmental sustainability of the food industry by minimising waste and creating high-value products from what was previously considered discarded material (Kannah et al., 2020). For instance, citrus peel by-products from juice production contain aromatic compounds locked within their molecular structure. Through processes like cold-pressing or steam distillation, these peels can be revalorised into essential oils with applications in perfumes, cosmetics, and flavourings, retaining the molecular bonds. A further example is coffee grounds: Coffee grounds discarded after brewing contain bioactive compounds. Extraction methods like supercritical fluid extraction can recover these compounds intact for use in dietary supplements, skincare products, or natural food additives, maintaining their molecular integrity (Romano et al., 2023).

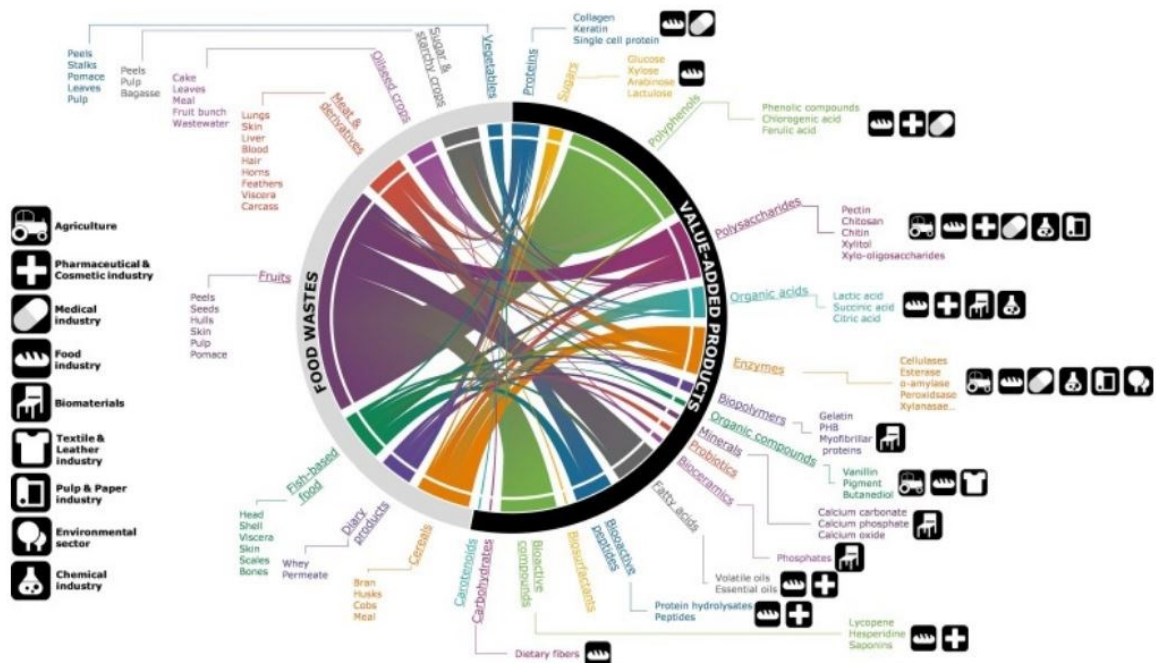
Fig. 2 illustrates potential pathways to valorise food waste into added-value bio-based products and the sector of application. The thickness of the connecting lines represents the number of different pathways tested, as documented in the scientific literature. Interestingly, vegetables (24%) and fruits (22%) stand out

as the primary culprits behind substantial food waste, trailed by cereals (12%), meat (11%), and oil crops (10%). Even though fish and eggs constitute smaller proportions of the food supply chain, their overall food waste quantities remain relatively low in absolute terms. Interestingly, a significant portion of these food groups (50% for fish and 31% for eggs) goes to waste despite their lower contribution to the total food waste.

Subsequently, repurposing for animal feed or non-edible applications, and recovery for energy or composting follow suit. Advanced technologies have the capacity to extract valuable nutrients from food waste, which can subsequently be employed as inputs for fertilisers or various other applications (Kannah et al., 2020). Only as a last resort, disposal methods, such as landfill disposal, are contemplated when no other alternatives are viable.

Taking apple pomace as an example, there are several alternatives for reducing food wastage. One option is composting, where apple pomace can be turned into nutrient-rich compost for use in agriculture. Another option is anaerobic digestion, which involves breaking down pomace to produce biogas and organic fertilisers. Apple pomace can also be used for animal feed, providing a sustainable source of

Fig. 2: Potential pathways to valorise food waste into added-value bio-based products and the sector of application (European Commission Joint Research Center, 2020; adapted from Caldeira et al., 2020)



nutrition for livestock. Alternatively, apple pomace can be processed and used as ingredients for new food products, such as jams or fruit-flavoured beverages. These alternatives help to minimise food waste and contribute to a more sustainable and resource-efficient food system (Diekmann & Germelmann, 2023).

Food waste prevention actions can further be categorised in five classes according to their goal (see Caldeira et al., 2019, p. 11-12):

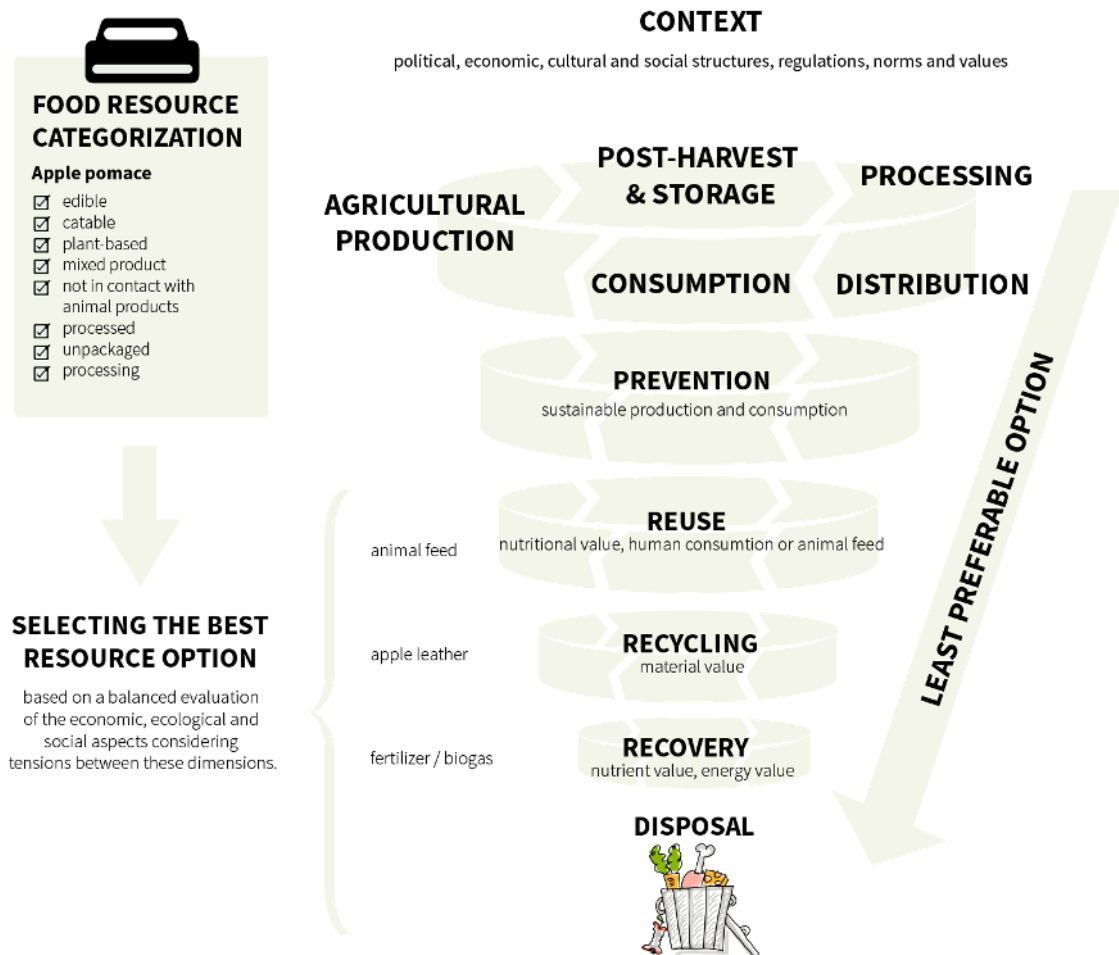
- 1 **Redistribution of food for human consumption** (e.g. surplus food redistribution, gleaning, digital redistribution tools),
- 2 **Food valorisation** (e.g., value added processing, animal feed),
- 3 **Consumers behaviour change** (e.g. awareness/educational campaign, digital tool, school programs, awards),
- 4 **Improvement of the supply chain efficiency** (e.g. process innovation, innovation of products, training and guidelines,

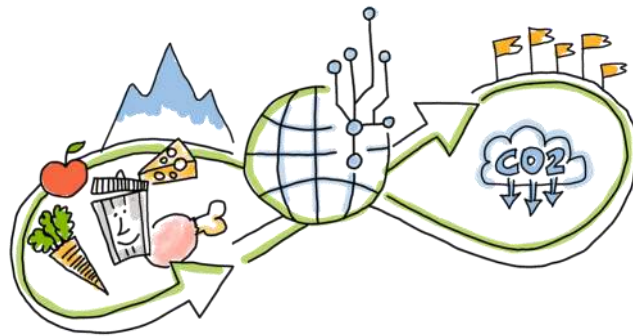
price discount, imperfect product sale, certification, public procurement, digital tools for supply chain efficiency), and

- 5 **Food waste prevention governance** (e.g. voluntary agreement, regulatory framework/policy, national food waste prevention program, fiscal incentives).

The research project CEFoodCycle focuses on the first two classes of waste prevention interventions, i.e. redistribution and recovering of food for human consumption and food valorisation. Following is a description of related facts and figures in the five Alpine Space regions (Section 2) and we show best practices of circular food waste prevention initiatives (Section 3).

Fig. 3 Different end-of-life alternatives for food wastage reduction, using the example of apple pomace alternatives (Diekmann & Germelmann, 2023).





Section II

Where we started: Facts & Figures



Food Waste in Europe

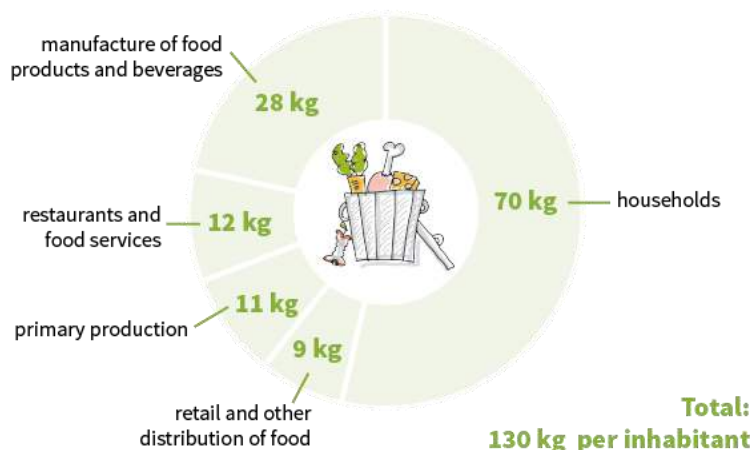
In 2021, the second year of the COVID-19 pandemic, around 131 kilograms (kg) of food waste per inhabitant were generated in the EU. Households produce 54% of food waste, accounting for 70 kg per inhabitant (European Union, 2022; Eurostat, 2023a). The remaining 46% of food waste was generated further upstream in the food supply chain. Notably, food waste at the household level is nearly twice the quantity of food waste originating from the primary production and processing and beverages manufacturing sectors, registering at 11 kg and 28 kg per capita, respectively, which equivalents to 9% and 21%, respectively. Restaurants and food services contributed to 12 kg of food waste per individual, equivalent to 9%. In contrast, the retail and other food distribution sector exhibited the lowest quantity of food waste, with 9 kg per capita, equivalent to 7%. It is essential to acknowledge that the impact of the COVID-19 lockdowns on food waste in these two sectors is currently under analysis (European Union, 2022; Eurostat, 2023a).

Cyprus led the way in 2020 with the highest average amount of food waste collected, coming in at 397 kilograms per person, a significant margin ahead of the next highest, which was Denmark at 221 kilograms per person. Among the 22 EU Member States with available data, seven of them reported collecting less than 100 kilograms of food waste per person in 2020, with Croatia and Slovenia having the lowest amounts at 71 and 68 kilograms per

person, respectively. In the majority of EU Member States that reported data, households were responsible for over 50% of the total collected food waste in 2020. In almost all Member States, households stood out as the primary source of collected food waste. However, there were exceptions in Cyprus and Denmark, where the share of waste collected from processing and manufacturing activities exceeded that from households. Meanwhile, in the Netherlands and Spain, the share of waste from processing and manufacturing equalled that from households. Additionally, Slovenia saw a notably high proportion (29.4%) of collected food waste originating from food-serving establishments when considering other sources (European Union, 2022; Eurostat, 2023a).

Edible food equivalent to six garbage trucks is lost or wasted every second. In monetary terms, roughly 50% of global annual total costs of \$5.7 trillion are due to the way food is produced and consumed. Currently, the agrifood sector contributes approximately 25% of global greenhouse emissions, damages air, water and soil and harms people's health. Globally, and until 2019 within the European Union, there was no methodology and no minimum quality requirements for a uniform measurement of food waste. The first comparable data within the European Union arose in 2022 (Eurostat, 2023b), but inconsistencies still remain and therefore data is to be treated with caution.

Food waste in the EU by main economic sectors, 2021 (kg per inhabitant)



Data not available: Czechia, Germany, Greece, Spain, Cyprus, Malta, Romania.
Due to roundings, the sum of the values does not match the total. © eurostat

Fig.4: Food waste in the EU by main economic sectors (2021)

European Circular Food Economy and Key Stakeholders

The Alpine Space is a region known for its rich biodiversity, a connection to traditional farming practices, and commitment to sustainable development. While research and scientific literature on food has undergone a sizable proliferation of articles, specifically food safety, production traceability, product quality, and environmental degradation (Zhang et., 2022), the focus on stakeholders and their crucial role to drive positive change and achieve a more circular and resource-efficient food system has not yet received enough attention.

The food sector includes and touches various stakeholders that create a complex ecosystem. Adapting Marrucci et al. (2022) and Diekmann & Germelmann (2022), we follow three different operating levels of Circular Economy in the food sector, namely at the micro-level (products, companies for primary production, grocery shops, canteens, restaurants, NGOs, social organisations), meso-level (umbrella organisations, research and educational organisations, businesses from other industry sectors in which food waste is considered a resource), and macro-level (policymakers, economic, cultural and social structures, norms and values). In the context of sustainable food practices, the involvement of these stakeholders is crucial in driving systemic changes.

The cooperation between different stakeholders and market food structure is facilitated by the comprehensive EU Green Deal strategy that aims to achieve food waste reduction, enhancing valorisation, redistribution and recovery of food waste. Here are some key points to highlight:

1 Food Waste Reduction Targets

The Commission is set to propose legally binding targets to reduce food waste across the EU, by the end of 2023. Those targets defined against a baseline for EU food waste levels set following the first EU-wide monitoring of food waste levels. ([European Parliament, 2020](#))

2 Food Waste Measurement

The EU has been working on augmenting and improving the quantification of food waste levels to ensure that national efforts against food waste are informed by a solid evidence base and support sharing of innovation and best practice. ([European Commission, 2023a](#))

3 Use by date and Food Waste Prevention

Better understanding and use by date marking on food, i.e., “use by” and “best before” dates, by all actors concerned, can prevent and reduce food waste in the EU. ([European Commission, 2023a](#))

4 Food Donation

When food waste cannot be prevented at source, surplus food should be redistributed for human consumption when safe to do so, see also European Commission (2020b) ([European Commission, 2023a](#)).

5 EU Platforms on Food Losses and Food Waste

Platforms such as [BioBase](#) (Austria), [vcg.ai](#) (Germany) or [Optifood](#) (Slovenia) bring together demand and supply to reuse and reduce food waste, also facilitating the sharing of best practices. ([European Commission, 2019b](#))

6 Farm to Fork Strategy

As part of the European Green Deal, this strategy puts forward a series of actions to enable the transition to a sustainable EU food system that safeguards food security and ensures access to healthy diets sourced from a healthy planet. ([European Commission, 2023b](#))

The following chapter explores CE food initiatives in the participating countries of the Alpine Space region. Also, the structure of the food value stream is described per participating country, outlining key market players, market structures and legislative issues.



Insights from Austria

Fachhochschule Salzburg | Paris Lodron University Salzburg

Circular Economy Food Initiatives in Austria

Slow Food Austria is an international movement that promotes sustainable and regional food production. For this purpose, events and campaigns are regularly organised to raise awareness for regional food availability and supply. It connects local food producers, food artisans and consumers are connected. ([Slow-Food, 2023](#))

Lebensmittel-Cluster is a hub run by Business Upper Austria and showcases best practices that use food waste as a resource for new product development. ([Lebensmittel-Cluster, 2024](#))

Launched in 2023, the objective of the **aws Sustainable Food Systems Initiative** is to mobilise and specifically financially support (radical) innovation potentials within the context of food systems through raising awareness, networking, and the exchange of expertise. ([aws, 2024](#))

The **Bio-economy Austria cluster** centres with its activities around a living economy based on renewable materials, which has been a cornerstone of eco-social thinking. Although the current focus is set on the biomass from the forest (wood), food is a missing link with great potential to facilitate the sustainable regenerative transition. ([BMK, 2024](#))

The **BioBASE innovation platform** focuses on the topics of bioeconomy and Circular Economy, thereby looking at the entire value chains - across all sector boundaries: from the provision of raw materials to the various conversion pathways (chemical, biotechnological, thermal) to basic materials and their processing into the end product, including the shaping processes and recycling options at the end of the life cycle. The platform is a central infor-

mation hub for service agencies for business, science, administration and politics. ([BioBASE, 2024](#))

Circular Economy Forum Austria and **Circular Futures** are the two largest independent multi-stakeholder platforms for the promotion of the Circular Economy. These forums support companies and their environment on the way to the Circular Economy and connect important actors for the creation of innovative value cycles. ([Circular Economy Forum Austria, 2024](#); [Circular Futures, 2024](#))

Government, federal states, science and NGOs are pursuing the goal to reduce by half avoidable food waste in kitchens by 2030. ([United Against Waste, 2024](#))

Climate Lab in Vienna creates alliances between leading corporations, startups, scientists, NGOs, and public sector institutions to achieve climate neutrality goals and the transition to a Circular Economy. While their focus is on the fields energy, mobility, and construction, food is yet to be added. ([Climate Lab, 2024](#))

In autumn 2023, a task force on Circular Economy was set up by the Austrian federal government, aiming to accompany the implementation of the Circular Economy strategy, critically examine it and evaluate it accordingly ([OTS, 2023](#)).

Structure of the Food Value Stream

Austria has 2.6 million hectares of utilised **agricultural area** (UAA) of which 25.7% is farmed organically. Approximately two-thirds of Austria's 165,000 farms are primarily dedicated to cattle and sheep farming. The main agricultural products in Austria are milk (3.4 billion kg), cereals (5.1 million tons) and beef (0.6 million

tons). Austria was the largest producer of organic milk in the EU in 2020, accounting for 19.4% of total organic milk production. It was also the second-largest producer of organic cereals, with a share of 14.6% ([European Union, 2022](#)).

The most important industries were the production of bakery products, meat products (pig and poultry) and alcoholic beverages. In recent years, Austria has risen to become the European Union's second-largest soybean producer. Additionally, Austria holds a notable position in global wine production, contributing 1% of the total output. The flagship wine of Austria is *Grüner Veltliner*, which dominates 37% of the country's vineyards ([Statistik Austria, 2021](#)).

The **Austrian food processing industry** plays a significant role in the Austrian economy. In 2020, there were 4023 food and beverage manufacturing companies ([European Union, 2022](#)) in Austria, which is 15.6% of all manufacturing companies (Manufacture) in Austria and 0.20% of all manufacturing companies ([European Union, 2022](#)) in the EU. In 2020, the Manufacture of food products and Manufacture of beverages in Austria generated a turnover of EUR 26.6 billion, which is 12.9% of the turnover of all manufacturing companies in Austria and 0.37% of the turnover of all manufacturing companies in the EU ([European Union, 2022](#)). In terms of trade, in 2021, Austria's total agricultural and related products imports were \$21.1 billion, and exports were \$23.6 billion, the majority of these goods were traded with EU Member States ([International Trade Organization, 2022](#)).

In 2020, the Austrian Food and Beverage retail sector achieved a turnover of around €23.74 billion ([Statista, 2023](#)). Food retailing in Austria, which is organised via retail chains, comprises around 5,300 sales outlets and employs around 114,600 people. Of these, more than 1,600 locations are operated by independent retailers who employ a total of more than 14,000 people ([Statista, 2023](#)). The three largest food retailers in Austria are REWE Group (Billa, Merkur, Penny), Spar and Hofer ([Österreichisches Gallup-Institut & Österreichische Post, 2018](#)). Direct marketing of agricultu-

ral products is slowly growing, since 2016 from 27% to 28% in 2023. According to a recent KeyQUEST survey of 500 farm managers in Austria, 83% rate the future prospects of direct marketing as very positive or rather positive ([Bauernnetzwerk, 2021](#)).

The value added by Food and Beverage retail specialist shops in Austria totalled €745 million in 2020. Micro businesses generated an added value of €456.2 million, small businesses €102.5 million, medium-sized businesses €60.3 million and large businesses €126.2 million.

According to Lund-Durlacher and Gössling (2021), there were 39,392 **food service businesses** registered in Austria in 2018, indicating a slight decrease since 2010 (-3.2%). Up to 2019, small businesses with up to 9 employees dominated the sector, accounting for 92.5% of all food service operations, while larger food service businesses with 50 or more employees account for only 0.7% of the total.

In Austria, **food banks** (e.g. [SOMA](#), [Samariterbund](#), [Vinzi Gruppe](#), [Rotes Kreuz](#)), **social supermarkets** or other initiatives play a crucial role in providing food to those in need (Holweg & Lienbacher, 2011; Lienbacher et al., 2021).

Regarding food waste for **energy production**, biogas is mainly produced from biowaste, food waste, liquid manure, dung and plants. There are currently around 350 biogas plants in Austria, which produce around 150 million cubic metres of biogas per year. This covers just under two percent of Austria's gas consumption ([Wien Energie, 2023](#)).

BOKU is a research intensive university in the food sector, e.g. Department of Food Science and Technology ([BOKU, 2023](#)), amongst others and a valuable partner for research projects.

In Austria, a national Circular Economy strategy has been defined with the vision that the Austrian economy and society will be transformed into a climate-neutral and sustainable Circular Economy by 2050 ([BMK, 2023](#)). As regards to food distribution in Austria, the Austrian Federal Ministry for Sustainability and Tourism (BMK) finalised an "Agreement 2017-2030 on Food Waste Prevention in Food Companies" with major players in the food indust-

ry. According to the BMK and social organisations, this approach has proven effective in Austria. However, concerns have been raised by social institutions about the feasibility of ensuring adequate financial and personnel resources, along with sufficient refrigeration, storage, and distribution capacities, especially if there were to be a legal prohibition on discarding edible food from the food retail sector.

The "Aquaculture Strategy 2020" (Blaas, 2012) led to an increase in in-house production, which subsequently also led to an increase in slaughter waste. About 50% of a single fish is consumed, the rest is slaughter waste and is largely processed outside the production site.

A summary of Austrian legislation targeting food waste prevention or management with indirect impacts on food waste can be found online (reducefoodwaste.eu, 2023). It is based on the report "Austria – Country Report on national food waste policy" from the EU project FUSIONS (Schneider & Lebersorger, 2016) and was updated by the authors to also cover the years 2015 and 2016.

With the Renewable Gas Act, which the federal government in Austria plans to pass soon, the production of biogas is to be expanded (BML, 2023). The target is 7.5 terawatt hours annually by 2030.

Food waste

In 2020, 1,211,534 tons of food waste were generated in Austria, all along the value chain (European Commission, 2023c). Starting with the production stage, 13,879 tons of food never reach the customer or processing stage, where 173,734 additional tons of food waste are generated. The largest portion of food waste, totalling 737,639 tons, originates from private households. In the food service industry, approximately 201,956 tons of food waste are discarded. The retail sector contributes the least to preventable food waste, generating 84,326 tons. (European Commission, 2023c)

Following guidelines outlined in the Government Programme 2020–2024, the food retail industry is set to be restricted from discarding food suitable for human consumption. The existing cooperative model in Austria, founded on voluntary participation, is deemed effective by both the Federal Ministry for Climate Action and representatives of social institutions. Notably, there has been a significant improvement in food distribution to social institutions by food retailers, with the amount doubling from 6,125 tons in 2013 to 12,250 tons in 2017. (Rechnungshof, 2021)

Fig. 5: Fact Box: Food Waste Austria (European Commission, 2023c; data from 2020)





Insights from France

CCI Nice Côte d'Azur | AVITEM

Circular Food Economy Initiatives in the South of France

PRECI Network: Regional platform dedicated to the Circular Economy to support businesses towards new sustainable and competitive business models, map circular initiatives and foster networking. Created in 2019 by the South Region, the State, the Environment and Energy Management Agency (ADEME), the Regional Chamber of Commerce and Industry (CCIR), the Provence-Alpes-Côte d'Azur Chamber of Trades and Crafts (CMAR) and Banque des Territoires. ([PRECI, 2024](#)):

REGALIM: The Provence-Alpes-Côte d'Azur Regional Network for Combating Food Loss and Waste was launched by ADEME, the Regional Directorate for Food, Agriculture and Forestry (DRAAF) and the Region in 2019. This network features a very useful [interactive map of initiatives](#) at regional level. ([REGALIM, 2024](#))

Food In Provence-Alpes-Côte d'Azur is the regional network of professional organisations dedicated to improving the overall performance of the region's agri-food businesses. ARIA Sud, CRITT Agroalimentaire ([CRITT Agroalimentaire, 2024](#)) Paca and IFRIA Sud provide effective, complementary services to meet all the sector's needs and professions. ([Food In Provence-Alpes-Côte d'Azur, 2024](#))

The **Slow Food network** ([2024](#)) is active in France, through sub-initiatives such as Slow Food Consortium, Sentinelle Slow Food, Arche du Goût and Alliance Slow Food des Cuisiniers. Zero Waste Europe also has its French sub-network ([Zero Waste France, 2024](#)), and local versions in [Marseille](#), [Nice](#) and [Toulon](#), aiming to spread the zero waste approach among citizens and professionals alike.

CRITT Agroalimentaire PACA provides advice and technical support to companies on their

innovation projects, industrial performance, food safety, the nutritional quality of products, reducing environmental impact (energy, water, waste), creating/optimising organic ranges and optimising the environmental footprint of food products. Their services include inter- and intra-company training, individual coaching and the dissemination of technical and regulatory information. ([CRITT Agroalimentaire, 2024](#))

Pôle Eco-Conception: The Eco-design and Lifecycle Performance Centre is France's centre of expertise, skills and knowledge in eco-design; a driving force and catalyst for its promotion, deployment and application to the widest possible audience, including along the food value stream. ([Eco-Conception, 2024](#))

Fertilidée is a cooperative organisation working alongside local authorities and businesses to build resilient regions in terms of food stream. ([Fertilidée, 2024](#))

Ecozept is a French-German consultancy and research agency specialising in sustainable agri-food markets, the Circular Economy and the sustainable management of agricultural areas. ([Ecozept, 2024](#))

Métha'Synergie provides support to methanisation projects for residual organic matter (backed by several public and private actors (Environment & Energy Management Agency, South Region, Regional Department for Environment, Planning & Housing, Regional Chamber of Agriculture, [Geres](#), [GRTgaz](#) and [GRDF](#)). ([Métha'Synergie, 2024](#))

Structure of the Food Value Stream

The agrifood industry is the 1st economic sector in France, and 2nd European food value stream after Germany, with a turnover of

about €200 billion and over 450 000 jobs within around 17 000 companies of which 98% are SMEs, according to the National Association of Food Industries ([ANIA, 2023](#)). Overall, the biggest sectors (in terms of production, jobs and turnover) are meat, dairy, cereals and beverages, but there are strong regional disparities. The Southern Provence-Alpes-Côte d'Azur region stands out for its high relative weighting in activities linked to the "cocoa, chocolate, confectionery, sugar, tea, coffee" sector, the "drinks" sector, the processing and preservation of "fruit and vegetables" and "prepared dishes and condiments". The predominance of the 'fruit & vegetable' sector in the region is linked to the processing of locally produced agricultural raw materials: The South-East of France is the leading fruit-producing region (with over 50% of orchards) and a key vegetable-producing region ([Aria Sud, 2023](#)). Many fruit and vegetable processors have chosen to locate as close as possible to this production area.

In Alpes-Maritimes, 12.8% of exports are food industry products, only 1.9% of which is primary food produce, versus 11.11% and 3.9% of imports. Interestingly, the two main destinations for exports are Germany and Italy, whilst the main origin by far for imports is neighbouring Italy. This shows the relevance of the Alpine Space geographical focus in terms of economic interdependence and complementarity, including in the field of food and waste.

In 2021, France had 2.8 million hectares of utilised agricultural area (UAA) farmed organically, the largest area in Europe, followed by Spain (2.44 million ha) and Italy (2 million). At the French level, that represents 14% of farms, 11% of farming surfaces, over 230 000 jobs and a 13 billion euro market (7% share of the food market) ([agriculture.gouv.fr., 2023](#)). The South region has the biggest share of organic UAA, at 35.8%, and an annual increase of 10% in farm numbers, surfaces and jobs in 2021 ([Le Réseau des Agriculteurs BIO de Provence-Alpes-Côte d'Azur, 2022](#)).

In terms of consumption and distribution channels, one third of a consumer's organic purchases is made of grocery items, another third is fresh fruit and vegetables, eggs, milk

and dairy products. In a context marked by the aftermath of COVID-19, with a fall in household food consumption (-2.28%), the value of organic food purchases fell by 1.3% compared to 2020. However, the sector is still worth €13 billion, and has maintained a stable market share (6.63%) of French grocery shopping.

The fall in sales of organic products in 2021 is not seen in all distribution channels: it is mainly seen in supermarkets (-3.9%) and specialist shops (-1.8%). Conversely, organic sales are rising sharply in direct sales (+7.9%) and among craft retailers (+5.8%).

Collective catering, one of the most important potential levers for the ecological transition, was almost back to its pre-pandemic level by 2021: organic food purchases in this sector amounted to €377 million, or 6.6% of its total purchasing volume. As a reminder, the EGalim law, which came into force in 2019, sets collective catering a target of 50% quality and sustainable products on the plate, including at least 20% organic products. This market represents significant growth potential for the organic sector. All the players in the sector, from chefs and canteen staff to producer groups and local councillors, are getting organised to adapt their operations and meet this regulatory requirement.

Cooperative supermarkets are shops where customers are both co-owners and volunteer workers. First introduced in France in 2016, the model is gradually spreading across the country. There are currently around 40 cooperative supermarkets, but their development is accelerating and around fifty other projects are under consideration. In cooperative supermarkets, power and decisions are subject to a vote by the co-owners (participatory democracy). This applies, for example, to the choice of products; most of the time, preference is given to short circuits and local producers. This reduces the number of intermediaries involved and gives us control over the supply of products, in terms of quality, quantity and price. The voluntary work of the members also helps to reduce costs, enabling us to offer cheaper products while paying producers a fair price. Products in a cooperative supermarket are 30% to 40% cheaper than in a con-

ventional supermarket. In the South region, the main examples are [SuperCafoutch](#) (Marseille), [Nice Coop'](#), [La Coop sur Mer](#) (Toulon) and [La Meute](#) (Grasse).

The Associations for the Preservation of Local Agriculture (AMAP) are partnerships between a group of consumers and a farm, based on a system of distributing "baskets" of produce from the farm. It is a solidarity-based contract, based on a financial commitment from consumers, who pay in advance for a share of production over a period defined by the type of production and the geographical location. For the farmer, AMAPs mean maintaining farming activity by guaranteeing income, and for the consumer, fresh, seasonal, often organic food produced from local or ancient plant varieties or animal breeds, at a fair price for both partners. The regional website of southern AMAPs ([Les AMAP de Provence, 2024](#)) displays a number of options, including the Marseille cooperative ([Les Paniers de Marseille, 2024](#)). Short circuit and direct purchase from the producer include other options such as [La Ruche Qui Dit Oui](#) (2024).

Lastly, the national Federation of Food Banks ([Banques alimentaires, 2024](#)) is fighting food insecurity, especially by combating food waste. The network collects products, sorts and stores them for redistribution. These products are given on an equitable basis to partner associations, local community centres and social grocery shops, which are responsible for distributing them to people in receipt of food aid. These partner associations are supported throughout the year by the network in their mission to help the people they serve, through training, workshops and educational tools.

In 1986, France created the European Federation of Food Banks (FEBA), whose mission is to represent its members at European and international level, to support Food Banks in Europe by sharing experience, training and finding partners, and to encourage the creation of new Food Banks. Present in 24 European countries, the 335 Food Banks and branches in the FEBA network distributed 860,000 tons of foodstuffs in 2020 to 48,126 partner associations, which welcomed 9.5 million deprived people thanks to 37,016 employees (85% volunteers).

Due to the introduction of regulations in 2024 regarding the sorting, collection and valorisation, the food stream transition emphasis in France lies on biowaste, which is - in the context of food - defined as food or kitchen waste from households, offices, restaurants, wholesalers, canteens, caterers or retail outlets. This definition corresponds to biodegradable waste and includes, amongst others, food waste as leftovers from meals or food preparation, uneaten products that have gone out of date, and used cooking oil.

Biowaste

In the South Region in 2019, the agricultural sector had 18,600 establishments and 1,358,000 tons of waste produced, most of which is organic. It is estimated that more than 993,000 tons of organic waste (vegetables, straw, wine residue, etc.) are produced each year in the region. 70% of companies are unaware of the quantity of biowaste they produce ([Marcoux et al., 2022](#)). Involving the carrying out of weighing campaigns, the evaluation of biowaste production is a complex process to implement for companies, which do not always have the time and means. This is why, as part of the implementation of the regulations relating to "large producers" of biowaste, several studies carried out by sector unions in partnership with the Environment and Energy Management Agency (ADEME) made it possible to establish reference ratios to estimate the production of biowaste based on activity parameters known to companies. Regarding the CEFoodCycle pilot in France, a first estimate of biowaste deposit linked to the hotel and catering sector in Alpes-Maritimes was carried out on the basis of:

- National ratios identified as part of our documentary research, especially those noted in the GNI-SYNHORCAT study;
- The number of establishments and jobs linked to the hotel and catering sector in Alpes-Maritimes. These data were obtained using the MAGE model (Geolocalised Analysis Model of the Economy), an algorithm developed by the Aix-Marseille-Provence Chamber of CCI, which produces estimates of salaried (public and private)

and non-salaried employment to then obtain an estimate of total employment.

As Table 1 illustrates, the potential for biowaste produced by hotels & catering companies in Alpes-Maritimes is estimated at approximately 32 tons per day.

In 2010, with a view to limiting greenhouse gas emissions and promoting the return of organic matter to the soil, **the law establishing a national commitment to the environment** (known as the Grenelle II law) made the follo-

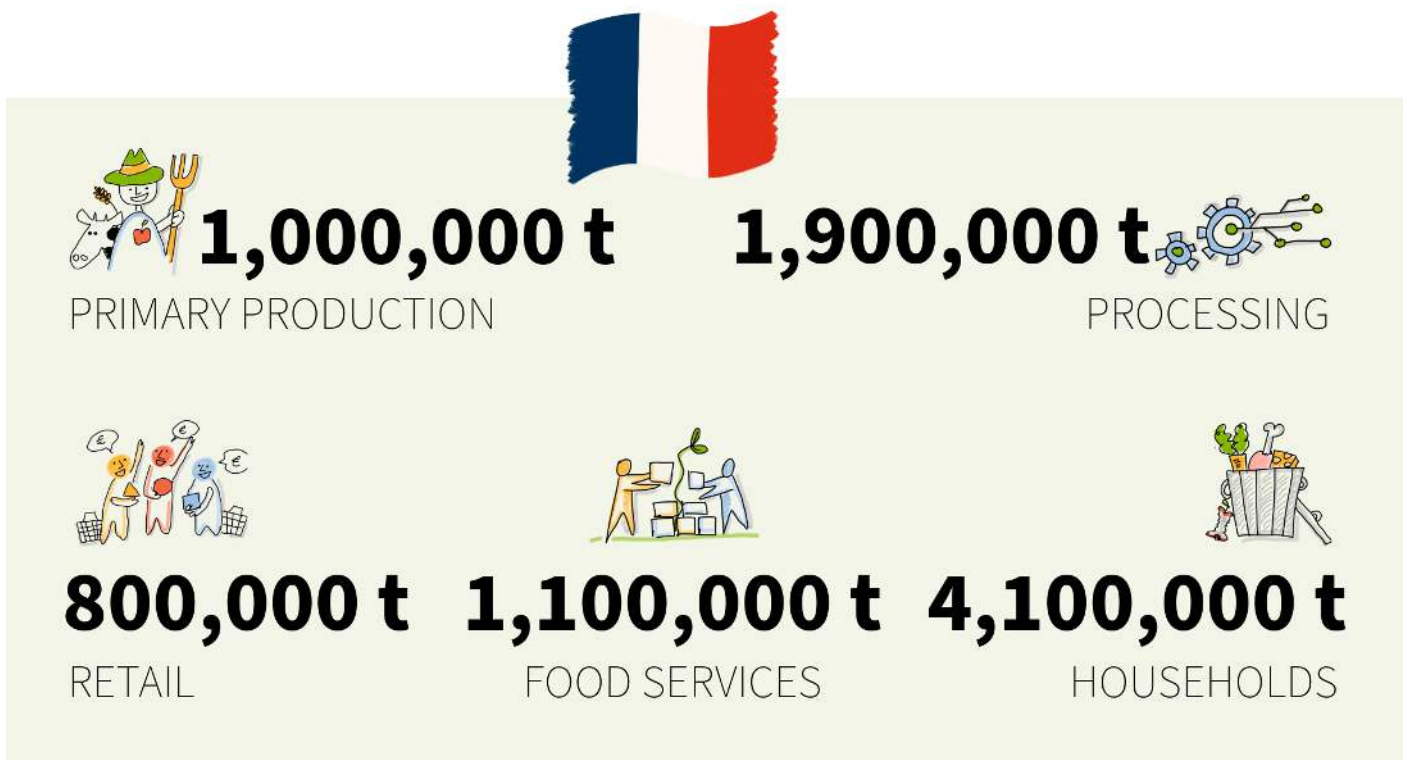
wing compulsory for “large producers” bio-waste: sorting at source, biological valorisation, appropriate collection. **The law relating to the energy transition for green growth** ([Légifrance, 2024a](#)), supplemented by the **law relating to the fight against waste and the Circular Economy** (known as the AGECE law; [Légifrance, 2024b](#)) have strengthened the threshold to 5 tons of biowaste per year on January 1, 2023, with a view to its generalisation to all professionals (and households) on January 1, 2024.

	Number of establishments	Estimation of job numbers	Hypothesis of kitchen job numbers *	kg/kitchen staff/day <small>According to GNISYNHORCAT study</small>	kg/day
Hotels and similar accommodation (5510Z)	1 337	8 169	1 225	4.6	5 637
Traditional catering (5610A)	4 731	14 658	2 199	6.7	14 731
Cafeterias and other self-services (5610B)	17	122	18	6.1	111
Fast food (5610C)	4 621	9 444	1 417	6.4	9 066
Beverage outlets (5630Z)	997	2 199	330	6.1	2 012
				TOTAL	31 558

Table 1: Biowaste potential in Alpes-Maritimes

* The number of kitchen jobs was estimated based on the following assumptions:
Restaurants: 60% of jobs related to cooking
Hotels: 15% of jobs related to cooking

Fig. 6: Fact Box: Food Waste France ([European Commission, 2023c](#); data from 2020)





Insights from Germany

Umweltcluster Bayern | Hochschule München

Circular Economy Food Initiatives in Bavaria

Zero Waste Munich advocates for food savers, garbage collectors, urban gardeners and sustainability as a way to lead Munich to becoming a Zero Waste City. It motivates people to live a more sustainable lifestyle. ([Zero Waste München, 2024](#))

The **Community Kitchen**'s mission is to save food that would otherwise end up in the trash, and after checking edibility, process it into meals for their own restaurant, for homes and events. They have the capacity to process several tons of rescued food per day. On average, 15 tons of food is saved from being discarded weekly. ([Community Kitchen München, 2024](#))

Circular Munich is a non-profit association that aims to drive Circular Economy at the local level to co-create a circular, greener, inclusive and caring city for all. They promote collective action and civic engagement to create change for impact. ([Circular Munich, 2024](#))

Rehab.Public is a non-profit grassroots organisation established in 2012. It stands for rehabilitating and recultivating common goals of social interaction, to ensure long-term preservation of the livelihoods of current and future generations. ([Rehab.Public, 2024](#))

The aim of the Bavarian Food Cluster ([KErn, 2020](#)) is to strengthen the competitiveness and innovative capacity of Bavaria as a centre of food production. As a networking platform, the cluster brings together key players from agriculture, the food trade, the food industry, and science. The Nutrition Cluster, as is also known, is based at the Competence Centre for Nutrition (KErn) in Kulmbach, Upper Franconia. It closely monitors developments in the food industry in order to identify innovations

and develop relevant, forward-looking projects and events for the Bavarian agriculture and food industry. Over 200 projects and 1,300 events have been initiated and supported. The Food Cluster is a member of the "go-cluster" programme, a measure of the Federal Ministry for Economic Affairs and Energy (BMWi). The "go-cluster" programme brings together the most efficient innovation clusters in Germany.

KErn Kompetenzzentrum für Ernährung addresses relevant authorities and partners in nutrition: state institutions such as officials; education, health, and social institutions; doctors and midwives; nutrition advice; industry; and the media. KErn's central functions comprise appropriately documenting the latest knowledge about nutrition and food related themes and preparing it for different target groups. ([KErn, 2024](#))

Fraunhofer Food Alliance builds on decades of collaboration. The expertise of 13 Fraunhofer Institutes, which are part of the Fraunhofer network of around 76 institutes, is pooled under the umbrella of the Alliance. Customers from the food industry benefit from this unique scientific infrastructure and interdisciplinary expertise along the entire value chain: from innovative approaches, e.g. in the areas of agriculture, product protection and analytics, food and logistics, to new processing technologies and developments in terms of sustainability and the Circular Economy. ([Fraunhofer Food Alliance, 2024](#))

Genuss Schätze Bayern project was created in 2017 by the Bavarian State Ministry of Food, Agriculture and Forestry (StMELF) with the goal to increase consumer interest in Bavaria's food and agriculture products ([Genuss Schätze Bayern, 2024](#)). Within this framework its task is to establish and support value chains for special products in cooperation with eco-

conomic actors by highlighting the value of product taste, authenticity, and quality, cultural heritage, economic stability and mindfulness ([FRIDGE Interreg Europe](#)).

The Federal Ministry for Food and Agriculture collaborates with partners, including food banks, and involves the Federal Government and regional ministries in developing strategies to combat food waste ([Federal Ministry for Food and Agriculture, 2019](#)). The “We save food alliance” launched in 2016 is an example. The initiative presented 17 proposals to rescue food in the supply chain. This regional project supports measures like logistical support for food charities and makes them aware when there are goods available for pick-up (EU Platform on Food Losses and Food Waste, 2019). While there is no legal obligation for retailers to donate food, Germany’s Food Bank national strategy has in place voluntary agreements to encourage donations of food before its best before date ([Safe, 2023](#)). Retailers follow a code of good practice approved by the Ministry of Health.

Structure of the Food Value Stream

Bavaria is the largest Federal state of Germany, a major agricultural region with 85% of its land being rural. It has 2.6 million hectares of forest, 3.2 million hectares of agricultural land,

with over 106,000 farms and associated food processing industry, making agriculture one of the largest economic sectors ([StMELF, 2022](#)). The agricultural use includes 65% arable land and 34% grassland. Notably, every third German farm is in Bavaria. The region is a leader in aquaculture, having one-third of Germany's trout ponds and 70% of carp ponds. In organic farming, Bavaria leads with 11,100 farms covering 385,000 hectares, making up 30% of Germany's organic farms in 2021. The average farm size is 36 hectares, with 59% being part-time and 41% full-time holdings ([StMELF, 2021](#)).

Bavaria plays a prominent role in Germany’s agricultural and food production sectors, particularly in the dairy and meat sectors ([Bayerisches Landesamt für Statistik, 2022](#)). With 55 dairies, 33,670 farms, and 1.20 million cows, Bavaria contributes significantly to Europe’s dairy output, producing 8.43 million tons annually. The region is a major player in organic milk, responsible for over 50% of Germany’s production. In meat production, Bavaria’s 1,500 slaughterhouses generate 289,000 tons of beef and veal, 621,000 tons of pork, and 104,000 tons of poultry.

The region also hosts 150 mills for grain processing. Bavaria’s brewing industry thrives with around 640 breweries, and the Hallertau area. Spanning 19,500 hectares, it is the wor-

Table 2: Food production in numbers, Bavaria (StMELF, 2021)

<p>Dairy Sector</p> <ul style="list-style-type: none"> • 55 dairies and 33,670 dairy farms housing 1.20 million cows. • Average annual milk yield per cow: 7,700 kg. • Total milk production: 8.43 million tons, making Bavaria a crucial dairy region in Europe. • Bavaria contributes significantly to organic milk, producing over 50% of Germany's organic milk. 	<p>Meat Production</p> <ul style="list-style-type: none"> • 1,500 slaughterhouses (including butchers). • Beef and veal production: 289,000 tons (self-sufficiency 170%). • Pork production: 621,000 tons (self-sufficiency 94%). • Poultry production: 104,000 tons (self-sufficiency 52%).
<p>Grain Processing</p> <ul style="list-style-type: none"> • About 150 commercial mills contribute to grain processing. 	<p>Beer Brewing</p> <ul style="list-style-type: none"> • Approximately 640 breweries, nearly half located in Bavaria. • Hallertau, with around 19,500 hectares, is the world's largest hop-growing area.

ld's largest hop-growing region. Overall, Bavaria significantly shapes Germany's food production landscape (StMELF, 2022).

The food processing & beverage industry in Bavaria is a significant contributor to the region's economy, reflecting the overall strength of the food and beverage sector in the country (GTAI, 2022). Germany's food and beverage industry is the fourth largest industry sector, generating EUR 185.3 billion in production value in 2020. This industry is characterised by its small and medium-sized enterprises, with over 6,100 companies providing jobs for approximately 614,000 people. The main contributors to production value are meat and sausage products (24.3%), dairy products (15.5%), and baked goods (9.4%). In addition, covers a wide range of products, including beer, cheese, baked goods, wheat beer, noodles, pasta, mustards, sauces, and condiments, showcasing the region's diverse culinary tradition and agricultural heritage. Furthermore, Bavaria has established itself as a solid development hot spot for AgTech start-ups and companies. Bavaria, as the leading food producer and agricultural hub in Germany, is in a position to influence the country's agricultural turnover (Invest in Bavaria, 2019).

It has the fourth-largest share of the total commercial vegetable production (14%) in Germany (Destatis, 2021). In general, Bavaria benefits from a strong position in the local processing industry and international sales markets, however, concerns about the challenges imposed by legal regulations particularly in relation to vegetable production are a consideration. Bavaria has an established presence in international markets with specific vegetables such as pickles, asparagus, cabbage, and potatoes, along with the associated canning industry. Bavaria and the high-quality demand of retailers for product and process innovation among producers in the region, are strong factors in the preservation and appreciation of vegetable production, in terms of the region's image, provision of local healthy food, and ecosystem services such as maintaining biodiversity, landscape and soil conservation. The vegetable production in this region benefits from reasonable land prices, good soils, a well

recognised production expertise, which is identified as significant for the successful landscape development of production clusters (Giuliana, 2008; Tavoletti & foodTe Velde, 2008).

The agri-products industry's adoption of new influences and commitment to innovation align with circularity initiatives emphasising the conversion of resources into value cycles through sustainable practices that extend across regional food supply chains. This includes cultivation, production (manual and industrial), and supporting demand in agriculture, including value creation, cultivation, production and trade (B2B and retail) (Bertram et al., 2021).

In Bavaria, the approach to **food distribution** involves a diverse array of interventions aimed at the development of the local economy and its sustainable practices. It hosts numerous producers from various sectors such as dairies, bakeries, meat product manufacturers and confectionery. Bavarian traditions are also reflected in its food trucks, kiosks and speciality food producers offering authentic German speciality meat items. Bavaria's strategic initiatives include the development of infrastructure to facilitate the distribution of local products, the consolidation of local food producers, the preservation of traditional culinary diversity, the provision of advisory services on market dynamics, the promotion of food supply chains, and the enhancement of professional skills within the agricultural sectors.

Bavaria's strong focus on agricultural innovation, including initiatives in AgTech and future nutrition, has positioned the region as a hot-spot for sustainable food production and waste management. In Bavaria, food waste is being increasingly utilised for **energy production** through processes such as anaerobic digestion (AD) (Lansing et al., 2019). Codigestion projects in Bavaria have focused on the utilisation of food waste in combination with other organic substrates, such as dairy manure, to maximise biogas production and energy recovery.

According to a survey by the Bavarian Food Cluster, 85% of **German consumers** prefer

locally produced food, with particular interest in products “made in Bavaria” (Kern, 2020). The value of food in Germany is reflected in the relatively low cost of groceries compared to many other countries. According to a report, the cost of groceries in Germany is relatively low, thanks to plenty of homegrown produce and competitive discount supermarkets. This factor may influence the value of food (GTAI, 2022).

Bavaria cooperates in multiple ways with its neighbours with the goal to achieve large-scale, cross border endeavours to tackle common geographical challenges (Chilla, & Sielker, 2022; Paasi & Zimmerbauer, 2016). These spaces of activity provide the state of Bavaria with opportunities to shape the legislative agenda at both higher and lower levels of political processes. Influencing the development of agri-food, and favourable conditions in relation to innovation, infrastructure, market demand, collaboration, and product competitiveness present in the region and, contributing to its potential in both national and international markets (Gabriel & Bitsch, 2023).

Strong focus on Bioeconomy

In Bavaria, **the bioeconomy sector** represents a significant shift in the economic structure, seeking to promote environmental and resource conservation, addressing climate issues, and generating economic value by utilising local natural resources. In Germany, food waste generates on average 4% of the country’s annual greenhouse gas emissions (BMEL, 2023a). According to AgrarOLkG, in 2021 there were a total of 216 recognised producer organisations in Bavaria, of which 74 crop producers were active in plant production (StMELF, 2021).

In November 2020, the Bavarian state government adopted the “Future.Bioeconomy.Bavaria - Shaping Transformation Sustainably and Innovatively” strategy. This strategy was crafted with Bavarian stakeholders in the bioeconomy sector with the aim of empowering and supporting actors in transformation, fostering collaboration to reinforce circular and sustainable bioeconomy (StMELF, 2022).

Fig. 6: Fact Box: Food Waste Germany (European Commission, 2023c; data from 2020)





Insights from Italy

IDM Südtirol - Alto Adige | LAMORO

Circular Economy Food Initiatives in Alto Adige / South Tyrol

Regional strategy for Circular Economy is an initiative from the autonomous province of Bolzano. This project aims to develop a regional strategy for the Circular Economy in the region, based on the principles of reducing waste, reusing resources, and recycling materials. ([Eurac Research, 2024a](#)).

Another initiative in the realm of Circular Economy and sustainability in Alto Adige/South Tyrol is the NEST project ([Eurac Research, 2024b](#)). It focuses on various aspects of agriculture, from production and trading of food and beverages to natural resource management and rural development ([Eurac Research, 2020](#)).

The South Tyrolean fruit industry is one of the most important economic sectors in the region, producing high-quality apples and other fruits for local and international markets. However, the fruit industry also faces challenges such as climate change, resource scarcity, and waste generation. To address these challenges, their focus is on making the production more sustainable, reducing packaging waste, and promoting social change through awareness, education, and collaboration to encourage circular thinking and practices. ([Sustainapple, 2024](#))

Structure of the Food Value Stream South Tyrol / Alto Adige

South Tyrol is a significant player in the **fields of fruit and wine production**. The area covers a total land mass of 455,840 hectares, 62% of which is agricultural land. However, due to the region's mountainous terrain, only 28% (209,232 hectares) is utilised for cultivation, meadows, and pastures. The agricultural sec-

tor is not just a cornerstone of the local economy but also a steward of the natural resources, including landscape, soil, water, and biodiversity ([Eurac Research, 2020](#)). The region stands out as the largest apple-growing area in Europe, contributing to 10 percent of the continent's apple harvest ([Irsara, 2023](#)). This robust production capacity is significant for the export business, with 19% of the total food products exported. Of this export volume, 14% comprises agricultural products, reflecting the region's strong focus on farming and food production.

The **retail structure of food products** in South Tyrol demonstrates besides the regular supermarket distribution a significant reliance on direct marketing, contributing notably to the income of small and medium local enterprises. **Direct marketing** in the region accounts for a substantial €44.7 million in turnover, averaging about €98,400 per company ([Südtiroler Bauernbund, 2023](#)). This figure represents over half (55%) of total sales. Vineyards alone generate 20% of this revenue. The primary sales channel is direct farm sales, utilised by 83.7% of direct marketers. The retail structure of food products in South Tyrol is not only reliant on direct marketing, but also significantly contributes to the region's economy through both local sales and exports. About one-third of these businesses are also active in farmers' markets, while a quarter offer home delivery services, a practice that increased in recent years. Approximately 75% of the enterprises also supply the gastronomy sector, and around two-thirds engage with retail food stores. Half of the direct marketers distribute their products through wholesalers. About two-thirds of the revenue from direct marketing businesses is generated through these indirect channels, amounting to €29.926 million, while direct sales account for €14.821

million in turnover. This highlights the critical importance of collaboration with both wholesale and retail sectors, as well as the gastronomy industry, in the overall distribution strategy of food products in South Tyrol.

The landscape of food companies is led by a large number of SMEs as shown by the numbers of direct sales that is a practice predominant of such companies. There are just **a few larger industrial food processing companies** in the region, mainly working with apples, wine, milk and cured ham, the same products that are also exported as agricultural or processed food.

Gastronomy in South Tyrol holds an important place in the region's economy, reflecting not just its culinary heritage and the amount of high quality hotels and restaurants but also its significant contribution to employment. Nearly 30% of all employees of the private sector in South Tyrol work in hospitality and gastronomy ([Provincial Statistics Institute ASTAT, 2022](#)). This high percentage underscores the importance of this industry in the local economic landscape.

Cooperatives such as Südtiroler Bauernbund focus in recent years on sustainable food practices, such as composting, use of organic fertilisers, biochar, aquaponics, and local farming, and contribute to reducing food waste by utilising organic waste and promoting local food production ([Südtiroler Bauernbund, 2024](#)).

Social organisations such as Banco Alimentare/Landestafel ODV, (Food Bank), called Cacciatori di Briciole, work towards reducing food waste and addressing food insecurity. They

play a critical role in collecting surplus food from businesses and redistributing it to vulnerable populations in South Tyrol. Adding up to 446 tons in the province of Bolzano and 398 tons in the province of Trento in 2022 ([Banco Alimentare Trentino Alto Adige, 2022](#)).

Collaboration with **research institutions** like EURAC Research with the Institute for regional development, Free University of Bolzano with the Faculty of Agricultural, Environmental and Food Sciences and Laimburg Research Centre can provide scientific expertise to assess the environmental impact of various food production methods.

Fraunhofer Research Institute is involved in the EU Project TeBiCE ([Fraunhofer, 2023](#)), Territorial Biorefineries for Circular Economy and therefore also actively contributing to the transition to Circular Economy practices in the region.

The NOI Techpark is home to the "Food & Health" sector, which also deals specifically with food by-products. It plans the opening of the Faculty of Engineering of the Free University of Bolzano in 2024. ([NOI Techpark, 2024](#))

In the **energy sector** of South Tyrol a big development towards renewable energy was made, especially in Hydroelectric production due to its geographical predisposition for this way of renewable energy production. Figures from the years 2018 and 2019 show a slight increase in hydroelectric production (6,855 million of kWh in 2018 to 6,930 in 2019), which is about 2.4% of Italy's entire production (see Table 3).

Table 3: Electricity production and consumption—2018 and 2019 (data: [Provincial Statistics Institute ASTAT, 2021](#))

Electricity production & consumption	2018	2019	
	Millions of kWh	Millions of kWh	% of Italy
Gross output	6,855	6,930	2.4
of which: Hydroelectric production	6,026	6,110	12.7
Consumption	3,129	3,188	1.1
Agriculture	191	230	3.8
Industry	893	983	0.8
Services	1,485	1,403	1.5
Private households	560	572	0.9

The **total consumption of food** in South Tyrol amounts to approximately 240,000 tons per year, with tourist food consumption accounting for about 40,000 tons per year ([Landwirtschafts Report 2020](#)). In terms of recycling of organic waste and composting, it

has slightly decreased from 12,770 t in 2019 to 12,714 t in 2022, whereas fermentation has almost tripled from 6,700 t in 2019 to 18,662 t in 2022 as shown in Table 4. ([Provincial Statistics Institute ASTAT, 2021](#))

Table 4: Utilization of Organic Waste

Category/year (metric tons)	2019	2020	2021	2022
Composting	12,770	11,919	12,780	12,714
Fermentation	6,700	11,470	17,550	18,663
Farm-based Fermentation	1,520	1,348	1,275	1,591
Composting outside South Tyrol	5,470	5,109	3,736	5,900
Total by Office for Waste Management	39,330	34,528	35,341	38,868

Circular Economy Food Initiatives Piedmont

In Piedmont, it is the University of Gastronomic Sciences of Pollenzo in collaboration with the Piedmont Region that drives sustainability and Circular Economy in five important supply chains for the region, i.e. wine, milk and dairy products, rice, water and bovine meat (see Fig. 5). Their focus is on the agri-food supply chain. ([Regione Piemonte, 2023](#))

Circular Economy for Food ([CEFF, 2023](#)) is a knowledge hub that collects best practices of the application of the principles of Circular Economy in the agri-food chain, research, publications and awareness events, to help companies and institutions adopt the correct strategies for the transition to a new production model.

Unioncamere Piemonte, in collaboration with the Chambers of Commerce of Piedmont, promotes the Best Practices of Circular Economy and business sustainability. The main objective of the initiative is to promote awareness of the Circular Economy as a tool for economic competitiveness, as well as environmental and social sustainability. ([CSR Piemonte, 2024](#))

AGRIFOOD Innovation Hub supports SMEs and cluster members in identifying their needs and setting up plans for innovation, R&D and tech-

nology transfer in the fields of food technologies, traceability, product/process innovation, microbiology and food safety, sustainability, as well as virtuous management of food production, recovery and valorisation of waste from the agri-food supply chains. ([Polo Agrifood, 2024](#))

A Good Opportunity project promoted by the Piedmont Region aims to increase consumer awareness towards more sustainable lifestyles and consumption. Through the A Good Opportunity app, consumers are made aware of how to limit food waste and focus on the causes that generate waste. ([Una Buona Occasione, 2024](#))

Structure of the Food Value Stream Piedmont

In terms of territorial extension, Piedmont is the second-largest region in Italy. 43.3% of the regional territory is mountainous, the hilly areas represent 30.3% of the territory, while the plains (high and low) make up 26.4%.

36% of Piedmont's territory is dedicated to **agricultural production**. The ratio between the resident population and the surface area dedicated to agriculture is equal to 452 inhabitants for every 100 hectares of used agricultural surface, a much higher value than the Euro-

pean average (277 inhabitants for every 100 hectares of used agricultural surface). In 2021 workers employed in agriculture were 3.4% of the total employed (4.1% is the Italian average and 3.7% the average in the EU-27). In 2021 the value of production in the agricultural sector is €4,159.1 million, broken down as follows: 45.5% agricultural crops, 35.1% livestock farming, 19.4% services and secondary activities (CREA, 2023).

In 2022, two strong critical issues emerged that affected the trends of agricultural production: drought high temperatures and the international geopolitical crisis with its repercussions on raw material prices (IRES, 2022).

The **food and beverage industry** constitutes an important asset of Piedmontese manufacturing with a total added value of approximately €3.4 billion (2020 data). It affects Piedmontese manufacturing by 14%. In 2020, the food and beverage industry in Piedmont has just under 37,400 employees, a slight decrease (-1.9%) compared to 2019; in particular, the food industry has 33,300 workers, representing over a third employed in the production of baked and flour products, while the beverage industry employs approximately 4,100 workers (CREA, 2023).

In Piedmont, the **regional agri-food sector** is characterised by a growing projection towards foreign markets. The basis of the growing exports is the quality and valorisation of the products. Wine is the sector that is mostly based on certified and protected production (IRES, 2022). Agri-food is one of the most vital sectors of the regional economy, representing 9.4% (in value) of imports and 14.9% of overall agri-food exports at a national level. It is structurally oriented towards a productive organisation which imports raw materials and exports processed products (CREA, 2023). In the Piedmont region, agricultural and food exports are primarily driven by fresh fruit, wine and processed food. This may include items produced using both local and non-local raw materials, such as coffee.

Piedmont is known for its high quality products, such as fruits, vegetables, wine, rice, cereals and meat, thanks to a rich tradition of local supply chains. The region's food and

wine are appreciated worldwide, representing the excellence of Italian cuisine. Piedmont also excels in other quality production offerings ranging from sweets, chocolates, baked goods to cheeses, cured meats, rice, pasta, fruits, rice, pasta, fruits, vegetables and the prestigious white truffle wines. In Piedmont, 89.4% of the wine produced falls under one of the 59 Designations of Origin.

Another important sector is the dairy sector, where Piedmont holds 7 Protected Designation of Origin, albeit with limited production volume. In other sectors, excluding the Piedmont Hazelnut PGI (Protected Geographical Indication), which is experiencing a real production surge, there are a plurality of protected productions (73 in total) but with minimal influence on the regional agricultural economy. The wealth of the Piedmontese territory, characterised by its divisions and unique features, is recognised in a multitude of typical products (341) regulated under the designation PAT (Traditional Agri-Food Product) according to the IRES Piemonte and Osservatorio Rurale del Piemonte PROSPERA (IRES, 2022).

In 2022, activities connected to the **Bioeconomy in Italy**, defined the basis of the perimeter indicated in the previous paragraph, generating an estimated output of €415.3 billion, and employing approximately two million people. The most significant contribution to the growth of the bioeconomy in 2022 was the agri-food supply chain, followed fashion system and paper products (Intesa Sanpaolo, 2023).

Regarding regional policy development in Piedmont, Regional Law n. 12/2015 promotes and supports projects for the **valorisation and distribution of unsold goods** with the aim of reducing the production of food waste.

In July 2022, the Regional Authority approved the Regional Strategy for the Sustainable Development of Piedmont, whose Strategic Macro Area no. 1 aims to accompany the transition of the Piedmontese production system towards a model capable of combining competitiveness and sustainability: Piedmont adopts an approach that takes into account all phases of the product life cycle (LCA), so that waste becomes a resource and develops production chains that produce socio-economic

and environmental benefits. ([Regione Piemonte, 2022](#))

Within the Smart Specialization Strategy of Piedmont for the period 2021-2027, Food is one of the 6 Priority Innovation Systems on which the regional strategy is based. Food is central to the transformations brought about by the great challenges of sustainability, climate change and the ageing of the population ([Regione Piemonte, 2021](#)). The food system has ever more extensive connections with the other Priority Systems.

The Food Districts promoted by the Piedmont Region also contribute to reducing food waste. The Food Districts aim to enhance agricultural and agri-food production by encouraging synergies between local businesses. The Food Districts guarantee food safety by reducing the environmental impact of production and reducing food waste (Regional plan for the management of urban waste and the remediation of polluted areas). ([Regione Piemonte, 2024](#))

Fig. 7: Fact Box: Food Waste Italy
([European Commission, 2023c](#); data from 2020)





Insights from Slovenia

E-zavod | BSC Kranj

Circular Economy Food Initiatives in Slovenia

In Slovenia, several food waste prevention initiatives and businesses have been established, contributing to the reduction of food losses/waste at different levels across different sectors. Some of the circularity solutions that are existing or in development are digital marketplaces to preserve surplus food (e.g. [Prihrani](#), [Optifood platform](#)), food donation systems (Lions, Karitas, etc.); innovation and social enterprises transforming surplus food into new market products or accessible meals for low-income households (for example [ETRI skupnost](#) in Slovenia).

Slovenia has established several clusters with the goal to improve the food systems through various interventions. Following is a selection of initiatives.

EIT FOOD HUB in Slovenia aims to stimulate entrepreneurial and innovative activity in agri-food through more efficient access to many instruments and financial support offered by the EIT FOOD Community. The EIT FOOD HUB Slovenia training courses and workshops for students, start-ups, researchers and the interested public. ([Univerza v Ljubljani, 2024](#))

Together with the Slovenian government, EIT Climate-KIC is leading the Deep Demonstration of a Circular, Regenerative and Low-Carbon Economy to develop pathways for a more radical transition to a net-zero world. The initiative is looking into a transformation pathway for the food systems. ([Climate-KIC, 2024](#))

The project "Our Superfood" is a joint national and sectoral project to promote locally produced and processed food. It is also a platform designed to raise awareness about the challenge of food waste and some of the possible solutions. ([Naša super hrana, 2024](#))

SRIP HRANA is a long-term Strategic Research and Innovation partnership for Sustainable Food Production in Slovenia. It has developed into a dynamic community of agriculture holdings, companies, cooperatives, research institutions, investors and other interested parties, whose main interests are focused on improvement of research and development activities in the companies for the purpose of agri-food sector development. ([Srip hrana, 2024](#))

Importantly, Slovenia has the [national food waste reduction strategy](#) and a [corresponding action plan](#), where 57 measures are defined for achieving the food waste reduction in line with SDG 12.3 goal.

In the food production sector there are various agricultural cooperatives in Slovenia who practise circularity by collectively managing resources, optimising land use, and promoting sustainable agricultural practices among their member farmers. Furthermore, there are companies and networks that focus on producing a range of traditional Slovenian products while emphasising environmentally friendly and sustainable practices (e.g. Bohinjsko, Dobrote Dolenjske).

There are also numerous small-scale and local organic farmers and producers in Slovenia that follow circularity and sustainability principles in their farming and production practices, partly as a result of adhering to traditions and partly by introducing new systems based on regenerative farming, biodynamic and closed-loop farming principles.

Several large scale food manufacturers are also investing in and developing methods of surplus and by-product utilisation (e.g. Pangea - insect farming for protein base animal feed).

Likewise, large retail groups drive initiatives to

reduce food waste and promote sustainability (e.g. partnerships with local producers, initiatives to optimise supply chain efficiency, working with food banks and running campaigns on food waste reduction such as beer made from waste bread, famous chefs cooking with leftovers, etc.).

Structure of the Food Value Stream

73% of the country area is classified as rural territory and about 25% of total land is classified as agricultural land. 76% of the agricultural area falls under less favoured areas (mountain areas and alike). Approximately two-thirds of the agricultural land is farmed extensively (i.e. the land is in permanent grassland - 58%, or covered with permanent crops - 6%). Just over one third of agricultural land is arable ([Agricultural Institute of Slovenia, 2021](#)).

In 2020, agriculture, together with hunting, forestry and fishing, contributed 2.3% to total added value and 6.9% to total employment ([Agricultural Institute of Slovenia, 2021](#)). During the same period, Slovenia contributed non-processed cheese valued at €30.7 million (0.1% of EU production), fresh bread valued at €96.9 million (0.34% of EU production), and an unspecified quantity of beer to the market. Furthermore, Slovenia produced soft drinks worth €33.6 million, accounting for 0.18% of the EU's soft drink production ([European Union, 2022](#)).

Slovenia is a net importer of food, as domestic production does not satisfy the total population needs. Self-sufficiency rates fluctuate year on year due to the changes in production volumes and in part also changing consumption habits. Slovenia has generally high self-sufficiency rates for milk, meat, eggs, cereals, and maize. In 2020, the self-sufficiency rate in cereals in Slovenia was 88%, in meat 84% and in vegetables 48%. In 2021, Slovenia imported EUR 2.3 million of food and beverages, which was almost three times as much as in 2000 ([Slovenian Environment Agency, 2024](#); [Republic of Slovenia Statistical Office, 2022a](#)).

Most of the consumed food (more than 70%) is imported, only about a third is of Slovenian origin. According to the estimates made in Slo-

venia on the basis of the CORINE data on land use and data on agricultural land use, between 60% and 80% of all utilised agricultural areas in Slovenia are located in High Nature Value farmland areas. These areas represent between 20 and 30% of the entire national territory ([Slovenian Environment Agency, 2024](#)).

Slovenia has over 700 registered **food processing enterprises** (2017), their numbers are steadily growing. Out of those enterprises, 78% are micro-sized, 16% are small, 4% are medium and the remaining 2% are large. The added value produced by these companies in 2017 was 499 million EUR and the number of employees was 13,683 – making the added value per employee 36,472 EUR. Net revenues from foreign markets are growing. Large enterprises constitute about 2% of all food processing enterprises, yet they contribute significantly to the highest share of employment (53%), added value (64%) and net sales revenue (62%).

In 2020, Slovenia recorded 2,723 **food and beverage manufacturing establishments**, comprising 13.6% in manufacturing and 0.13% of the total manufacturing establishments in the EU. Currently there are just over 2000 registered companies in **the food retail and distribution sector** ([AJPES, 2023](#)). In 2022, the turnover from the sale of goods in the food and beverage sector amounted to just under 3000 million EUR (SURS, 2022).

In terms of employment, the food and beverage manufacturing sector in Slovenia hired 18.6 thousand individuals in 2020, representing 8.7% of all employees in Slovenian manufacturing establishments and a modest 0.06% of the EU's manufacturing workforce. The workforce share in Slovenia's food and beverage manufacturing compared to the EU was 0.4%.

According to Eurostat, in 2020, Slovenia accommodated 10.3 thousand **food and beverage trade and service companies** ([European Union, 2022](#)). Among these, 1.0 thousand were wholesalers, 1.0 thousand were retailers, and 8.3 thousand were food and beverage service companies. Collectively, they employed 57.1 thousand individuals, generating a turnover of €7.4 billion and contributing a value-added of €1.4 billion. While the majority (80.6%) of food

and beverage trade and service companies in Slovenia operated in the food and beverage service sector in 2020, their contribution to employment and value-added was relatively lower at 46.8% and 29.1%, respectively.

Out of the 2000 **food and beverage trade companies** in Slovenia in 2020, 552 were wholesalers. These comprised 489 micro-enterprises (0 to 9 employees), 51 small enterprises (10 to 49 employees), and 12 medium-sized enterprises (50 to 249 employees). Large enterprises (250 or more employees) were not reported. The total turnover of wholesale companies reached €1.7 billion in 2020. The value-added by wholesale companies in Slovenia amounted to €163.4 million in 2020. Among them, micro-enterprises contributed €31.0 million, small enterprises contributed €56.6 million, and medium-sized enterprises contributed €75.9 million. Notably, large enterprises reported zero value-added.

In 2020, Slovenia's **food and beverage retail speciality stores** numbered 417. Of these, 401 were micro-enterprises, 14 were small enterprises, and 2 were medium-sized enterprises, with no large enterprises reported. Together, they achieved a turnover of €149.1 million and a total value-added of €26.4 million. The six biggest food retailers own about 1200 shops across Slovenia (Grgič, 2023).

The **households' end-consumption expenditure** on food and beverage, including catering services, amounted to €5.2 billion in Slovenia

in 2020, averaging €2,490 per person. These expenditures represented 22.0% of households' total consumption expenditure: 14.4% for food, 1.5% for non-alcoholic beverages, 1.7% for alcoholic beverages, and 4.4% for catering services. Regarding affordability, the percentage of people in Slovenia who could not afford a meal with meat, chicken, fish, or a vegetarian equivalent every other day was 3.9% in 2019. This increased to 4.3% in 2020, slightly decreased to 4.2% in 2021, and further dropped to 3.5% in 2022 ([European Union, 2022](#)).

Food waste

The sustainable **biomass feedstock** potential from the agricultural sector in Slovenia is estimated at 0.7 million tons of dry material (DM) per year at the national level. The largest potential from secondary residues is from cereal bran, with a total amount of 55 Kton dry matter per year. About 2.7 Kton DM of pressed grape dregs are available from the wine industry. For the Gorenjska region these numbers are between 25-50 kton DM from arable crops residues and 5-10 kton DM for perennial crops ([CELEBio, 2020](#); [S2Biom project, 2023](#)). Sustainability risks related to harvesting agricultural residues are biodiversity and soil biodiversity loss when harvesting too many crop residues, and moderate risks to organic carbon and nutrient reduction in soil. The potential for residual biomass in Slovenia is low,

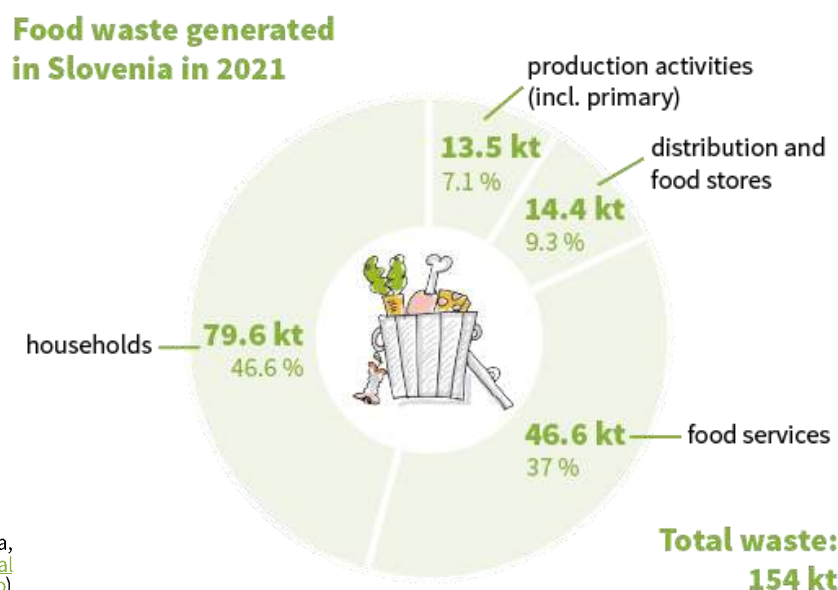


Fig. 8: Food waste by source, Slovenia, 2022 ([Republic of Slovenia Statistical Office, 2022b](#))

particularly when other traditional uses and risk factors are considered (CELEBio, 2020; S2Biom project, 2023).

According to the Statistical Office of the Republic of Slovenia (SURS, 2023), the total amount of food waste increased between 2013 and 2022 by 22% (from 118 to 151 thousand tons). Food waste has increased in all sectors (production activities incl. primary, distribution and retail, food services and households).

The largest share of food waste (47% or 70,3 kt in 2022) is produced by **households** (as shown in Fig. 8). In **food manufacturing and processing**, the top 4 food waste producing industries are Bread & Pastry Manufacture 44%, Meat and Poultry Meat Products 7%, Processing and Preserving Meat 6%, and Beer manufacture 4%. In 2022 this sector produced 7.1% or 10,6 kt of all food waste. (SURS, 2023)

Food services accounted for approximately 37% (56 kt) of all food waste in 2022 (SURS, 2023).

Food retail and distribution accounted for approximately 9,3% (14 kt) of all food waste in 2022 (SURS data). A decrease of 2% from 2021 data. In Slovenia, most food retail groups work to some extent on strategies to avoid food waste. They have partnerships with local producers and have worked on initiatives to optimise supply chain efficiency (expiration date, produce imperfections, overstocking). They work with food banks and occasionally run

campaigns on food waste reduction. Some of the most interesting initiatives launched by these food chains are converting leftover bread to beer, fresh bread made of leftover bread, recipes, and tips from renowned chefs on using food leftovers to avoid food waste. These are mostly geared as a public awareness campaign with high promotion content of the company's green business orientation.

One of the key waste reduction activities implemented by food retail groups is food donation. In Slovenia there are several humanitarian organisations that have well-developed collection, storage, and distribution systems for donated food. In 2017, the Slovenian government introduced the tax exemption policy for donated food. This encourages food producers, retailers, and restaurants to donate surplus food to charities and food banks, as they could potentially deduct the value of donated food from their taxable income. It also introduced regulations that required certain food businesses, including large supermarkets, to report their food waste data. This measure helped track and analyse food waste at the retail level and encouraged companies to take steps to reduce waste. Food waste in Slovenia is treated in several ways, as shown on Fig. 9.

The research shows that more food waste is generated in urban areas. In Slovenia, about 48% of households do their own composting (these figures are not included in the statistical

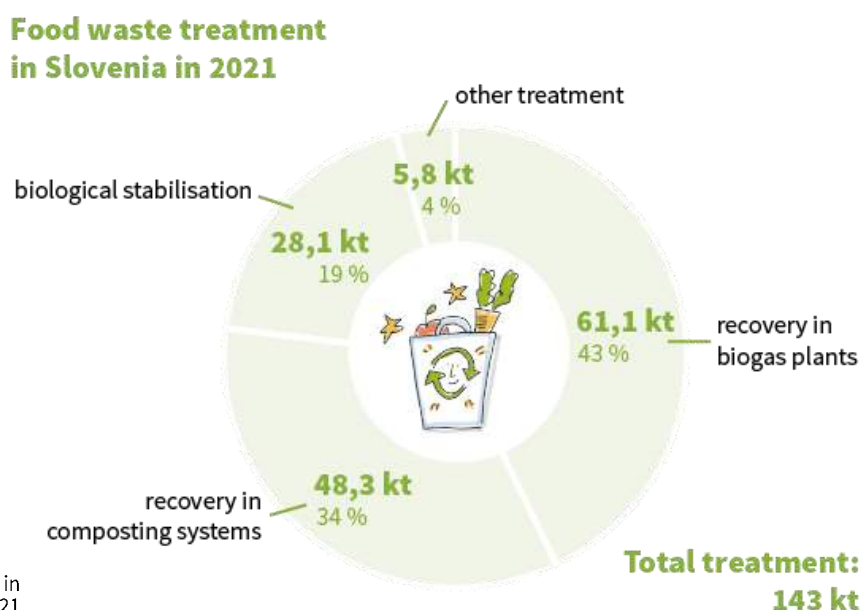


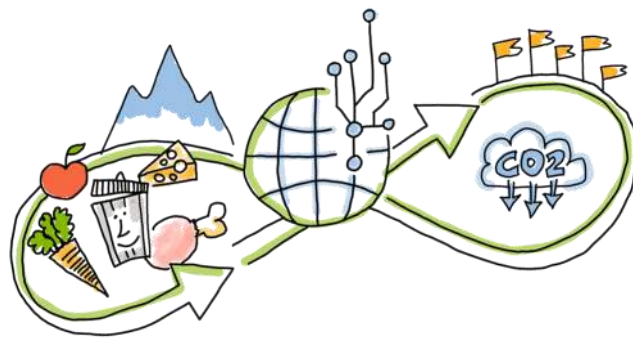
Fig. 9: Food waste treatment in Slovenia in 2021

data). Slovenia is among the countries with the highest percentage of separately collected waste and management of recycling (71% of municipal waste).

Slovenia has a national action plan for tackling food waste titled “Respect our food, respect our planet” and where 57 measures are defined to contribute to the SDG 12.3 aiming to halve the total food waste per inhabitant ([Republika Slovenija, 2023](#)). The country is focused on reducing waste generation in various sectors.

Fig. 10: Fact Box: Food Waste Slovenia ([European Commission, 2023c](#); data from 2020)





Section III

What we found: Selection of Best Practices

Some startups and larger food companies have already incorporated the principles of the Circular Economy into their business models. To promote a Circular Economy and, consequently, reduce food waste, various strategies such as reducing, reusing, and recycling are employed. In the following section, we

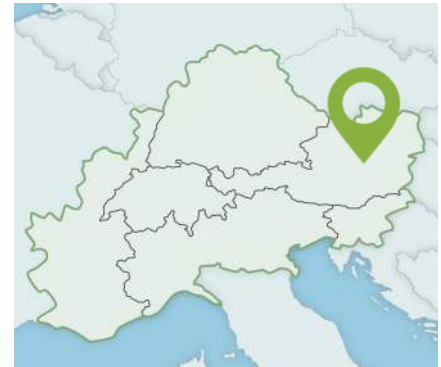
will showcase best practice examples from the Alpine Regions, highlighting different business models and strategies. These examples illustrate how innovative ideas can be applied across various food categories to close the loops, conserve resources, and promote more sustainable operations.





Kern Tec

Location	Austria
Founding Year	2019
Food category	Kernel-based products
Value-Chain-Stage	Processing
Strategy	Re-use



How are loops closed?

Kern Tec uses previously unused fruit kernels to develop innovative, sustainable ingredients and easy-to-use ready-to-use solutions for the food industry - from versatile milk alternatives to delicious nut spreads.

Impact of the best practice

According to the startup and the Rewe Group, over 2.3 billion apricot kernels have been saved from going to waste so far ([Brutkasten, 2023](#)).

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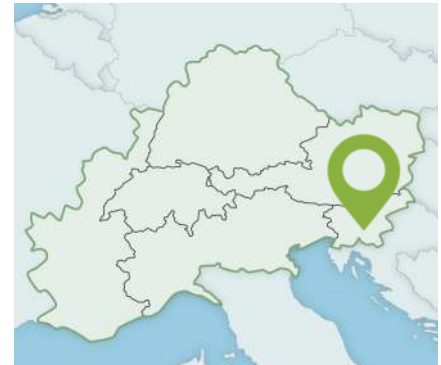


© image: Kern Tec GmbH



Mini tovarna - ETRI skupnost

Location	Various locations in Slovenia
Founding Year	2020
Food category	Food waste/Food surplus/Food produce that does not meet the market standard-many food and beverage categories
Value-Chain-Stage	Processing, Food Services, Redistribution
Strategy	Re-use, Up-cycling



How are loops closed?

Mini tovarna by ETRI group is a food waste reducing operation that works both with local food producers and retailers as well as with food innovators developing new food products that prevent surplus food from being waste. Moreover, it works on the redistribution of food supplies and up-skilling, raising awareness and building social capital for transformation towards a more sustainable society. The initiative aims to address the dual challenge of food waste and food insecurity.

At Etri group, they source surplus food from various companies, preventing it from ending up in landfills. A food technology team at Etri production sites called Mini Tovarna, are transforming surplus food into new products, for example, discarded bread is made into items such as dumplings, savory and sweet bread puddings, granola, and cookies.

Impact of the best practice

This sustainable approach ensures that food, which would otherwise be wasted, becomes nourishing meals. Etri distributes these meals, serving a segment to students and staff at the Biotechnical Faculty (company meals) and providing the rest to the humanitarian institute "Pod strehco", where the elderly and those in need receive free, quality meals. All the products are packaged in environmentally friendly packaging or glass jars that are returned through a deposit system for reuse.



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© images: Etri Group



Biova project

Location	Turin (Italy)
Founding Year	2019
Food category	Bread products
Value-Chain-Stage	Processing
Strategy	Re-use



How are loops closed?

Biova is a traditional bread from Piedmont. BIOVA PROJECT collects unsold bread and uses it to replace up to 30% of the barley malt traditionally used to make beer. The beer is then distributed in co-branding through the same supply channels as the unsold bread, with a label indicating the origin of the bread used. But the circle does not close here, because BIOVA PROJECT has found a way to reuse beer waste to produce snacks and to create the packaging of the products themselves. Impact of the best practice.

Impact of the project

Replace up to 30% of the barley malt, which is traditionally used for making beer.



© images: Biova Project

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Banco Alimentare

del Trentino Alto Adige/Landestafel ODV

Location	Trentino - Südtirol / Alto Adige
Founding Year	2003
Food category	Unsold food
Value-Chain-Stage	Retailer
Strategy	Re-distribute



How are loops closed?

The food is used by the people who get it and does not go to waste.

Impact of the project

This organisation redistributes around 840 tons of unsold food each year to people with less economic possibilities in the region Trentino-Alto Adige with around 1 million inhabitants.

© image: Banco Alimentare



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Les Alchimistes

Location	France (Paris)
Founding Year	2016
Food category	Bio waste (restaurants, company or school canteens, hospitals, markets)
Value-Chain-Stage	End-of-chain food waste after consumption by end-consumers
Strategy	Recycle



How are loops closed?

Les Alchimistes collect and process organic waste to transform it into compost. The produced compost is sold to retailers or directly to farmers.

Impact of the project

The startup processes an average of 12,000 tons of food waste per year.

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© images: Les Alchimistes

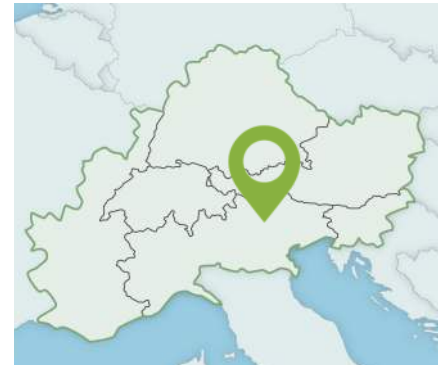




Biogene Systems

Fraunhofer IWKS

Location	Germany
Founding Year	Ongoing research, first projects regarding this technique: 2016 (H2020-Hyper Bio-)
Food category	Pomace/marc (apples, tea, raspberries)
Value-Chain-Stage	All stages of the value chain
Strategy	Re-use



How are loops closed?

The ongoing research at Fraunhofer IWKS includes many different approaches to reuse food waste / remnants from the agriculture and food production. These remnants can be used for the extraction of cellulose fibres, i.e. to produce fibre reinforced materials, as well as the production of bio-plastics or feeding stuff for animals. The strategy is to utilise bio-based resources across various industrial sectors that arise as excess/by-products, expanding beyond just energy use. Solution approaches are the development and optimization of:

- Processes for fibre extraction from by-products of the food, cosmetic, and pharmaceutical industries.
- Bio-based adhesion promoters between fibre and matrix in bio-composite materials.
- Biodegradable coatings/polymers, i.e. for fertilisers with controlled nutrient release.

- Tailored strategies to prevent food waste.
- Process and product optimization for cost and resource efficiency.
- Another next step approach is the reuse of these remnants (i.e. after the cellulose extraction) as animal feed.

Impact of the project

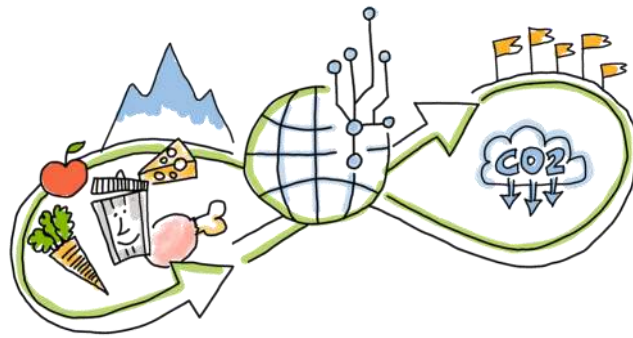
Due to the use of remnants from the food production, it is possible to produce alternative biobased raw materials that don't compete with food production. Bio-plastics, adhesion agents and coatings can be used sustainably and sensibly under ecological, economic, and social considerations only when this condition is fulfilled.

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Section IV

Where we are going: Circular Food Hubs





Bavaria | Salzburg

Circular Food Hub

Vision

The Circular Food Hub Bavaria - Salzburg envisions the establishment of a robust foundation of circularity in food value chains. In a participatory approach with companies from the manufacturing industry, gastronomy and tourism, it is aimed to close the loop. By including waste transfer and reintegration channelling waste generated back to the initial stage of fruits and vegetables, a circular ecosystem is created. By promoting transparency and collaboration, the hub allows farmers, producers, manufacturers, gastronomy and tourism businesses to connect directly. Moreover, despite being a business-to-business (B2B) model, the proximity of end consumers enhances knowledge and contributes in reducing food waste.

Product categories

Grains

Fruits & vegetables

Contact details

www.fh-salzburg.ac.at/circularfoodhub

Involved partners

- FH Salzburg GmbH
- Hochschule München
- Paris Lodron Universität Salzburg
- Umweltcluster Bayern





South Tyrol | Alto Adige Circular Food Hub

Vision

The Circular Food Hub South Tyrol aims to be a leading force in the creation of a sustainable, innovative, and thriving circular food economy in South Tyrol. It is currently developing and networking stakeholders in the region to promote the idea of circularity in South Tyrol, and to promote collaboration and facilitate knowledge sharing (companies, interest groups, universities, research institutions & laboratories and farmers). The hub wants to raise awareness of ways to combat regular food and to foster innovation and sustainable entrepreneurship in the region.

The Circular Food Hub South Tyrol is the first point of contact for the circular economy in the food economy in the region. It is a leading force in creating a sustainable, innovative, and thriving circular food economy in South Tyrol to reduce food waste.

Product categories

Coffee

Poultry

Contact details

www.idm-suedtirol.com/de/news-terminen/news-terminen/circular-economy-food-hub

Involved partner

IDM Südtirol - Alto Adige





Piedmont Circular Food Hub

Vision

The Circular Food Hub involves institutional actors, mentor companies, local networks and actors who facilitate the dialogue between different entities (such as universities, research centres and development and promotional actors). Its primary objective is to revamp economic models by adopting a circular rather than linear approach. Additionally, it opens up opportunities to leverage the productive, valorisation and innovative capabilities of local companies, thus creating opportunities, work and well-being and environmental protection. This approach also contributes to adapting to climate change and the protection of the ecosystem.

Product categories

Wine

Bread

Rice

Contact details

<https://lamoro.it/circularfoodhub/>

Involved partner

LAMORO





Alpes-Maritimes Circular Food Hub

Vision

The creation of a Circular Food Hub is relevant for the Alpes-Martimes Region and focuses on reducing food waste in the restaurant and hotel industry. The objective is to raise awareness, educate and support stakeholders in these sectors to reduce their environmental footprint and promote a more responsible management of biowaste. Collaboration with decision-makers, Chambers of commerce and industry and other local stakeholders is essential to achieve these goals. The hub will serve as a physical and virtual meeting point to bring together actors involved in the fight against food waste, thus promoting collaboration, innovation and sustainability.

Product categories

Fruits & vegetables

(hotel industry & gastronomy)

Contact details

<https://www.cote-azur.cci.fr/cefoodcycle/>

Involved partners

- CCI Nice Côte d'Azur
- AVITEM



AViTeM

Agency for sustainable Mediterranean
cities and territories



Slovenia

Circular Food Hub

Vision

The Circular Food Hub in Slovenia (Gorenjska region) supports closed loop generation and network creation, provides expertise, educational and empowerment workshops, development of approaches for closing the loops and to raise awareness in food-related sectors.

Close cooperation with stakeholders (companies, NGO's, public sector, interested general public) allows the hub to develop circular principles and to gradually foster innovative approaches and solutions in daily practices

Product categories

Processed food

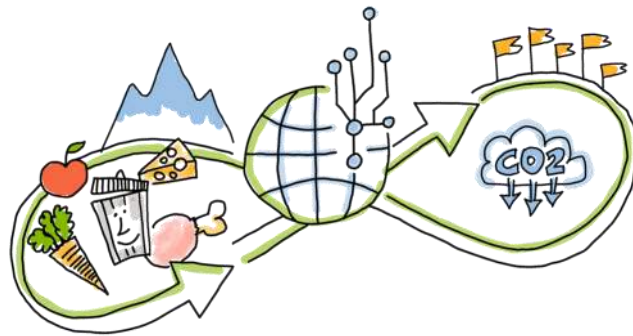
Contact details

www.bsc-kranj.si/food-circular-hub

Involved partners

- BSC Kranj
- E-zavod





Section V

Invitation to Stakeholders: Get in Touch



As global concerns regarding environmental sustainability and resource management intensify, the paradigm surrounding food waste is shifting from a challenge to an opportunity. This whitepaper proposes the creation of a comprehensive compendium that explores the effective utilisation of food waste as a valuable resource, emphasising stakeholder involvement and sharing best practices across five different countries in the Alpine region.

This document aims to consolidate up-to-date information on innovative strategies, successful initiatives, and collaborative approaches that have proven effective in transforming food waste into a valuable resource. By examining case studies and initiatives from different cultural and economic contexts, this document will provide a nuanced understanding of the various challenges and opportunities associated with managing food waste on a global scale.

Stakeholder involvement is a key theme in this document, recognising the importance of engaging diverse actors, including government bodies, businesses, communities, and non-governmental organisations. By showcasing successful partnerships and collaborative efforts, the document aims to inspire further cooperation and synergy among stakeholders at local, national, and international levels.

The whitepaper also identifies and highlights best practices that have demonstrated success in mitigating food waste and maximising its potential as a resource. These practices may include technological innovations, policy frameworks, community-driven initiatives, and business models that contribute to a more sustainable and circular approach to food waste management.

In conclusion, this whitepaper is an invitation to experts, researchers, policymakers, and practitioners to contribute their insights, experiences, and knowledge to enrich the document. By collaboratively updating and expanding the information within, this document seeks to become a valuable resource for stakeholders across five countries, fostering a global network dedicated to addressing the challenges of food waste and harnessing its potential as a sustainable resource. Through collective efforts, the compendium aims to inspire and guide future endeavours in the pursuit of a more sustainable and circular food system.



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Bibliography

- ADEME. (2016). Pertes et gaspillages alimentaires. L'état des lieux et leur gestion par étapes de la chaîne alimentaire (p. 165). ADEME.
- Agricultural Institute of Slovenia (2021). Slovenian Agriculture in Numbers. https://www.kis.si/f/docs/Slovenian_Agriculture_in_Numbers/KIS_Slovensko_kmetijstvo_v_stevilkah_2021_EN_spl_et.pdf
- agriculture.gouv.fr. (2023). Infographie - L'agriculture biologique. <https://agriculture.gouv.fr/infographie-agriculture-biologique> (accessed 31.01.2024).
- AJPES (2023). Slovenia Business register. <https://www.ajpes.si/prs/> (accessed 23.10.2023).
- ANIA (2023). <https://www.ania.net/> (accessed 23.10.2023).
- Aria Sud (2023). Le tissu des entreprises: Le secteur agroalimentaire en France <https://www.ariasud.com/les-iaa/> (accessed 23.10.2023).
- aws (2024). aws Sustainable Food Systems Initiative <https://www.aws.at/aws-sustainable-food-systems-initiative/> (accessed 31.01.2024).
- Banco Alimentare Trentino Alto Adige - Landestafel (2022). Bilancio Sociale. https://cdn3.bancoalimentare.it/sites/bancoalimentare.it/files/bilancio_sociale_2022_compressed.pdf
- Banques Alimentaires (2024). Homepage. <https://www.banquealimentaire.org/> (accessed 31.01.2024)
- Bauernnetzwerk (2021). Landwirte sehen in der Direktvermarktung die größten Zukunftschancen. <https://www.bauernnetzwerk.at/direktvermarktung/> (accessed 17.10.2023).
- Bayerisches Landesamt für Statistik (2022). Bavarian Statistics 2022. Fürth. https://www.statistik.bayern.de/mam/produkte/jahrbuch/bayerndaten_2022-eng.pdf
- Bertram, D., Chilla, T., & Wilhelm, C. (2021). Short Value Chains in Food Production: The Role of Spatial Proximity for Economic and Land Use Dynamics. *Land*, 10(9), 979.
- BioBASE (2024). BioBASE Kompass. <https://biobase.at/biobase-kompass/> (accessed 31.01.2024).
- Blaas (2012). Aquaculture 2020 - Austrian strategy to increase the national fish production. Federal Ministry of Agriculture, Forestry, Environment and Water Management Division III/5. Vienna. https://info.bml.gv.at/service/publikationen/landwirtschaft/aquakultur_engl.html (accessed 31.01.2024)
- BMEL (2023a). Lebensmittelabfälle in Deutschland: Aktuelle Zahlen zur Höhe der Lebensmittelabfälle nach Sektoren <https://www.bmel.de/DE/themen/ernaehrung/lebensmittelverschwendung/studie-lebensmittelabfaelle-deutschland.html> (accessed 06.02.2024)
- BMEL (2023b). National Strategy for Food Waste Reduction. <https://www.bmel.de/EN/topics/food-and-nutrition/food-waste/national-strategy-for-food-waste-reduction.html#doc77578bodyText2> (accessed 06.02.2024).
- BMK (2023). Kreislaufwirtschafts-Strategie: Österreich auf dem Weg zu einer nachhaltigen und zirkulären Gesellschaft. https://www.bmk.gv.at/themen/klima_umwelt/abfall/Kreislaufwirtschaft/strategie.html (accessed 19.10.2023).
- BMK (2024). Bioökonomiestrategie für Österreich. https://www.bmk.gv.at/themen/klima_umwelt/klimaschutz/biooekonomie/strategie.html (accessed 31.01.2024).
- BML (2023). Biogas aus Österreich: Erneuerbare-Gase-Gesetz geht in Begutachtung <https://info.bml.gv.at/themen/wald/wald-und-klima/erneuerbare-gase-gesetz-in-begutachtung.html> (accessed 21.10.2023).
- BOKU (2023). Department of Food Science and Technology (DLWT). University of Natural Resources and Life Sciences. <https://boku.ac.at/en/dlwt> (accessed 20.11.2023).
- Brutkasten (2023). Kern Tec: Food-Startup schafft mit "Wunderkern Drink" Sprung in über 520 Supermärkte. <https://brutkasten.com/artikel/kerntec-wunderkern-billa-listung> (accessed 20.11.2023).
- Caldeira, C., Barco, H., De Laurentiis, V., & Sala, S. (2019). Review of studies on food waste accounting at Member State level. *Publications Office of the European Union: Luxembourg*.
- Caldeira, C., De Laurentiis, V., Sala, S. (2019). Assessment of food waste prevention actions: development of an evaluation framework to assess the performance of food waste prevention actions, Luxembourg (Luxembourg): doi:10.2760/9773.
- Carrefour Report (2022). Tackling food waste Carrefour 2022. <https://www.carrefour.com/sites/default/files/2023-06/Tackling%20food%20waste%20Carrefour%202022.pdf> (accessed 03.11.2023).
- CEFF (2023). Homepage. Circular Economy for Food. (accessed 13.11.2023).
- CELEBio (2020). D.2.1. Country Report: Slovenia. 2020. Central European Leaders of Bioeconomy. Horizon 2020. https://celebio.eu/wp-content/uploads/2021/04/CELEBio_D.2.1_Biobased-Economy-Business-Opportunities-in-SI.pdf (accessed 12.11.2023).
- Chilla, T., & Sielker, F. (Eds.). (2022). Cross-border spatial development in Bavaria: Dynamics in cooperation - Potentials of integration (Vol. 34). BoD-Books on Demand.
- Cicatiello, C., Franco, S., & Falasconi, L. (2019) Gli sprechi alimentari nella grande distribuzione organizzata in Italia. Quantificazione e analisi dei prodotti alimentari smaltiti nei supermercati e ipermercati. *REDUCE*. <https://www.sprecozero.it/wp-content/uploads/2020/07/Report-AR4-GDO.pdf> (accessed 13.11.2023).
- Circular Economy Forum Austria (2024). Homepage. <http://www.circulareconomyforum.at> (accessed 31.01.2024).
- Circular Futures (2024). Homepage. <https://www.circularfutures.at/> (accessed 31.01.2024).
- Circular Munich (2024). Homepage. <https://circular->

- munich.com/ (accessed 31.01.2024).
- Climate Lab (2024). Homepage. <https://climatelab.at/> (accessed 31.01.2024).
- Climate-KIC (2024). Deep Demonstration: Slovenia: Systems innovation for the transition to a circular, regenerative and low-carbon economy. <https://www.climate-kic.org/circularslovenia-2/> (accessed 31.01.2024).
- Community Kitchen München (2024). Homepage. <https://community-kitchen.com/unsere-mission/> (accessed 31.01.2024).
- CREA (2023). L'agricoltura nel Piemonte in cifre 2023. <https://www.crea.gov.it/en/web/politiche-e-bioeconomia/-/l-agricoltura-nel-piemonte-in-cifre-2023> (accessed 13.11.2023).
- CRITT Agroalimentaire (2024). Homepage. <https://critt-iaa-paca.com/fr/> (accessed 31.01.2024).
- CSR Piemonte (2024). Azioni per la promozione dell'economia circolare <https://www.csrpiemonte.it/economia-circolare/buone-pratiche.htm> (accessed 31.01.2024).
- Destatis (2020). Agriculture, forestry and fisheries: vegetable survey – cultivation and harvesting of vegetables and strawberries. Series 3.1.3. Federal Statistical Office, Wiesbaden, Germany.
- Diekmann, L., & Germelmann, C. C. (2023). Circular food economy: A new perspective on food waste. *Projects/Proyéctica/Projectique*, 34(1), 69-85.
- Eco-Conception (2024). L'association Pôle Eco-conception Performance du cycle de vie. <https://www.eco-conception.fr/static/l-association.html> (accessed 31.01.2024).
- Ecozept (2024). Homepage. <https://ecozept.com/fr/> (accessed 31.01.2024).
- EllenMacArthurFoundation (2023). What is a Circular Economy? <https://www.ellenmacarthurfoundation.org/topics/circular-economy-introduction/overview> (accessed 31.01.2024).
- Environment Agency Austria. (2017). Food Waste Statistics Austria. https://food.ec.europa.eu/system/files/2017-10/fw_eu-platform_20170925_sub-fwm_pres-02b.pdf (accessed 31.01.2024).
- Eurac Research (2020). Landwirtschaftsreport zur Nachhaltigkeit. <https://webassets.eurac.edu/31538/1620815463-landwirtschaftsreport-2020.pdf> (accessed 31.01.2024).
- Eurac Research (2024a). Landesstrategie zur Kreislaufwirtschaft. <https://www.eurac.edu/de/institutes-centers/institut-fuer-erneuerbare-energie/projects/landesstrategie-zur-kreislaufwirtschaft> (accessed 31.01.2024).
- Eurac Research (2024b). NEST Part 2: Gestaltung eines nachhaltigen Ernährungssystems in Südtirol. <https://www.eurac.edu/de/institutes-centers/institut-fuer-regionalentwicklung/projects/next-part-2> (accessed 31.01.2024).
- EUR-Lex (2023). Commission Regulation (EU) No 68/2013 of 16 January 2013 on the Catalogue of feed materials Text with EEA relevance. <https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32013R0068> (accessed 03.11.2023).
- europa.eu (2020). Food waste and food waste prevention - estimates. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Food_waste_and_food_waste_prevention_-_estimates&stable=0&redirect=no (accessed 03.10.2023).
- European Commission (2019a). Redistribution of surplus food: Examples of practices in the Member States. Saving food together. EU Platform on Food Losses and Food Waste. https://food.ec.europa.eu/system/files/2019-06/fw_eu-actions_food-donation_ms-practices-food-redis.pdf (accessed 31.01.2024).
- European Commission (2019b). Recommendations for Action in Food Waste Prevention. https://food.ec.europa.eu/system/files/2021-05/fs_eu-actions_action_platform_key-rcmnd_en.pdf (accessed 31.01.2024).
- European Commission (2020). Directorate-General for Health and Food Safety, Food redistribution in the EU – Mapping and analysis of existing regulatory and policy measures impacting food redistribution from EU Member States, Publications Office, <https://data.europa.eu/doi/10.2875/406299>
- European Commission (2022). Key figures on the European food chain. Eurostat. Luxembourg: Publications Office of the European Union, ISBN 978-92-76-59661-5 doi:10.2785/510715
- European Commission (2023a). EU actions against food waste. https://food.ec.europa.eu/safety/food-waste/eu-actions-against-food-waste_en (accessed 02.10.2023).
- European Commission (2023b). Farm to Fork strategy. https://food.ec.europa.eu/horizontal-topics/farm-fork-strategy_en (accessed 02.10.2023).
- European Commission (2023c). EU Food Loss and Waste Prevention Hub. https://ec.europa.eu/food/safety/food_waste/eu-food-loss-waste-prevention-hub/eu-member-states (accessed 31.01.2024).
- European Commission's Knowledge Centre for Bioeconomy (2020). Brief on food waste in the European Union. https://food.ec.europa.eu/document/download/d53de425-9468-4d56-82e0-f8d14a42ba28_en?filename=fw_lib_stud-rep-pol_ec-know-cen_bioeconomy_2021.pdf (accessed 31.01.2024).
- European Parliament (2020). Reducing food waste in the European Union. [https://www.europarl.europa.eu/thinktank/en/document/FPRS_BRI\(2020\)659376](https://www.europarl.europa.eu/thinktank/en/document/FPRS_BRI(2020)659376) (accessed 04.10.2023).
- European Parliament (2023). Circular economy: definition, importance and benefits. <https://www.europarl.europa.eu/news/en/headlines/economy/20151201STO05603/circular-economy-definition-importance-and-benefits> (accessed 04.10.2023).
- European Union (2020). The role of local and regional authorities in making food systems more sustainable. https://cor.europa.eu/en/engage/studies/Documents/Sustainable_food_systems.pdf (accessed 03.10.2023).
- European Union (2022). Key figures on the European food chain – 2022 edition. ISBN 978-92-76-59662-2 <https://ec.europa.eu/eurostat/web/products-key-figures/w/ks-fk-22-001> (accessed 03.10.2023).
- Eurostat (2023a). Homepage. https://ec.europa.eu/eurostat/databrowser/explore/all/all_themes (accessed 31.01.2024).
- Eurostat (2023b). Food waste and food waste prevention - estimates. <https://ec.europa.eu/eurostat/>

- [statistics-explained/index.php?title=Food_waste_and_food_waste_prevention_-_estimates&stable=0&redirect=no](#) (accessed 31.01.2024).
- Federal Ministry for Food and Agriculture (2019). Redistribution of surplus food: Examples of practices in the Member States. EU Platform on Food Losses and Food Waste. https://food.ec.europa.eu/system/files/2019-06/fw_eu_actions_food_donation_ms_practices-food-redis.pdf (accessed 03.11.2023).
- Feodorov, C., Velcea, AM, Ungureanu, F., Apostol, T., Robescu, LD., & Cocarta, DM (2022). Toward a Circular Bioeconomy within Food Waste Valorization: A Case Study of an On-Site Composting System of Restaurant Organic Waste, *Sustainability*, 14(14):8232. <https://doi.org/10.3390/su14148232>
- Fertilid e (2024). Homepage. <https://www.fertilidee.fr/> (accessed 31.01.2024).
- Food In Provence-Alpes-C te d'Azur (2024). Homepage. <https://foodinpaca.com/> (accessed 31.01.2024).
- Fraunhofer (2023). TeBiCE. <https://www.fraunhofer.it/en/Research/sustainable-innovation/tebice.html> (accessed 04.10.2023).
- Fraunhofer Food Alliance (2024). Homepage. <https://www.food.fraunhofer.de> (accessed 31.01.2024).
- Gabriel, A., & Bitsch, V. (2023). Everywhere the same? Competitiveness of two regional vegetable production clusters in Southern Germany, *International Food and Agribusiness Management Review*, 26(1), 139-157.
- Genuss Sch tze Bayern (2024). Homepage. <https://www.lfl.bayern.de/iem/regionalvermarktung/165416/index.php> (accessed 31.01.2024).
- Giordano, C., Alboni, F., & Falasconi, L. (2019). Quantities, Determinants, and Awareness of Households' Food Waste in Italy: A Comparison between Diary and Questionnaires Quantities'. *Sustainability*, 11(12), 3381.
- Giuliani, E. (2008). What drives innovative output in emerging clusters? Evidence from the wine industry. *SPRU Electronic Working Paper Series*, 169, 1-39.
- Grgi , M. (2023). Gospodarstvo se ohlaja, trgovin po Sloveniji pa je vse ve . DELO. <https://www.delo.si/gospodarstvo/novice/gospodarstvo-se-ohlaja-trgovin-po-sloveniji-pa-je-vse-vec/> (accessed 31.01.2024).
- GTAI (2022). The Food & Beverage Industry in Germany: Industry Overview. <https://www.gtai.de/resource/blob/64004/e80f4dd7ccd691158b0ee2bc10f8cd6c/industry-overview-food-beverage-industry-en-data.pdf> (accessed 31.01.2024).
- Holweg, C., & Lienbacher, E. (2011). Social marketing innovation: New thinking in retailing. *Journal of Non-profit & Public Sector Marketing*, 23(4), 307-326.
- Holweg, C., Lienbacher, E., & Zinn, W. (2010). Social supermarkets-a new challenge in supply chain management and sustainability. In *Supply Chain Forum: An International Journal* (Vol. 11, No. 4, pp. 50-58). Taylor & Francis.
- International Trade Organization (2022). Austria - Country Commercial Guide. <https://www.trade.gov/country-commercial-guides/austria-agricultural-sectors> (accessed 19.10.2023).
- Intesa Sanpaolo (2023). Bioeconomy in Europe. 9th Report. https://group.intesasanpaolo.com/content/dam/portalgroup/repository-documenti/research/it/bioeconomia/2023/Executive_summary_bioeconomy_ingl_June2023.pdf (accessed 13.11.2024).
- Invest in Bavaria (2019). Agriculture 4.0 – agtech innovations from Bavaria are significantly changing the industry. <https://www.invest-in-bavaria.com/en/blog/post/agriculture-40-agtech-innovations-from-bavaria-are-significantly-changing-the-industry> (accessed 31.01.2024).
- IPIFF (2023). International Platform of Insects for Food and Feed (IPIFF) <https://ipiff.org/> (accessed 31.01.2024).
- IRES Piemonte (2022). Piemonte Rurale 2022. <https://www.ires.piemonte.it/index.php/ires-a-short-history> (accessed 13.11.2023)
- Irsara, M. (2023). Schmackhaft am Puls der Zeit.IDM S dtirol. <https://www.idm-suedtirol.com/de/unsere-leistungen/sectorenentwicklung/sector-lebensmittel> (accessed 31.01.2024).
- Kannah, R. Y., Merrylin, J., Devi, T. P., Kavitha, S., Sivashanmugam, P., Kumar, G., & Banu, J. R. (2020). Food waste valorization: Biofuels and value added product recovery. *Bioresource Technology Reports*, 11, 100524. ISSN 2589-014X, <https://doi.org/10.1016/j.biteb.2020.100524>.
- KErn (2020) Bavarian Food Cluster. Bavarian State Ministry of Food, Agriculture and Forestry. <https://www.cluster-bayern-ernaehrung.de/wp-content/uploads/2021/04/Bavarian-Food-Cluster.pdf> (accessed 31.01.2024).
- KErn (2024). Homepage. <https://www.kern.bayern.de/> (accessed 31.01.2024).
- La Ruche qui dit Oui (2024). Homeoage. <https://laruchequiditoui.fr/fr> (accessed 31.01.2024).
- Lansing, S., H lsemann, B., Choudhury, A., Schueler, J., Lisboa, M. S., & Oechsner, H. (2019). Food waste co-digestion in Germany and the United States: From lab to full-scale systems. *Resources, Conservation and Recycling*, 148, 104-113.
- Le R seau des Agriculteurs BIO de Provence-Alpes-C te d'Azur (2022). Les chiffres cl s de l'agriculture biologique en PACA. <https://www.bio-provence.org/Chiffres-cles-de-la-bio-en-PACA-120> (accessed 31.01.2024).
- Lebensmittel-Cluster (2024). Homepage. <https://www.lebensmittel-cluster.at/> (accessed 31.01.2024).
- L gifrance (2024a). LOI n  2015-992 du 17 ao t 2015 relative   la transition  nerg tique pour la croissance verte (1). R publique Fran aise. <https://www.legifrance.gouv.fr/loda/id/JORFTEXT000031044385/?isSuggest=true> (accessed 31.01.2024).
- L gifrance (2024b). LOI n  2020-105 du 10 f vrier 2020 relative   la lutte contre le gaspillage et   l' conomie circulaire (1). R publique Fran aise. <https://www.legifrance.gouv.fr/loda/id/LEGISCTA000041554512> (accessed 31.01.2024).
- Les AMAP de Provence (2024). Homepage. <https://www.lesamapdeprovence.org/> (accessed 31.01.2024).
- Les Paniers de Marseille (2024). Homepage. <https://lespaniersmarseillais.org/> (accessed 31.01.2024).
- Lienbacher, E., Koschinsky, J., Holweg, C., & Vallaster, C. (2021). Spatial decision support for social hybrid organizations: siting new social supermarkets in Austria. *International Journal of Retail & Distribution Management*, 49(7), 999-1024.
- Lund-Durlacher, D., & G ssling S. (2021). An analysis of

- Austria's food service sector in the context of climate change, *Journal of Outdoor Recreation and Tourism*, 34, 100342.
- Marcoux, M., Tilbian J., Tournier, C., Beuret P., iNex Circular, Theobald, O., Rolland, T., (2022) Première estimation des coûts de gestion des déchets alimentaires des producteurs non ménagers. https://www.ordeec.org/fileadmin/user_upload/couts-biodechets-non-menagers-2022-synthesev3.pdf (accessed 31.01.2024).
- Marrucci, L., Daddi, T., & Iraldo, F. (2022). The Circular Economy, environmental performance and environmental management systems: the role of absorptive capacity. *Journal of Knowledge Management*, 26(8), 2107-2132.
- Méthas Synergie (2024). Homepage. <https://methasynergie.fr/> (accessed 31.01.2024).
- Minimo Impatto (2024). Homepage. <https://www.minimoimpatto.com/news/rifiuti-organici-cic-in-italia-la-raccolta-sale-a-71-milioni-di-tonnellate-75.html> (accessed 31.01.2024).
- Ministère de la transition écologique et de la cohésion des territoires (2024). <https://www.statistiques.developpement-durable.gouv.fr/les-dechets-alimentaires-en-france-et-dans-l-union-europeenne-en-2021> accessed 11.07.2024).
- Naša super hrana (2024). Homepage. <https://www.nasasuperhrana.si/> (accessed 31.01.2024).
- NOI Techpark (2024). Technology sector: Food & Health. <https://noi.bz.it/en/technology-sectors/food-health> (accessed 31.01.2024).
- Österreichisches Gallup-Institut & Österreichische Post (2018). Welcher der folgenden Lebensmittelhändler ist Ihr Lieblingsmarkt? In Statista. <https://de.statista.com/statistik/daten/studie/535004/umfrage/beliebteste-lebensmittelhaendler-in-oesterreich/> (accessed 18.10.2023).
- OTS (2023). Kick Off für Task-Force Kreislaufwirtschaft. https://www.ots.at/presseaussendung/OTS_20231006_OTS0122/kick-off-fuer-task-force-kreislaufwirtschaft (accessed 31.01.2024).
- Paasi, A., & Zimmerbauer, K. (2016). Penumbra borders and planning paradoxes: Relational thinking and the question of borders in spatial planning, *Environment and Planning A*, 48 (1), 75-93.
- Papargyropoulou, E., Lozano, R., Steinberger, J.K., Wright, N. & Ujang, b.Z. (2014). The food waste hierarchy as a framework for the management of food surplus and food waste, *Journal of Cleaner Production*, 76, 106-115.
- Polo Agrifood (2024). Homepage. <https://www.poloagrifood.it/site/homepage> (accessed 31.01.2024).
- PRECI (2024). Homepage. Preci Network. <https://www.reseau-prec.org/> (accessed 31.01.2024).
- Provincial Statistics Institute ASTAT (2021). South Tyrol in figures. Landesinstitut für Statistik Autonome Provinz Bozen - Südtirol. [https://astat.provinz.bz.it/downloads/Siz_2021-eng\(7\).pdf](https://astat.provinz.bz.it/downloads/Siz_2021-eng(7).pdf) (accessed 10.11.2023).
- Provincial Statistics Institute ASTAT (2022). Abhängig Beschäftigte und Entlohnungen in der Privatwirtschaft - 2020. https://astat.provinz.bz.it/de/aktuelles-publikationen-info.asp?news_action=300&news_image_id=1143021 (accessed 10.11.2023).
- Rechnungshof (2021). Bericht des Rechnungshofs: Verringerung der Lebensmittelverschwendung – Umsetzung des Unterziels 12.3 der Agenda 2030. https://www.rechnungshof.gv.at/rh/home/home/Bund2021_19_Lebensmittelverschwendung.pdf (accessed 19.10.2023).
- reducefoodwaste.eu (2023). Situation on food waste in Austria <http://www.reducefoodwaste.eu/situation-on-food-waste-in-austria.html> (accessed 23.10.2023).
- REGALIM (2024). REGALIM PACA - Réseau régional de lutte contre les pertes et le gaspillage alimentaires. <https://draaf.paca.agriculture.gouv.fr/regalim-paca-reseau-regional-de-lutte-contre-les-pertes-et-le-gaspillage-r548.html> (accessed 31.01.2024).
- Regione Piemonte (2021). La Strategie di specializzazione intelligente del Piemonte. https://www.regione.piemonte.it/web/sites/default/files/media/documenti/2022-01/s3_2021_2027_completa.pdf (accessed 15.11.2023).
- Regione Piemonte (2022). Strategia regionale per lo sviluppo sostenibile del Piemonte. Presentation. https://www.regione.piemonte.it/web/sites/default/files/media/documenti/2022-07/SRSvS%20uglio%202022_0.pdf (accessed 15.11.2023).
- Regione Piemonte (2023). Economia circolare e sistema agroalimentare. <https://www.regione.piemonte.it/web/temi/strategia-sviluppo-sostenibile/economia-circolare-sistema-agroalimentare> (accessed 10.11.2023).
- Regione Piemonte (2024). Distretti del cibo. <https://www.regione.piemonte.it/web/temi/agricoltura/cibo-territorio-consumo-alimentare/distretti-cibo> (accessed 31.01.2024).
- Rehab.Public (2024). Homepage. <https://rehab-republic.de/> (accessed 31.01.2024).
- Republic of Slovenia Statistical Office (2022). Food in Slovenia: Self-sufficiency and food imports. <https://www.stat.si/StatWeb/en/News/Index/10236> (accessed 31.01.2024).
- Republic of Slovenia Statistical Office (2022b). Slightly less food waste than a year earlier <https://www.stat.si/StatWeb/en/News/Index/11387> (accessed 31.01.2024).
- Republic of Slovenia Statistical Office (2019). Food Waste, Slovenia, 2018. <https://www.stat.si/StatWeb/en/news/Index/8433> (accessed 31.01.2024).
- Republic of Slovenia Statistical Office (2020). Food waste and waste indicators, Slovenia, 2019. <https://www.stat.si/StatWeb/en/News/Index/9230> (accessed 31.01.2024).
- Republika Slovenija (2023). AKCIJSKI NAČRT za izvajanje Strategije za manj izgub hrane in odpadne hrane v verigi preskrbe s hrano: »SPOŠTUJMO HRANO – SPOŠTUJMO PLANET« https://www.gov.si/assets/ministrstva/MKGP/PODROCJA/HRANA/Zavrski_odpadna_hrana/Akcijski_nacrt_za_izvajanje_strategije_in_obrazlozitev_ukrepov.pdf (accessed 31.01.2024).
- Romano R, De Luca L, Basile G, Nitride C, Pizzolongo F, Masi P. The Use of Carbon Dioxide as a Green Approach to Recover Bioactive Compounds from Spent Coffee Grounds. *Foods*. 2023; 12(10):1958. <https://doi.org/10.3390/foods12101958>
- Safe (2023). Food Donation in the EU: state of art, barriers, and perspectives. <https://www.safefoodadvocacy.eu/wp-content/>

- [uploads/2023/11/food-donations-position-paper-29.11.pdf](#) (accessed 03.11.2023).
- Santagata, R., Ripa, M., Genovese, A., & Ulgiati, S. (2021). Food waste recovery pathways: Challenges and opportunities for an emerging bio-based Circular Economy. A systematic review and an assessment. *Journal of Cleaner Production*, 286, 125490.
- Schebesta, H., & Candel, J.J.L. (2020). Game-changing potential of the EU's Farm to Fork Strategy. *Nature Food* 1, 586–588. <https://doi.org/10.1038/s43016-020-00166-9>
- Schmidt, T., Schneider, F., Leverenz, D., & Hafner, G. (2019). Food waste in Germany – Baseline 2015 – Summary (No. 71). Thünen Institute. https://www.researchgate.net/publication/339473130_Food_waste_in_Germany_-_Baseline_2015_-_Summary (accessed 31.01.2024).
- Schneider, F. & Lebersorger, S. (2016). Austria – Country report on national food waste policy. FUSIONS. <http://www.eu-fusions.org/phocadownload/country-report/AUSTRIA%20%2023.02.16.pdf> (accessed 31.01.2024).
- Slovenian Environmental Agency (2024). [KM05] High nature value farmland areas. <https://kazalci.arso.gov.si/en/content/high-nature-value-farmland-areas?tid=1> (accessed 31.01.2024).
- Slow Food Network (2024). La Carte de Slow Food en France. <https://slowfood.fr/carte-slow-food-france-conviviums-producteurs-sentinelles-alimentation-biodiversite/> (accessed 31.01.2024).
- Sustainapple (2024). Vorreiter einer überregionalen Kreislaufwirtschaft. <https://www.sustainapple.it/aktionsbereiche/vorreiter-einer-ueberregionalen-kreislaufwirtschaft/> (accessed 31.01.2024).
- Südtiroler Bauernbund (2024). Innovation. <https://www.sbb.it/de/service/innovation-suedtirol> (accessed 31.01.2024).
- Südtiroler Bauernbund (2023). Echte Chance direkt ab Hof. <https://www.sbb.it/de/sbb-news/detail/echte-chance-direkt-ab-hof> (accessed 03.11.2023).
- Slow-Food (2023). Slow Food Österreich. <https://www.slow-food.at/> (accessed 16.10.2023).
- Srip hrana (2024). Homepage. <https://www.gzs.si/srip-hrana/vsebinsa/English/About-SRIP-HRANA> (accessed 31.01.2024).
- Statista (2023). Statistiken zum Lebensmittelhandel in Österreich. <https://de.statista.com/themen/4494/lebensmittelhandel-in-oesterreich/#topicOverview> (accessed 18.10.2023).
- StMELF (2021). Bavaria in Comparison to Germany. Bavarian State Ministry of Food, Agriculture and Forestry. https://seerural.org/wp-content/uploads/2021/11/Prasentation_Westbalkanstaaten_21_11_09.pdf (accessed 31.01.2024).
- StMELF (2022). Bayerischer Agrarbericht 2022, Bayerisches Staatsministerium für Ernährung, Landwirtschaft und Forsten. <https://www.agrarbericht.bayern.de/landwirtschaft/erzeugerorganisationen.html> (accessed 16.10.2023).
- SURS (2023). Slightly less food waste than a year earlier. Republic of Slovenia Statistical Office. <https://www.stat.si/StatWeb/en/News/Index/11387> (accessed 31.01.2024).
- S2Biom project (2023). Homepage. <https://www.s2biom.eu/> (accessed 31.01.2024).
- Tavoletti, E., & te Velde, R. (2008). Cutting Porter's last diamond: Competitive and comparative (dis) advantages in the Dutch flower cluster. *Transition Studies Review*, 15, 303-319.
- Teigiserova, D. A., Hamelin, L., & Thomsen, M. (2020). Towards transparent valorization of food surplus, waste and loss: Clarifying definitions, food waste hierarchy, and role in the Circular Economy. *Science of the Total Environment*, 706, 136033.
- Una Buona Occasione (204). Homepage. <https://unabuonaoccasione.it/it/> (accessed 31.01.2024).
- UNEP (2014). Prevention and reduction of food and drink waste in businesses and households - Guidance for governments, local authorities, businesses and other organisations, Version 1.0. ISBN: 978-92-807-3346-4. https://www.fao.org/fileadmin/user_upload/save-food/PDF/Guidance-content.pdf (accessed 31.01.2024).
- United Against Waste (2024). Homepage. <https://united-against-waste.at/> (accessed 31.01.2024).
- United Nations Environment Programme (2021). Food Waste Index Report 2021. Nairobi. <https://www.unep.org/resources/report/unep-food-waste-index-report-2021> (accessed 31.01.2024).
- Univerza v Ljubljani (2024). Vzpostavitev podjetniško-inovacijskega stičišča EIT Food Hub Slovenija na Biotehniški fakulteti Univerze v Ljubljani. <https://www.bf.uni-lj.si/sl/novice/2021060113595592/vzpostavitev-podjetnisko-inovacijskega-sticisca-eit-food-hub-slovenija-na-biotehnikski-fakulteti-univerze-v-ljubljani/> (accessed 31.01.2024).
- Wien Energie (2023). Erdgas und Biogas. <https://www.wienenergie.at/ueber-uns/unternehmen/energie-klimaschutz/energieerzeugung/erdgas-und-biogas/> (accessed 31.01.2024).
- World Resources Institute (2020). SDG Target 12.3 on food loss and waste: 2020 progress report. https://food.ec.europa.eu/system/files/2021-04/fw_lib_wri-sdg-target_2020.pdf (accessed 31.01.2024).
- WWF-WRAP (2020). Halving Food Loss and Waste in the EU by 2030: the major steps needed to accelerate progress. Berlin (Germany), 72pp. https://food.ec.europa.eu/system/files/2021-05/fw_lib_srpl_wwf-wrap_halving_foodlossand-wasteintheeu_2020.pdf (accessed 31.01.2024).
- Zero Waste München (2024). Homepage. <http://www.zerowaste-muenchen.de> (accessed 31.01.2024).
- Zero Waste France (2024). Homepage. <https://www.zerowaste-france.org/> (accessed 31.01.2024).
- Zhang, Q., Dhir, A., & Kaur, P. (2022). Circular Economy and the food sector: A systematic literature review. *Sustainable Production and Consumption*, 32, 655-668.

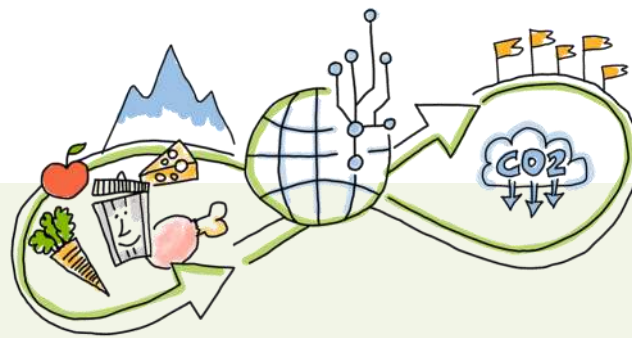
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