D4.3: "Circularity Strategies for SMEs" Handbook"

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AGROFFICIENCY

"Enhancing the Competitiveness and Sustainable Growth in the Agrofood Sector through the promotion of Circular Economy"

https://agrofficiency.eu

The Project is co-funded by the European Regional Development Fund (ERDF) and by national funds of the countries participating in the Interreg V-A "Greece-Bulgaria 2014-2020" Cooperation Programme.

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1 Introduction

The project entitled: "Enhancing the Competitiveness and Sustainable Growth in the Agrofood Sector through the promotion of Circular Economy", acronym: "AGROFFICIENCY", is part of the Operational Programme "Interreg V-A Greece-Bulgaria 2014-20" (https://agrofficiency.eu). The partners involved are as follows: the Chamber of Small & Medium Sized Industries of Thessaloniki, the Small Enterprises' Institute of the Hellenic Confederation of Professionals, Craftsmen and Merchants, the Greek Association of Supply Chain Management, the Regional Chamber of Commerce and Industry – Blagoevgrad and the Renewable Energy Sources Cluster (Blagoevgrad).

AGROFFICIENCY aims to promote entrepreneurship in the agri-food sector within the cross-border area of GREECE and BULGARIA, mainly through the exploitation of new ideas and promoting the set-up of new businesses with the help of digital incubators. The cross-border area on the Greek side includes regions of Thessaloniki, Serres, Drama, Kavala, Xanthi, Rodopi, and Evros, while on the Bulgarian side it covers the districts of Blagoevgrad, Smoljan, Khardzali and Haskovo.

The present handbook targets SMEs from the agri-food sector and aims to foster their sustainability and competitive advantages by applying and adopting the principles of circular economy and digitalization. It is grounded on a number of studies carried out by the project partners – state-of-the-art analysis on the agri-food sector with secondary data on the current state of the sector and primary data from small and micro enterprises, analysis on the circular economy and environmental impact that features primary data from small and micro enterprises of the agri-food sector and secondary data regarding circular economy implications and environmental impacts for the sector.

The handbook is structured into three chapters:

The first chapter sets out the circular economy issues in the agri-food sector, the drivers and barriers SMEs face, the EU policy framework and some specifics for Greece and Bulgaria.

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The second chapter highlights the circular economy benefits and challenges for the SMEs in the agri-food sectors of Greece and Bulgaria and the aspects of circularity that are specific for agri-food SMEs. It also gives examples of good practices of Greek and Bulgarian companies.

The last chapter includes practical advises and recommendations to agri-food SMEs on their way to circular and sustainable development for achieving higher competitiveness and resilience.

The project team would like to express its gratitude to all the contributors to its contents, incl. all the external parties who provided relevant information and good practices.

2 Circular Economy in the Agri-Food Sector

2.1 The importance of agri-food sector and its environmental impact

The global agri-food sector is expected to provide safe and nutritious food to a growing world population that is projected to grow from 7.9 billion people as of today, to close to 10 billion by 2050. Furthermore, this sector provides jobs and income to millions of people worldwide, a significant bulk of them in rural areas. Most of the people working in the agri-food remain in deep poverty. The population pressure, combined with growing incomes in the emerging and developing economies, leads to an increase demand for animal and crop produce and products.

The agri-food sector faces imminently three key challenges, also known as the "**triple challenge**": securing food for a growing population, providing income to the farmers, and protecting the environment. Balancing all three of them is a challenging task, especially with the environment protection being considered.

The global food system has a **large environmental imprint**:

- agriculture occupies nearly 40% of the earth's surface, which is far more than any other human activity;
- 70% of the global water is used for irrigation of agricultural crops;
- the agricultural use of freshwater contributes to around 11% of global greenhouse gas emissions (GHG), most of which come from raising cattle;

- 78% of global ocean and freshwater eutrophication (the pollution of waterways with nutrient-rich pollutants) is caused by agriculture;
- food accounts for over a quarter of global greenhouse gas emissions - 26%;
- agricultural land can also lead to deforestation, additional GHG emissions, and a loss of biodiversity.

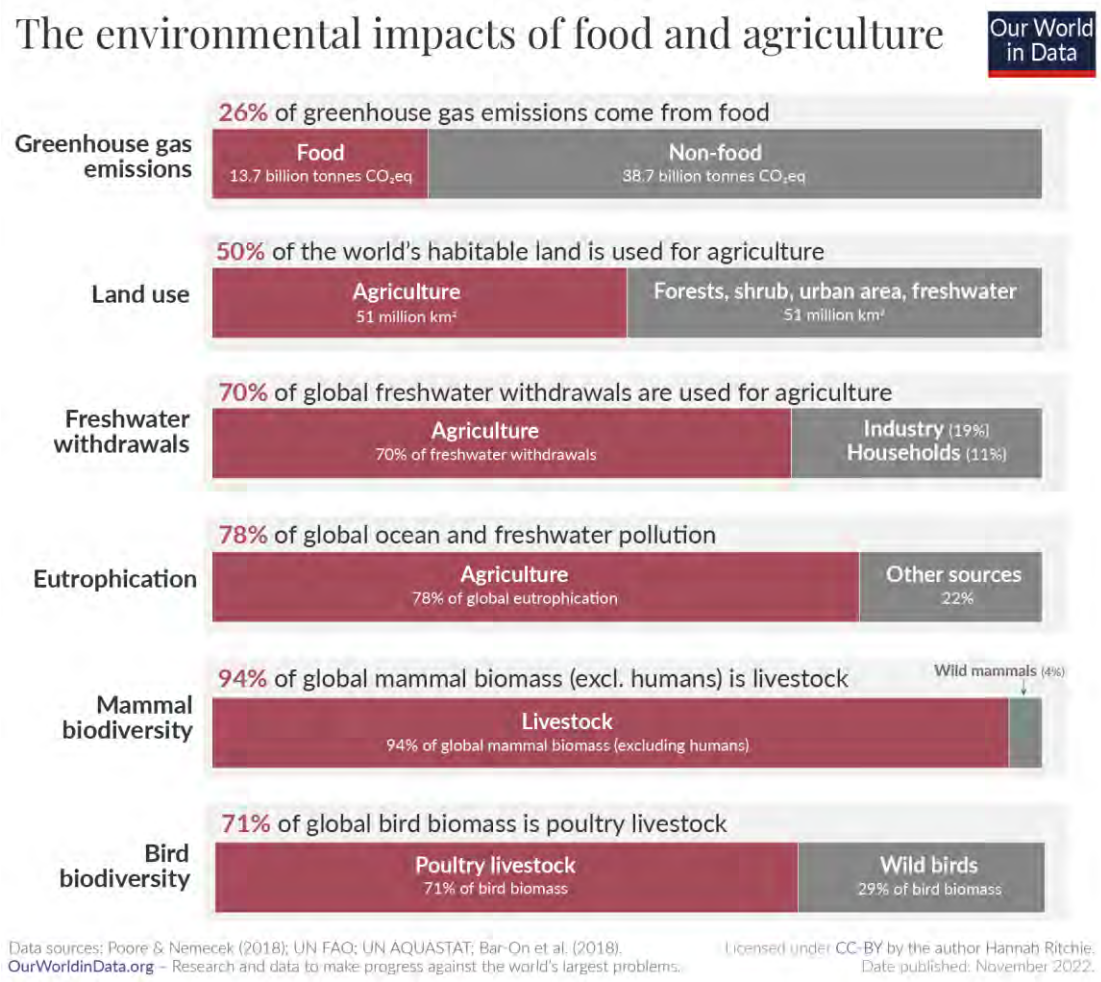

Figure 1: Environmental effects from agriculture sector production (Our World in Data)

Together with this, the summary of some of the main **global environmental factors** in the food and agriculture includes:

- farm impacts in crop or livestock production (including the manufacturing of inputs such as fertilizers, or emissions from manure);

- animal feed production;
- food processing;
- transport - from the farm up to retail;
- packaging;
- retail - energy consumption in retail stores, such as refrigeration.

Therefore, food is at the heart of tackling climate change, reducing water usage and pollution, reversing land deforestation, and protecting the wildlife.

As concerns Europe:

- around 10% of GHG in the **European Union** come from the sector of agriculture;
- nearly 70% of the EU's farming sector emissions come from the animal sector;
- and 68% of total agricultural land in the EU is used for animal production.

One of the biggest challenges to be solved in the food production chain is the reduction of GHG emissions. Food production is energy intense sector, the consumption of which cannot be solved with the current resources of renewable energy. That is why the research has suggested a combination of measures such as change of diet, reduction of food waste, use of technologies that make food production more efficient to address the energy gaps.

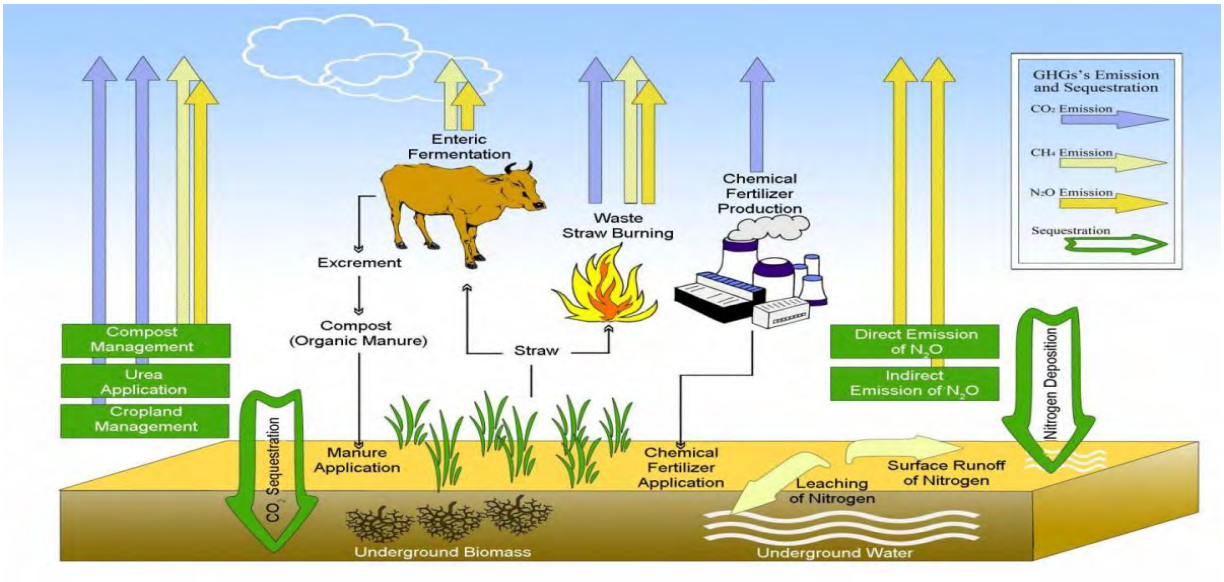

Figure 2: Source: Greenhouse emission from farming (Haitao Liu, J.L. e al 2015)

Greenhouse gas emissions in the sector of agriculture consist mainly of methane (enteric fermentation in ruminant animals, treatment of manure), and nitrous oxide (N2O – from spreading mineral and organic fertilizers, manure management).

Between 1990 and 2015, the emissions from the farming and food sectors declined by 20%, making it the only major farm sector in the world to have reduced its greenhouse gas emissions. These reductions affected both methane emissions from livestock, as well as N_2O emissions from agricultural soils and are attributed to the Nitrates Directive and a reduction in cattle numbers. However, recent years have seen an increase in nitrous oxide emissions at EU level, mostly due to the intensified use of inorganic fertilizers on cropland and grassland.

The EU is still in a process of finding the best measurable methods to achieve greenhouse gas reduction in agriculture. The EU Commission will draw on the experience of pilot projects to identify the farming methods that can reliably increase the organic matter in soil and thereby its carbon uptake. Once the questions about measurement, monitoring, verification, additionality and costs of sequestering carbon in soils have been resolved, farmers could get an additional income from participating in carbon markets.

The global food system encompasses production, processing, and distribution. The visualization shown here – based on data from the meta-analysis by Joseph Poore and Thomas Nemecek (2018), published in Science – summarizes food's share of total emissions and breaks it down by source.

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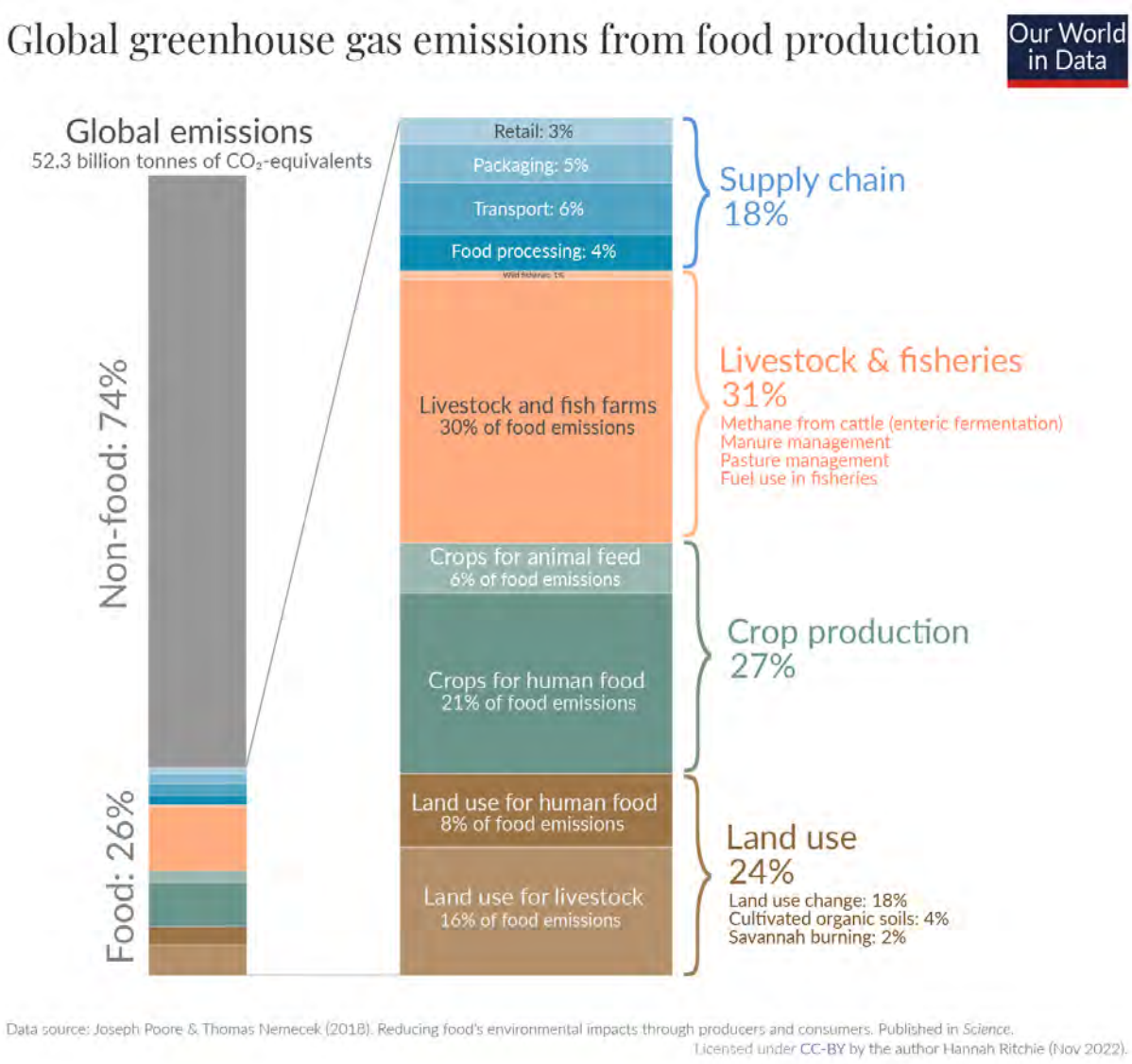

Figure 3: Global greenhouse gas emissions from agri-food sectors (Our World in Data)

There are four key **elements** to be factored in quantifying **food GHG emissions**. They are:

- Livestock & fisheries – they account for 31% of food emissions. Animals raised for meat, dairy, eggs and seafood production contribute to emissions in several ways. Cattle for example, produces methane through their digestive processes. Manure management, pasture management, and fuel consumption from fishing vessels also fall into this category. 31% of emissions relates to on-farm 'production' emissions only: it does not

include land use change or supply chain emissions from the production of crops for animal feed;

- Crop production – it accounts for 27% of food emissions. 21% of food's emissions comes from crop production that goes to direct human consumption, and 6% comes from the production of food for animals. They are the direct emissions, resulting from agricultural production – this includes elements such as the release of nitrous oxide from the application of fertilizers and manure; methane emissions from rice production; and carbon dioxide from agricultural machinery;
- Land use – it accounts for 24% of food emissions. Emissions from land usage for livestock accounts for 16% and crops for human consumption account for 8% in the GHG emissions. Deforestation and transforming land into cropland or pasture emits carbon dioxide.
- Food supply chains - they account for 18% of emissions. Food processing, food transport, packaging and retail require energy and resource inputs. It is assumed that eating local food is key to a low-gas emission. Yet, food transport emissions are only 6% of the total food emission on a global scale. Whilst supply chain emissions may seem high, at 18%, it's essential for reducing emissions by preventing food waste. Food waste emissions are the largest component in this section: 25% of emissions from food production ends up as a waste either from supply chain losses or consumers. What are the current solutions? - using durable packaging, longer refrigeration and food reprocessing can help to prevent food waste.

A research by Vilma Sandström et al. **compares greenhouse gas emissions from the common diet across countries in the European Union**. GHG emissions from food production, land-use and trade (i.e. transport) are among the key factors taken into account. The conclusions we can draw from this study are:

- Bulk of the emissions result from land use change or/and emissions at the farm level – it could be methane emissions from cattle; management of manure; or use of fertilizer. Only 6% of the GHG comes from transportation of food;
- 83% of the GHG emissions in the EU diet come from animal products such as dairy, meat and eggs. Plant related foods result in 17% of the GHG emissions. Most of the differences across countries stem from what quantity of meat and dairy products they eat. By

comparison, the environmental benefits from locally grown production are much smaller than eating a plant-based diet.

As concerns **Greece and Bulgaria**, the studies made within the project with significant participation of production companies from the agri-food sector (between 38 and 61% depending on the region), which are also predominantly micro enterprises (between 47 and 83% with up to 10 employees according to the region) with annual revenue under 500,000 Euro (between 61 and 72% according to the region) disclosed that:

- most of the companies do not assess the environmental impact of their operations (between 76 and 98% depending on the region);
- very few enterprises adopted/integrated green practices/technologies (between 10 and 33% depending on the region),

although the food industry is among the 6 most important sectors of both Greek and Bulgarian economies from the perspective of the total value of products sold.

2.2 The circular economy principles

The idea of circular economy (CE) is not a new concept. It was developed back in the 1970s, however, the actual revisit and expansion of the idea are quite recent. There are many definitions of CE, which, coupled with certain aspects linked to more familiar and traditional concepts, such as recycling, often creates a difficulty in understanding the breadth of the term. According to Regulation (EU) 2020/852[1], CE means an economic system whereby the value of products, materials and other resources in the economy is maintained for as long as possible, enhancing their efficient use in production and consumption, thereby reducing the environmental impact of their use, minimizing waste and the release of hazardous substances at all stages of their life cycle, including through the application of the waste hierarchy.

[1] Regulation (EU) 2020/852 of the European Parliament and of the Council of 18 June 2020 on the establishment of a framework to facilitate sustainable investment, and amending Regulation (EU) 2019/2088 https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32020R0852

The CE aims to **transform the current economy into self-sustaining** with the idea of reducing waste and the ecological and environmental imprint of industries before the ecological damage happens rather than addressing the consequences of the damages. This prevention is done by designing new economic models, manufacturing and industrial solutions that optimize the existing resources, rather than reaching out for new ones. The final goal of reaching CE is to minimize the environmental pressure created by the economic growth.

The CE also aims to build a sustainable society that is based on recyclable and renewable resources with less waste. This type of economy does not look at the natural resources as unlimited quantity and lays focus on reuse of the existing resources. CE development model evolves around the idea of producing goods and services accounting for the environmental and social costs. It is a model that enables or facilitates the creation of new societies in line with new waste management approaches and sustainability mindsets thus transforming the economies and the societies into more sustainable ones.

The objective of CE therefore is to **abolish the traditional linear model of the economy** based on "take-use-waste" that has been on stage in the past 150 years. The linear economy is clearly a one-way process with a beginning and an end. That model bases economic growth on the ideas of extracting resources, making products and services and then disposing the leftover into landfills or in incinerators, creating a lot of waste and pollution, which needs to be separately addressed. The circular model, on the other hand, is inspired by the existing living systems, where our **economic and production systems should work like organisms**, processing nutrients that can be sent back into the cycle thus closing the production loop. While CE aims to create cycles through which raw materials, components and products lose as little of their value as possible.

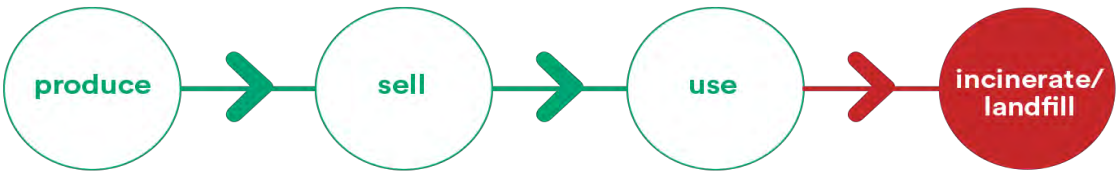

Figure 4: Chart of linear growth business model

At the shifting stage from a linear to a circular economy the transformation goes **beyond recycling and reusing** the discarded materials. The CE's environmental impact of products and

their components is reevaluated along its entire life cycle - from the initial concept stage through the end-use, where wastes are regenerated in a new form. The CE closes the loop of the linear pattern of "take-make-consume-throw away" by keeping the highest utility and value of the products, parts and materials as long as possible. In CE, waste is reduced to a minimum because everything that is produced is being transferred and reused somewhere else.

According to Ellen MacArthur, there is a sharp need to move towards an economy where waste is reused or recycled (circular economy). The circular model is based on five principles:

- Elimination of waste.
- Diversity is strength.
- Energy must come from renewable sources.
- Prices must reflect actual costs.
- The key is to think in terms of systems, to understand how things affect each other as a whole.

Therefore, CE aims at **transition from "cradle-to-grave" design to "cradle-to-cradle" design**. The cradle-to-grave design ("take-make-waste"), which is part of the linear economy is how most products we currently use are made. That system operates under the notion that there is an unlimited supply of Earth's resources to make products and unlimited availability of space in landfills for the products to be buried. While relying on infinite resources it likewise considers not the fact that one day they will run out.

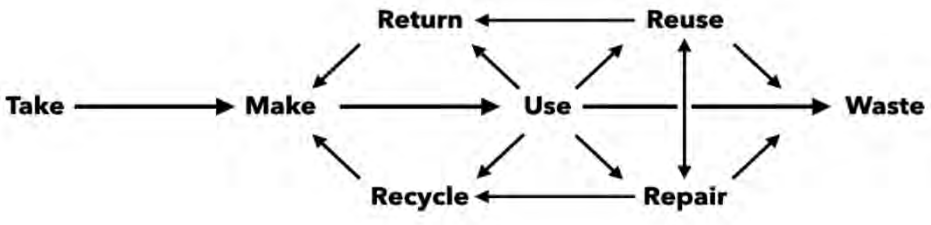

Figure 5: Cradle-to-Grave Design Model

The Cradle-to-cradle (C2C) model that underpins the CE, is a way of **designing products or processes that work more like ecological systems**. In practice, cradle-to-cradle is a radical

rethinking of the process of designing and packaging. C2C approach is modeled after nature's long-evolved, low-waste, energy-preserving processes. Just like a plant born from soil created by other dead plants - it grows using local resources, produces flowers or seeds, and then dies, creating in its turn food and soil for other organisms, the human beings can make products that are part of an ongoing closed circular system. Based on that, C2C is sometimes referred to as being biomimetic. For example, say someone wants a desk. The conventional cradle-to-grave model would include extracting petroleum products and metals from the earth and spending tremendous energy to transport and manufacture them into a desk that is used for a few years, which later breaks or is discarded, and ends up in the landfill. In the C2C model, the desk is made from materials that are already being used. The materials could be from another desk or a completely different type of product that is suitable for being transformed into a desk.

The cradle-to-cradle design principles have evolved over time, but the foundation remains the same. Cradle-to-cradle usually applies to product design, but it can also be used when thinking about designing processes or systems such as the CE business models. **Eliminating the concept of waste disposal is crucial to C2C**. Braungart and McDonough wrote that we should look at the waste not as a problem to get rid of, but in the way nature works - "waste equals food." This is a fundamental concept for C2C, and products and materials can be designed to be used perpetually. So, instead of waste, the used materials are nutrients that can be fed into a circular system.

Figure 6: The circular economy model

The CE therefore is a model of production and consumption that involves the exchange, leasing, reuse, repair, renovation and recycling of existing materials and products as much as possible in order to extend their life cycle. In practice, the circular economy means reducing waste to the minimum possible level. When a product reaches the end of its life, the materials used in its manufacture are retained in the economy to be used again and again by adding value to the product.

The CE can be widely applied in the agri-food sector for the benefit of regional and national economies. It is connected with the **Farm-to-Fork strategy** (F2F) which is at the heart of the EU Green Deal and will enable the transition to a sustainable EU food system that preserves food security and gives access to healthy diets sourced from a healthy food. It will reduce the environmental and climate impact of the EU food stem and will strengthen its resilience.

EU's Farm to Fork strategy is not a specific legislative proposal in itself but an outline of new premises for the future food systems. The strategy sets out an action plan for non-legislative initiatives, amendments to existing legislation and new legislation, which will be submitted to the usual impact assessment and consultation process, followed by the bloc's legislative process. The targets and actions specified in the F2F strategy are assigned to four clusters (see fig. 7).

Figure 7: Farm to Fork Concept (European Commission)

The F2F strategy sets targets, which aim to transform the EU food system by 2030 (see figure 8). It offers strict measures to ensure that the healthy food option is accessible for all EU citizens. That is provided by improved labelling criteria. The F2F strategy aims to accelerate the transition to a

sustainable food ecosystem that will also reduce the risks associated with climate change. Even if some of its targets, such as the reduction of antimicrobial sales, are not directly related to a climate action, GHG emission reduction has to be achieved in all areas of the value chain, i.e., in the growing, storing, processing, packaging, transporting, eating and discarding of food. Parts of the F2F strategy – such as rewarding farmers for removing CO2 from the atmosphere, rules for imports associated with deforestation – are primarily aimed at reducing the GHG emissions; while others should incur emission reductions even if their main objectives lie elsewhere, e.g. higher animal welfare standards (leading to fewer animals overall), larger organic farming areas (increase carbon stored in soil), more power to small farmers vis-à-vis large food companies, reducing food waste and changing consumer habits of eating meat.

Figure 8: 2030 EU food sustainability targets (European Commission)

It's also important to encourage the implementation of CE principles in the agri-food businesses in **Greece and Bulgaria**, as far as they are not popular enough among them – the studies within the project AGROFFICIENCY show:

- few of the businesses adopted CE practices into their operations (4-29% depending on the region);
- moreover, the CE concept is not even part of the corporate strategy for most of the enterprises (53-88% depending on the region);

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- nevertheless, the companies do not usually offer training to their employees on the CE principles (valid for between 85 and 100% of respondents depending on the region). If any training is available, it's: provided to the company by external sources (in about 70% of the cases), is available to only some levels of the employees (in about 54% of the cases), and is not mandatory (in about 77% of the cases).

Those figures disclose, unfortunately, that CE is not among the priorities of agri-food companies in those two regions of Bulgaria and Greece and that they have to be supported in their transition to a greener, more sustainable and more circular business model for better performance and benefits for their employees, regions, national economies and societies.

2.3 Barriers and Drivers for the circular economy in the agri-food sector

There are many obstacles and **barriers** on various levels which hamper the faster introduction of the CE more widely. They can be summarized in the following categories:

- **Governmental issues**: ineffective or unsupportive policies, lack of measuring indicators, unclear vision, weak economic incentives, lack of conducive legal system, deficient institutional framework, lack of enough public information/awareness to support participation in reuse/recycle /remanufacturing;
- **Economic issues**: large capital investments requirements, significant transaction costs, high upfront/startup costs and insufficient short-term benefits that prevent investment, asymmetric information, uncertain return and profit;
- **Technological issues**: product complexity overwhelms separation of materials making recycling harder; lack of enough information when tracking material composition of products to enable recycling and remanufacturing, inappropriate technology, lag between design and diffusion, lack of necessary skills in the workforce, of technical support and training;
- **Managerial and societal issues**: lack of interest in the leadership in CE at management level, higher priority given to other supply chain issues, various organizational structures within firms inhibiting the implementation of CE practices, lack of successful business models and training, transnational supply chains with a lot of complexity, lack of good

relationships in supply chain, thus being "stuck" with the current suppliers, inability to transition from linear technologies, remanufacturing requires experience and knowledge, business routines, lack of consumer awareness about refurbished or remanufactured products, rigidity of consumer behaviour, perception that quality of refurbished or remanufactured product is lower.

As far as different studies disclose that the cultural barriers before the introduction of CE prevail, it's very important to promote the successful examples in this regard. Therefore, we share herein a number of show-cases relevant for the agri-food sector. Furthermore, some of them impact other sectors too.

Pigmento Naturale

Pigmento Naturale is an Italian based startup, which produces natural pigments from industrial and agricultural waste for applications in green building, textile, painting, food and more. The company returns to the application of natural dye respecting the principle of environmental and economic sustainability, as in the past, but with innovative methods, combining new technologies and tradition.

"We make natural pigments from agricultural and food waste – explains Miriam Mastromartino, one of the founders. Examples? From the waste of the onions, we get colors ranging from yellow to orange to green, from coffee grounds we make beige, gray and brown".

The dyes are without sophistications, additive or chemical contaminations. They are sold in powder or liquid form and are intended for various sectors like textile, bio housing, alimentary and cosmetics. Pigment colors are hypoallergenic, ecological and follow the principles of circular economy and zero waste production.

"Our goal is to change the concept of coloring by creating large-scale natural dyes, obtained from vegetable waste. The dyes can be used in the textile, green building, food, cosmetic and home care sectors, orienting us towards a circular economy model", Mastromartino added.

Source: Pigmento Naturale (pigmentonaturale.com)

As far as the **drivers** are concerned, the justification and faith in the forthcoming evolution of such a broader system are very important. Therefore, the public policy efforts have to be oriented to measures for promotion of the positive aspects of CE as follows:

- it reduces waste since it promotes the recycling of finished goods;
- it reduces the risk of potential price volatility of the raw materials;
- it achieves efficiency since the resources are recycled to get new products;
- it promotes continuous usage of products and spurs new business opportunities by promoting reusage rather than purchasing a new item;
- it benefits and preserves the environment;
- it creates new businesses, and new employment opportunities.

More specifically, the **drivers** can be summarized in following categories:

- **Governmental issues:** clear vision, increasing environmental legislation, standards and waste management directives, effective support policies, measuring indicators, economic incentives, supportive institutional framework and public information and promotion;

- **Economic issues**: rising resource demand and consequent pressures, resource depletion, resource cost increases and volatility, leading to incentives towards solutions for cost reduction and stability;
- **Technological issues**: availability of technologies that facilitate resource optimization, re-manufacturing and regeneration of by-products as input to other processes, development of sharing solutions with superior consumer experience and convenience;
- **Managerial and societal issues**: corporate awareness at managerial level regarding CE and willingness to apply its principles in the company's activity and to collaborate in the value chain, social awareness, environmental literacy and shifting consumer preferences (from ownership of assets to services models), pressure on part of the suppliers, business partners generally and the very consumers for application of the CE principles and for making the company and its products greener and its activity – more circular, etc.

As seen from the above list, the CE drivers influence businesses and societies more and more actively. Some of the examples of successful businesses in the CE domain cross their national borders to promote the concept at international level. This proves that the CE is a relevant and competitive concept from both regional, local and global perspective. Therefore, this Handbook presents show-cases illustrating that businesses can be green, sustainable and competitive when adopting the CE concept. In addition, such companies' potential partners and clients can easily recognize their successful business model and appreciate it from a market point of view.

Peats Soil

Peats Soil is a second-generation Australian based company focused on receiving, processing, and marketing recyclable organic resources in bulk and bag forms. It also built a mobile, on-site bin, called BiobiN, that starts the composting process for organic waste (fruit, vegetables, and meat) and manages the smell from it. The company has also developed processes for creating biogas and biodiesel. 15 years ago, Peter Wadewitz, Managing Director of both Peats Soils & BiobiN® developed the BiobiN® that enables the start of composting of organic waste before its being collected by Peats.

Peats Soil receives and processes green organics materials from curbsides areas and from businesses including hotels, supermarkets, schools, office buildings, food processors and

manufacturers. It processes organic materials to create soil improvement products for agribusinesses, households and other businesses. Peats Soil processes 100,000 - 150,000 tons of organic waste annually. The patented BiobiN® aeration system starts the composting process of organic material, reducing bacteria and other pathogens. Once the waste is collected by Peats, the processed or partially processed organic material can be added to products such as soil conditioners, compost, and biofuels – providing a valuable supply of nutrients, carbon and organic matter to agricultural soils, landscape supplies and alternative fuels. This compost material goes back to gardens, farms and vineyards as organic and carbon-rich material to improve soil health. Peats also capture the methane gas produced by rotting organic material and creates biogas. Today, Peats has built over 500 BiobiNs most of which are used in Australia. There are also BiobiNs in China, USA and UAE, markets that present big opportunities for organic waste capture and conversion.

The company's next ambition is to become a world leader in sustainable and innovative organics recycling to produce valuable landscaping, garden, and horticulture products. Peats Soil is working to have its 25-truck fleet run on biodiesel produced through the onsite biodiesel plant and the whole operation powered by biogas from an anaerobic digestion process.

Source: Peats Soil (https://www.peatssoil.com.au)

As concerns **Greece and Bulgaria**, the studies held within the project AGROFFICIENCY show that the managerial and societal issues are quite influential for them as well - although the responses to the question "*To what extent do you engage with suppliers to increase sourcing based on CE principles?*" differ across the countries, they are however in both case not very engaged in general (about 74% of the Greek companies and 100% of the Bulgarian enterprises have indicated a score of 1-3 from a 1-5 scale, where 1 is 'not engaged' and 5 – 'highly engaged). Regarding the clients' pressure on the companies to become more circular, the situation is a bit different and more optimistic for Greece in comparison to Bulgaria – only about 35% of the Greek respondents compared to a 100% Bulgarian ones answered they have detected little or no such pressure from customers (answering 1 and 2 on a 1-5 scale, where 1 is "no pressure" and 5 – "very pressured"). This comes to show that even if pressure on the part of customers exists, the companies hardly manage to sufficiently and efficiently address CE issues in their activities, including in their relations with suppliers or all along the supply chain. This indicates that companies seem to need

external help with both training and consultancy. Moreover, this is also confirmed by the corporate answers to the questions about the consulting services used (in the same studies):

- most of the respondents answered they have never used consulting services in the bottleneck areas of their activities (between 67% and 80% of the Greek and Bulgarian companies respectively);
- insufficient funding was pointed out by 53% of the Greek enterprises as the main reason behind the above, while significant share of the Bulgarian companies (39%) considered the existing support mechanisms not good enough. In addition, Bulgarian enterprises often indicated low capacity of their human resources as yet another reason (39% of the responses). Similar response distribution was given by Greek region;
- and last, but not least, most of the companies do not participate in any business support structure (71% of the Greek enterprises and 90% of the Bulgarian ones) to help them deal with the relevant problematic issues of their activities.

Those results illustrate the need for additional support to businesses from both sides of the border, along with campaigns to further encourage SMEs to benefit from the existing support services and mechanisms.

There are some successful examples from both countries that showcase how good will and entrepreneurship can solve problems or seize opportunities.

Ecosystem by Dimiter

In Greece, a large variety of aromatic and pharmaceutical plants like saffron, oregano and siderites are cultivated systematically. From the total production, around 65% is discarded even though its bio-reactive value is similar to that used commercially.

With the Hellenic Agricultural Organization (HAO) Dimiter has started up an ecosystem in the area in order to produce and test animal breeding products by utilizing the crop residues of aromatic and pharmaceutical plants. The ecosystem consists of two industries that produce, process, package and sell spices, herbs, aromatics, beverages, and animal breeding products (Bagatzounis Markos & Sons S.A., Greek Feed Industries EL.VI.Z) and two university labs (Nutrition Lab of Aristotle University of Thessaloniki, Lab of Pharmacognosy and Chemistry of

Natural products of National and Kapodistrian University of Athens). The aim is to finally commercialize these products in order to satisfy the addressed needs of animal breeders. These needs are urgent, especially since the prohibition of antibiotic growth promoters in animal breeding as feed additives in the EU. Animal breeders are now searching for natural additives to substitute these antibiotics and research has shown significant antimicrobial effects of several aromatic and pharmaceutical plants. The ecosystem built is a successful example of how scientific research and market needs can be connected, resulting in improvement of resource efficiency and increase in job opportunities. The final outputs are animal breeding products of high value certified and licensed for commercial distribution. So far, at least three farms purchase the product. The ecosystem will continue the cooperation in order to produce more innovative products, such as beverages for human consumption.

Source: https://www.interregeurope.eu/policylearning/good-practices/item/2423/innovative-bio-reactive-products-from-aromatic-and-pharmaceutical-plants-by-products/

Zero Wave and Blagichka

Zero Wave is a Bulgarian company whose mission is to turn waste into resources. It produces 100% biodegradable tableware and food products, that are made from a material currently treated as waste and discarded after use – the residual malt after beer production, which is also a big methane pollutant. The company uses own technology that transforms the so-called waste into a valuable resource. The team researched the malt's material qualities and found out that it is 100% usable. It has significant nutritial characteristics – it is rich in protein and fiber, and has a minimal amount of carbohydrates and fats. These features are considered to be much better than the alike of the popular coconut and almond flours. The company's products have no preservatives and stabilizers. The outer packaging is made of recycled kraft cardboard, which can later on be reused.

The vision of the company is to promote circular economy and sustainable development as business model of the future. "We live times when every carbon footprint saved paves the way to a better tomorrow. With our products, we save tons of methane that would have been released in the atmosphere, while at the same time we eliminate disposable plastics with our

biodegradable utensils. Best of all, the European Union and its 2019 directive on disposable plastics are already in place and many companies have to switch to alternatives", the management says.

The portfolio of Zero Wave's products includes: crispy malt crackers with black and white sesame, pumpkin or sunflower seeds and dry tomatoes, a 100% bio degradeable and compostable plate, that is edible and resistant to all types of food and liquids incl. flavoured food with high or low temperature. The plate is offered in a variety of flavours, forms and sizes.

The products are correlated to another green business of the Zero Wave entrepreneurs – Blagichka – the first zero-waste restaurant in Bulgaria. Its clients can enjoy the food on site or by delivery. Take away orders are delivered in reusable boxes. The clients can also bring their own containers for the delivery. Everything that goes through the kitchen is reused, or comes in its own box, jar or reusable bag. What is not recovered goes to the metal bins for separate collection. The food waste goes to a large composter, the result of which is a natural soil used to fertilize the nearby garden. The founder Blazhka Dimitrova said she coped well with the prejudice of the locals: "With the opening of the restaurant, it was difficult to convince everyone that such a place is possible to exist. I do not hide the fact that we also have packaging that we fail to use, but then we necessarily recycle it – we also have a mini recycling station at the restaurant. And despite this, we rarely generate more than 1% waste".

Source: Zero Wave, Blagichka (http://zerowavebg.com, https://blagichka.com and http://www.arcfund.net/arcartShow.php?id=18497)

2.4 EU political framework

Talking about support mechanisms and policies, we should pay attention to the EU regulatory environment. The concept of the circular economy gained importance relatively recently on EU level, mainly because of the high commodity prices in a situation of prolonged economic crisis. In 2011, the European Commission launched the '**Flagship initiative on resource efficiency**' and a '**Roadmap to a Resource Efficient Europe**'. In July 2014, the Commission adopted '**Towards a circular economy: a zero-waste programme for Europe**', which lists six waste management directives that created the EU's first **'Circular Economy Package' (CEP)**. The main goals of the

CEP were to boost recycling and prevent the loss of valuable materials, to create jobs and spur economic growth, to offer new business models, eco-design and industrial symbiosis that can contribute to the transition to a 'zero waste' economy, and to reduce greenhouse emissions and other environmental impacts. It also proposed setting a non-binding target to increase material productivity by 30% between 2014 and 2030, along with introducing and tightening existing waste-related targets.

In December 2014 the EU Commission withdrew the CEP stating that it would instead introduce a new, more ambitious package by the end of 2015, which would cover the full economic cycle, rather than focusing on waste reduction and recycling. In December 2015 the Commission adopted the revised CEP, entitled '**Closing the Loop – An EU action plan for the circular economy'**, with the overall objectives of contributing 'to the EU's efforts to develop a sustainable, low carbon, resource efficient and competitive economy' to be delivered by 54 'actions' to be carried out by 2020. This section will describe the main elements of the revised CEP using the policy intervention classification and discuss progress with their implementation and their effectiveness in achieving their objectives.

The main regulatory requirements resulting from the CEP are binding goals on landfilling and recycling, which went into effect in July 2018. The targets include requirements for 65% of municipal waste to be recycled by 2035, and 70% of packaging waste by 2030, with intermediate targets for both, and a maximum of 10% of municipal waste to be sent to the landfill by 2035 (with waste suitable for recycling or other recovery prohibited from landfill by 2030). Like with the pre-existing waste-related targets, member states are mostly free to select the specific policy instruments appropriate to achieve these targets. However, they must adhere to a range of other new requirements, including the obligation to establish separate collection for paper, metal, plastic and glass waste, and the establishment of EPR (Extended Producer Responsibility) schemes for all packaging by the end of 2024.

In 2017, 30% of total municipal waste in the EU28 was recycled. This is a substantial increase from 11% in 1995 (Eurostat, 2019a), but is a way below the 2020 target of 50% set by the 2008 **Waste Framework Directive**. 67% of all packaging waste was recycled in 2017 (varying from 40% in Malta to 82% in Belgium), with most member states meeting the target of 55% to be achieved by 2008-2015, and 17 already achieving the new 2025 target of 65% (and 6 even

achieving the 2030 target) (Eurostat, 2019c). Around 23% of municipal waste in the EU27 was sent to landfill in 2017 – nearly half the value experienced ten years prior, with substantial variation between member states, ranging from less than 1% in the top five, and above 70% in the lowest five (Eurostat, 2019a). As such, although broad trends are promising, meeting the targets set in 2018 – particularly for total recycling and landfilling - will require substantial further policy effort in many member states.

The CEP also aimed to increase emphasis on circular economy aspects in requirements set under the **Ecodesign Directive**, including standards on material efficiency. Various eco-design regulations adopted in October 2019, including for washing machines, dishwashers, and refrigerators, include circular economy-related requirements, and, following a request by the Commission, standards on material efficiency aspects, including durability, repairability and recyclability. Other EU-wide regulatory ambitions proposed by the CEP, including minimum requirements for water reuse in agricultural irrigation and standards for secondary raw materials and material-efficient recycling for electronic waste and related products, are at various stages of development. Setting the appropriate fiscal framework using economic instruments is promoted as a core objective to encourage the development of resource efficiency and circularity in the EU.

The **environmental taxes**, a cornerstone instrument in efforts to set the appropriate fiscal framework through pricing the externalities associated with resource extraction and use, accounted for just 6.1% of total revenues from taxes and social contributions in the EU28 in 2017 (ranging from 4.4% in Luxembourg, to 10.2% in both Greece and Slovenia). The vast majority (77%) of these revenues were raised through taxes on energy products, with taxes on resource extraction and pollution (excluding GHG emissions but including waste management levies) together accounting for just 1% of total environmental tax revenue (Eurostat, 2019b). The generally weak environmental fiscal position in the EU is further illustrated by the presence of **environmentally harmful subsidies** (EHS), with debate most often focused on fossil fuel subsidies in the context of the need for climate change mitigation. In the EU, such subsidies were estimated to be worth €55 billion in 2016 (European Commission, 2019c). Although not directly tackled as part of the CEP, both these elements are addressed in the 2011 Roadmap, which proposed that member states should 'shift taxation away from labor to environmental impacts', with 'a major shift' achieved by 2020, and 'prepare plans and timetables to phase out EHS', with a phase out achieved by 2020 (European Commission, 2011: 11).

Education, information, and awareness proposed by the CEP may be grouped into three broad categories. The first category seeks to **improve the collection and availability of data**, including the further development of the **EU Raw Materials Information System** (RMIS), the development of a common way and indicators to measure food waste, and the development of a monitoring framework for the circular economy. Progress has been made on all these fronts. The RMIS, launched in November 2017, presents data and other information across 12 thematic blocks covering crucial raw materials, secondary raw materials, and environmental and social sustainability. A **common methodology to food waste measuring** was adopted by the Commission in May 2019, and the circular economy monitoring framework with a set of 15 indicators across the value chain was first published in January 2018 (European Commission, 2019b).

The second category of interventions are those that seek to **promote best practice amongst businesses, particularly in waste management**. This includes the inclusion of circular economy aspects into **Best Available Technique Reference** (BREF) documents, published as part of the **Industrial Emissions Directive**. The third category are those that provide **information to the end consumer**. This includes presentation of circular economy-related information on product energy labelling (information on availability of spare parts, ease of repair, and facilitating end-of-life treatment is now available on such labels for various products); a 'fitness check' for the **EU's Ecolabel**. The CEP proposed action to enhance the integration of circular economy requirements into its voluntary GPP (Green Public Procurement) criteria and support a greater uptake of these criteria across member states, and in the EU's own institutions. Circular economy requirements are now included for various product categories, with the 3rd edition of the 'Buying Green' handbook and the brochure '**Public Procurement for a Circular Economy**' published to support uptake.

Various **innovation support and collaboration platform interventions** were proposed by the CEP. Principal among these is a focus on circular economy issues under 'Horizon 2020', the EU's research and innovation programme for 2014-2020. Between 2016 and 2018, over 250 research projects related to the circular economy were financed, including those directly contributing to the actions described above, with public funding of over €1.2 billion (European Commission, 2019d). An additional €950 million was available for projects in 2018-2020 (European Commission, 2019b). Moreover, CEP 'actions' include establishing a pan-EU network of

technological infrastructures for SMEs to adopt advanced manufacturing, improving the exchange of information between manufacturers and recyclers of electric products. In February 2018, the online Information for Recyclers Platform – I4R – was launched, to facilitate such information sharing as required by the WEEE Directive.

As far as the agrifood sector in concerned, by 2023 the European Commission will present a proposal for a "**legislative framework for sustainable food systems**" that will aim to promote policy coherence at EU and national levels, meaning it will set common definitions and targets for all participants in the food system. There are around 37 different measures in the strategy, ranging from avoiding "marketing campaigns to advertise meat at very low prices" to "reducing dependence on long-haul transportation [of food]" to "developing an integrated nutrient management action plan to address nutrient pollution and increase in sustainability of the livestock sector".

Some of the measures to be addressed by 2024 are:

- initiative to reward farming practices that remove CO2 from the atmosphere, i.e., development of a regulatory framework for certifying carbon removals based on robust and transparent carbon accounting;
- facilitate the placing on the market of sustainable and innovative feed additives; reduction of the dependency on critical feed materials (e.g., soya grown on deforested land) by fostering EU-grown plant proteins;
- legislative proposal and other measures to avoid or minimize placing of products associated with deforestation or forest degradation on the EU market;
- recommendations to each member state on the nine objectives of the Common Agricultural Policy (CAP) to be included in their strategic plans;
- clarification of the competition rules and monitoring the implementation of the unfair trading practices (UTPs) directive;
- action plan to reduce pollution from fertilizers;
- action plan for the organic sector for 2021-2026 to stimulate supply and demand for organic products;
- proposal for a Farm Sustainability Data Network (data and advice on sustainable farming practices);

- proposal for a revision of the existing animal welfare legislation, including transportation and slaughter;
- use up-to-date methodologies for measuring food waste account for a baseline set up from Member States date, and propose legally binding targets to reduce food waste across the EU.

The other perspective of EU as concerns the agri-food sector is the **Common Agricultural Policy** (CAP). Its focus falls on quality over quantity. It helps and encourages manufacturers not only to produce, but also to protect the environment and the animals they use during the production.

The new CAP for the period 2021 – 2027 is to be implemented through the adoption and approval of a CAP Strategic Plan per Member State, covering both the Pillar I (direct payments, sectoral interventions) and the Pillar II (rural development). The operating model of the new CAP will focus on:

- maximising the contribution of the CAP to environmental protection and climate change through setting ambitious environmental and climate targets by the CMOs (Common Organisation of Markets);
- establishing a new relationship with the MS (Member States), strengthening the principle of subsidiarity and planning flexibility, while moving from a system based on compliance to one based on "achieving results» and promoting innovation, knowledge and new technologies (e.g. digitalisation) in agriculture.

Moreover, the EU aims to ensure coherence between industrial, environmental, climate and energy policies to create an optimal business environment for sustainable growth, job creation and innovation. To support this, the EU has set an ambitious agenda to turn the EU economy into a cyclical one, where the value of products and materials is maintained for as long as possible, yielding significant economic benefits. The EU also supports European industry in the transition to a climate-neutral economy and improves the energy efficiency of products through **ecodesign legislation** (European Commission, 2021). The areas of action of the EU to achieve sustainability are distinguished (European 10 Commission, 2021): the transition to a circular economy is not only equivalent to adjustments aimed at reducing the negative effects of the linear economy. Instead, it represents a systemic change that creates long-term resilience, business and economic

opportunities, and provides environmental and social benefits (The Concept of a Circular Economy).

With regard to CE, the EU undertakes a series of actions to support the transition to a more COC. These cover the cycle of production and consumption, and the purchase of secondary raw materials. In a COC, the value of products and materials is maintained for as long as possible and the use of waste and resources is minimized. This can contribute to innovation, growth and job creation (European Commission, 2021). On 11 March 2020, the Commission adopted a new action plan for COCs under the new industrial strategy (European Commission, Directorate-General for the Environment, 2020) for a cleaner and more competitive Europe. The plan is based on the success of the previous action plan adopted in 2015 and the conclusions of its implementation report (European Commission, 2021). At the same time, the European industry is moving to a climate-neutral economy, signaling a change in the energy, manufacturing, transport and construction sectors (European Commission, 2021).

Ecodesign and energy labeling legislation is another effective tool for improving the energy efficiency of products. It helps to eliminate the lowest performing products on the market, making a significant contribution to the EU's energy efficiency target for 2020. The energy savings associated with eco-design and energy labeling are estimated at 800 TWh per year by 2020.

Finally, the strategy for a sustainable environment is an integrated approach to an ecologically neutral, smart and resilient surrounding for all EU citizens. It will include (European Commission, 2021):

- Principles of Circular Economy and life cycle approaches;
- Climate, energy and resource efficiency;
- Construction and demolition waste management;
- Accessibility, digitization and skills.

Reference should also be pointed out to the **Farm to Fork Strategy** as an important element of the EU policy framework. In May 2020, the European Commission published a report on the EU's path to 2050 entitled "From farm to fork" outlining the new strategy for a fair, healthy and environmentally friendly food system (EU 2020). In this context, an integrated approach to how

Europeans should assess food sustainability was proposed. It specifies that creating an enabling environment for food that facilitates healthy and sustainable food choices will benefit the health and quality of life of consumers and reduce the social costs to citizens' health. Furthermore, it should be noted that the Covid-19 epidemic has highlighted the close interconnection between public health, ecosystems, supply chains and consumption patterns, highlighting the importance of a resilient food system. According to the European Commission, the strategy:

- will strengthen the efforts to tackle climate change, protect the environment and preserve biodiversity;
- will help to significantly reduce the dependence, risk and use of chemical pesticides, as well as fertilisers and antibiotics. The Commission will identify the measures needed to achieve these reductions on the basis of a dialogue with stakeholders;
- will also contribute to achieving a CE by reducing the environmental impact of the processing sectors and food retailing through measures related to transport, storage, packaging and food waste;
- will stimulate sustainable food consumption and promote affordable food for all. The Commission will help consumers make healthy and sustainable food choices and reduce food waste and explore new ways to provide consumers with better information on details such as where the food comes from, its nutritional value and environmental footprint;
- finally, there are new opportunities for all actors in the food value chain. New technologies and scientific discoveries combined with growing public awareness and demand for sustainable food will bring benefit to all the stakeholders.

3 The business perspectives

3.1 What are the benefits for SMEs circular economy can bring?

The CE is a modern economic model of sustainable development, which, if implemented in a cooperative and participatory way, can enhance social consistency and promote strong regional economies. The potential CE benefits for a company depend on the strategy adopted, the extent to which processes are made cyclical, the environment in which the company operates and, last but not least, its role in the value chain. According to the 2016 EEA study "Circular Economy in

Europe" and "Let's help SMEs to go circular" (KPMG, 2018[2]) the following major benefits are identified:

- reduced use of raw materials, energy and drinking water;
- improved resource security and reduced dependence on imports thanks to the lower demand for raw materials;
- reduced exposure to the rise and volatility of resource prices;
- savings associated with the improved resource efficiency and lower exposure to volatility of raw material prices;
- new opportunities for innovation;
- greening the company profile;
- new business models, markets and growth opportunities.

Some examples of good practices in the domain of CE illustrate the wide range of benefits from its implementation by the businesses:

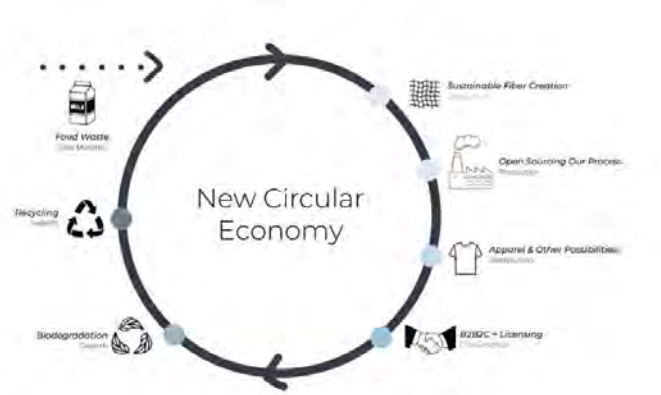
MiTerro

MiTerro is a USA start-up biotechnology company which creates plastic-alternative biomaterials made from agricultural waste. MiTerro's goal is to reduce plastic and food waste using a circular economy model with innovations for upcycling and engineering agricultural waste (milk and other dairy products) to create alternatives to plastic used in food, packaging, and textiles industries.

Addressing the key issues of food waste and plastic packaging waste, MiTerro creates sustainable and durable flexible packaging materials made of milk waste. The company has developed a technology that transforms wasted or spoiled milk into a high-quality textile fibre to be used in clothing and textiles.

[2] KPMG (2018), Let's help SMEs to go circular, The Netherlands. Retrieved on: https://ec.europa.eu/environment/sme/pdf/Training%20materials_English.pdf

On its web site, MiTerra states: "our films are home compostable, ocean degradable, and 3-5 times cheaper than other bio-based materials."



Source: Mi Terro (https://www.miterro.com)

Fungi Futures

Another good example is an enterprise, based in the United Kingdom) and established in 2010. Its develops its innovative product "GroCycle Box" for growing oyster mushrooms at home within 14 days, and is used in urban mushroom farms. The substrate for the mushroom cultivation is produced from espresso coffee grounds collected from local caffes. More than 30 tons of coffee residues have been recycled and 7,000 kg of mushrooms have been produced in four years, with more than 10,000 individual packs distributed.

Source: Fungi Futures (https://grocycle.com)

Ecovative design

An American company producing packaging materials from organics such as mushrooms and agricultural waste. By using these materials, the packaging produced is biodegradable and can thus be returned to soil as a nutrient after use. In addition, minimal energy consumption is required for the manufacturing (the plant part of the mushroom) as the micelle grows within six days.

Source: Ecovative design (https://ecovative.com/)

The benefits, therefore, can be divided into the following groups, based on the direction of their advantages for the SMEs:

- benefits connected with **resource management** – the increasing scarcity of non-renewable natural resources (e.g. fossil fuels, metals and minerals) has resulted in rising resource prices and price volatility, which results in higher material costs for businesses. By adopting circular economy strategies and practices, businesses can reduce the amount of materials needed for their production and meet the needs of their customers. They can also become less sensitive to the import of resources and the variation of their prices;
- benefits connected with the **innovation management** – the circular economy mindset stimulates innovation, it provides a new perspective to examine the business model and operations of a business. Looking at this new perspective the SME can offer new ideas and stimulate innovation. For example, looking for ways to reduce the amount of materials used in construction, the Dutch company BAM invented new building materials from plastic waste. Another perspective of innovation can be the adoption of new business models. The sharing economy through integrated digital platforms such as Airbnb, Uber etc. is an example. In Europe, Airbnb claims to produce around 0-30% less waste, use 50% less water and emit 90% less CO2 than hotels;
- benefits related to the **management of the company image and reputation** - consumers and businesses are increasingly aware of the environmental impact of the products they use. As a result, they are often more attuned to sustainability when making their purchasing decisions. By adopting circular economy strategies and practices, businesses can reduce the environmental costs of their products and thus differentiate and better position themselves on the market compared to their competitors. On the other hand, they can become more attractive for their clients and customers who prefer to trust a green provider. A company could take further advantage from its reputation as a responsible market player with 'circular behaviour', for instance create new green jobs, develop green skills of the employees, ensure better health and safety outcomes of the business for both its employees and the region.

Below follow examples of Greece and Bulgarian SMEs that apply the CE concept into their businesses:

Lavis

The company was founded in 1981 in Greece. It provides services for the holistic management of animal by-products. On a daily basis, animal by-products are processed and upgraded into high-quality products such as bone meal, poultry meal and animal fat. These products are the most important sources of protein for animal diets and are widely used in animal feed industry. They can also be used as raw materials for the production of fertilizers and bioenergy. The animal by-products are supplied by slaughterhouses and markets of the area at an agreed price.

Source: Lavis (https://lavis.gr/)

Cupffee

The Bulgarian Cupffee company produces eadible biodegradable cups for hot and cold beverages, made of natural ingredients only, which are free of GMO, artificial colorant, sweetener and preservatives. The cups are neutral in taste and do not alter the flavour of the drink. The production process is 100% environmentally friendly and does not generate industrial waste – all leftover materials are utilised as ingredients for other edible products. The cups are sold in over 40 states across the 6 continents. The company opened a new production facility in 2021 with a manufacturing capacity of 2.5 million cups per month.

Source: Cupffee (https://cupffee.me)

3.2 Challenges on the way to circular economy implementation by SMEs

There are many obstacles that do not allow small businesses to adopt circular economy business models (Geng and Doberstein, 2008; Ormazabal et al., 2016; Preston, 2012; Ritzén and Sandström, 2017; Rizos et al., 2016). More specifically, they concern:

- organisational culture and management towards environmental issues,
- lack of funds to support sustainable activities and innovation,
- insufficient rate of return to justify the transition to CE,
- lack of adequate state support,
- deficiency of information on the benefits and mechanisms of the CE, which keeps the opportunities hidden,
- lack of information on material flow data and on scientific and technological issues connected with CE,
- high level of bureaucracy in monitoring and reporting on the performance of SMEs in the CE sector,
- low technical capacity to facilitate the transition to new business models involving the application of sustainable production and consumption technologies and

- insufficient support from suppliers and consumers due to their low interest in environmental issues or lack of pre-extisting relations.

It's also important to mention that some resource efficiency gains can be achieved by maximizing synergies and coordinating materials and supply chains between multiple actors – but fixed old habits and lack of network connectivity can inhibit identification of such opportunities.

Another issue is linked to the absence of adequate public policy in the field, e.g. manufacturers do not have the incentive to design products amenable to recycling or remanufacturing, because they are not exposed to the costs of waste disposal. Even though resource-efficient behaviour contributes to the larger benefits for society and the environment by reducing pollution and resource depletion, if such impacts do not have a financial price, then resource efficiency models may not financially justifiable for the private actor.

Another dimension of the same problem are the procurement rules and taxes (or other financial instruments), which can be tailored to encourage CE transition. There are many mechanisms that can be applied by the public authorities for this purpose. For example, Sweden has tax rules that incentivise repair and longer product life spans, thereby reducing the number of new products. The German state of Baden-Württemberg promotes car-sharing by allocating a number of parking spaces to car-share vehicles instead of private cars.

If the cost of labour is too high in relation to the cost of materials, this can also mean that resource-efficient choices are not financially viable to individual companies. Risk perception associated with long-term investments in new and innovative resource-efficient processes and technologies may not make sense in the short term, provided that the status quo of the current economic structures remains in place.

There are also specific scenarios related to specific challenges for CE implementation:

- in certain cases (sharing economy, remanufacturing, etc.), manufacturers risk to undermine their own product sales, and consequently the profits of their production plants;
- manufacturers also need to establish a reverse logistics system for collecting products at the end of a service agreement, otherwise reuse, repair or remanufacture are not feasible.

In a nutshell, CE is a work-in-progress that is linked with framework conditions, incentives, market information, etc. All necessary elements need to be at hand to enable the transition to CE.

The challenges for CE implementation by SME businesses in **Greece and Bulgaria** do not significantly vary from the ones discussed above. There are, however, some regional specifics.

In order to implement CE practices in Greece:

- legislative and other interventions, structural changes and redesign of value chains are needed;
- changes may be required in production processes (extraction of raw materials, product and material design), handling and consumption, as well as new ways of treatment are needed for the waste generated, in order to enable its reuse as secondary raw materials;
- changes in cooperation models may also be a requirement as the CE relies exclusively on the interconnection of processes and networking between stakeholders and businesses.

For the moment, the concept of CE in the agricultural sector of Greece refers mainly to the management of biomass, aiming at the manufacture of products that serve different purposes, such as soil amendments, animal feed, export of organic and inorganic compounds, production of biofuels and energy, packaging materials, etc. An estimation of 7,500,000 tons of agricultural crop residues and 2,700,000 tons of forest residues are produced annually.

Here is an example from Greece that illustrates how CE concept can transform an agri-food enterprise into a both green and successful company for its own and society's benefit.

Tsakiris Family

The company is established in Greece and is specializing in the production of eggs. It owns 12 poultry farms with a production exceeding 4 million eggs per month and an egg pasteurizer. Additionally, the company owns and manages the fields of the grains that are fed to the hens.

Tsakiris Family has adopted practices based on circular economy principles. First of all, spoiled and expired eggs that cannot be sold go under pasteurization and are then sold to industries that process them into other useful products.

Secondly, the waste from the hens is forwarded to a biogas plant that produces electricity as its final product. The organic residue of the process is used as fertilizer in the grain fields.

This way the company transforms towards zero-waste and minimizes the burdens on the environment, setting an example of how livestock residues can be utilized to generate useful products such as energy and fertilizers.

Source: Tsakiris Family (https://www.tsakirisfamily.gr/el/)

As concerns Bulgaria, although the linear economic model has already been exhausted, the transition to a CE in the country is slow. The following are among the main obstacles:

- insufficient awareness about the CE among the farm owners and food plants owners, managers and entrepreneurs;
- reluctance or fear of the new, the unknown, and desire to stay on a safe side;
- insufficient resources for technological innovation and implementation of new, environmentally friendly and resource-saving technologies;
- insufficient motivation;
- lack of qualified employees.

The existing infrastructure and the present business models and technologies, together with the established behavior, keep the economy "attached" to the linear model. Furthermore, the local financial system often fails to provide investment in innovative and more complex business models, which deters many traditional investors. The low degree and limited scope of the environmental transformation in Bulgaria on the other hand, is related to the lack of a clearly defined macroeconomic framework to promote investment in new technologies focused on sustainability and energy efficiency.

Here is an example to prove that adequate corporate culture facilitates the implementation of CE principles by companies even if the state support is not sufficient.

Bio Way

The company has developed a business model for production of Shiitake mushrooms in Bulgarian rural regions by setting up of bio-farms, owned by individuals and/or legal entities and following identical standards. The first farm started working in the spring of 2014 and others followed afterwards.

The mushrooms are grown on oak logs in accordance with the organic farming principles (and alternatively to the so called "synthetic logs" where the mushrooms are grown on a bag of substrate). The purpose is to provide the mushrooms with conditions for development and growth that are similar as much as possible to those in their natural environment. In this way the farmers succeed to offer environmentally friendly and healthy food growing their mushrooms throughout the year. Their mushrooms have better taste and quality and their valuable elements are much more if compared to the "synthetic logs".

Bio Way invests environment-wise in its packages as well. On the one hand, the plates, in which the fresh mushrooms are offered, are based on wood veneer to preserve the flavor and integrity of the product. On the other hand, dryed mushrooms are also offered, packed in fully recyclable cardboard boxes. The other products under the brand – blanched or marinated mushrooms (with goji berry or garlic) are offered in reusable jars.

Source: Bio Way (https://www.bioway.bg/en/)

3.3 Circular economy business models and strategies for SMEs

Circular Economy Business Models[3] (CBM) are business models that put CE principles into practice. Every dimension of economic activity is concerned: business-to-business (B2B), business-to-consumer (B2C) and consumer-to-consumer (C2C). CBMs offer new opportunities for companies and transform the relation between producers and consumers. CBM can come in different forms. Some of the main approaches include:

- industrial symbiosis - B2B systems approach for a more integrated industrial system that identifies business opportunities to optimise industrial processes and to uptake underutilised resources (such as materials, energy, water, capacity, expertise, assets, or other by-products, etc.). This often involves finding innovative solutions that capture and exploit hitherto untapped synergies. Simple examples include the use of food waste from the catering sector to feed farm animals, or the use of non-toxic industrial waste to produce energy through incineration. Industrial symbiosis seeks to maintain the highest (reuse) value of materials and products;
- sharing economy (collaborative economy) – it is rapidly emerging across Europe being a new way of marketing and using products and services, commonly achieved through online platforms. Transactions usually involve three parties: the product/service provider, the online platform and the customer. It covers a great variety of sectors, from sharing houses and domestic services to car journeys or power tools – and it often encompasses the development of new business models;
- circular/sustainable design – it is also gaining ground in Europe and beyond. Design is central if products are to be resource efficient, long-lasting, easily repairable and recyclable. For example, the UK Centre for Sustainable Design is an active promoter of the concept. The UK Agency of Design has developed a Circular Economy Design Tool offering a good basis for exploring circular economy design opportunities. The agency developed a product – the Optimist Toaster – which embodies circular economy ideas such as

[3] Putting theory into Practice: Circular Economy Business Models in the EU, A Policy Brief from the Policy Learning Platform, March 2019, https://www.interregeurope.eu/sites/default/files/2021-12/Policy%20brief%20on%20circular%20economy%20business%20models%20in%20the%20EU.pdf

prolonging the life of the product; choosing an easily recyclable material – aluminum; and using very few parts that can break.

Other CBM include reverse logistics, which refers to managing the return flows of materials in a CE and mainly driven by Extended Producer Responsibility (EPR) and remanufacturing in which a used product is brought to at least the quality level of a new product through a process consisting of, for example: dismantling, cleaning, testing, processing and remounting of collected used parts.

As far as the EC priorities in the field refer to three basic areas, we will also set them as focus here as possible dimensions of SMEs' CE **strategies**: climate, energy and resource efficiency; construction and demolition waste management; accessibility, digitalization and skills, although it is sometimes hard to make strict differentiations among them.

➢ **Climate, energy and resource efficiency** – as far as the CE concept is based on the understanding that the natural resources are limited, the SMEs willing to implement this concept into their activities have to invest efforts in aspects such as: optimization of use of existing resources, resource savings, reuse of resources, use of recyclable and renewable resources, use of resources with minimal amount of residual waste. This is connected with the resources that are both contained in the product and used in the manufacturing process, e.g. energy and water, which are not so sector/sub-sector specific as raw materials.

During the course of the study carried out within the project AGROFFICIENCY, Greek and Bulgarian companies were asked about their attitudes in this regard and more specifically about the CE measures they are implementing or interested/aiming to implement as concerns to water and energy resources. Very few companies implement measures for **energy** recovery from waste (4,2% and 0% of the respondents respectively from Greece and Bulgaria) and the ones that are interested in implementing such measures are also not that many (one third of the Greek respondents and 24% of the Bulgarian SMEs).

Regarding biofuels, the percentage of Greek companies already using them is the same with the ones recovering energy from waste, while Bulgarian enterprises are more active with about 10% users of biofuels. Regarding the interest to implement measures connected with the use of biofuels in their activities in the future, it is higher than the one for energy recovery from waste (with 36% of the Greek respondents and 43% of the Bulgarian ones being interested).

The SMEs have also been asked about their attitude to the use of other renewable energy sources or energy recovery, where they showed a higher activity, with 5,6% of the Greek companies and about 24% of the Bulgarian ones already implementing such measures and 50% of the Greek companies and 53% of the Bulgarian ones interested to implement such measures.

Regarding energy consumption monitoring, almost 24% and 8% of the Greek and Bulgarian companies respectively implement such measures, and 44% of the Greek enterprises against 63% of their Bulgarian colleagues declared interest in the implementation of such measures. The situation with the monitoring of emissions is less optimistic with 7% and 0% respectively of the Greek and Bulgarian respondents implementing such measures, and with 40% of the Greek companies against 12% of the Bulgarian enterprises having an interest to adopt such measures.

There are few examples by Greek and Bulgarian businesses to illustrate some good practices in this regard:

Biogas Lagada

The company produces biogas through anaerobic digestion of waste from livestock and agriculture farms in a private facility in Greece. The organic waste is collected from local farms for free, transported in the facility and digested on-site. The produced biogas is utilized in a Combined Heat and Power unit. The generated electricity is provided to the national grid under an agreed cost per kWh, while the generated thermal energy covers the needs of the facility. The digestate is composted into soil amendment. The compost is mainly used by the owners of the facility who also own livestock farms and farmlands as well as in local farmlands. The facility processes annually 80,000 t of waste, including liquid cow, poultry and pork manure, cheese whey and olive mill by-products. The facility annually generates 8,400 MWh_{el}, enough to cover the needs of 1,500 households and 7,5000 t of organic fertilizer enough to nourish 500 ha of cultivation. This practice is an example of how bio-waste can be disposed sustainably, while minimizing the local CO_2 impact by an estimated 494,700 kg per year.

Source: Biogas Lagada (http://www.biogaslagada.gr/)

Revive

The company, established in Greece, collects, processes and offers used cooking oils for industrial use, i.e. in the production of biofuels and bio-lubricants in an environmentally sound way and in accordance with the EU legislation. The enterprise is staffed by engineers and technicians specialized in biofuels and bio-lubricants technology. The produced biodiesel offers increased lubrication and is environmentally friendly as it is biodegradable, non-toxic, contains almost zero sulfur, leads to reduced soot emissions and reduced carbon dioxide emissions resulting in mitigation of the greenhouse effect. Emissions of biodiesel are 40-50% lower than those of diesel except for nitrogen oxides. At the same time, with this kind of management of used cooking oils, the amount of fossil fuels and lubricants that the country imports is reduced, contributing to the energy balance and saving fossil resources. Moreover, the pollution of water is prevented.

Source: Revive (https://www.revive.gr/)

Versol

The Bulgarian enterprise grows a wide range of bio fruits and vegetables throughout the year. The purpose of its owners is to build an autonomous biodynamic farm that is less dependent on external factors. The enterprise produces most of the compounds used to treat the plants. It also generates the energy necessary for sustaining the farm in terms of electricity and heat by the use of solar energy. In addition, it collects rainwater for the irrigation needs thus using the available natural resources in more efficient manner. The waste products from the farm are composted or used for animal feed.

The enterprise also developed the concept of shared responsibility (based on the Community Supported Agriculture concept) to face the increasing demand for healthy farm food while offering fair prices and sharing relevant risks with consumer in a win-win scenario through customized delivery and subscriptions. The shared responsibility has 4 levels of consumer involvement:

- the consumers purchase the farm products in a conventional manner through intermidiaries like online trading platforms, organic stores, hypermarkets, etc.

- the consumers purchase selected products from the farmer via the so-called "Family basket" option – the farmer can sell maximum amount of various seasonal and available products without wasting production, while the customer saves 5-10% of the food price;

- the consumers purchase selected seasonal products within the "Family basket" service based on a long-term subscription and a delivery to the farmer's point – the farmer can plan its production for a maximum efficiency, while the delivery to the point helps save time for good farming practices. The consumers pay subscriptions in advance which is the highest level of shared responsibility where consumers share the risks and benefits of farming. In this way they become part of the farming methods and the farmer's efforts, re-connect with nature and get more sustainable consumption habits.

Source: Versol (https://www.versol.bg)

As concerns **water** consumption, few companies use rainwater in their activity, with significant prevalence of the Greek respondents (with about 14%) against their Bulgarian colleagues (with a 0%). What is more problematic, however, is that very few of the respondents show interest to implement such measures (21% of the Greek companies and none of their Bulgarian colleagues).

The situation regarding the cascade use of water (i.e., direct use of untreated wastewater in a manner that is safe) is not very different - only about 7% of the Greek respondents implement such measures with none of their Bulgarian colleagues doing so. As concerns the companies' interest in this direction, the situation is a bit more optimistic with 24% of the Greek companies against 35% of Bulgarian enterprises.

The SMEs have also been asked about their attitude to internal recirculation of water. Only 4% of the Greek respondents and none of their Bulgarian colleagues implement such measures, and 36% of the Greek companies have an interest in this direction against 22% of Bulgarian enterprises.

The other dimension of the water issue refers to the use of seawater or other non-potable water in the corporate activity, where the situation is even less optimistic – none of the Greek companies and only 2% of the Bulgarian ones implement such measures. Furthermore, 22% of the Greek respondents and 14% of their Bulgarian colleagues are interested in implementing such measures.

The Project is co-funded by the European Regional Development Fund (ERDF) and by national funds of the countries participating in the Interreg V-A "Greece-Bulgaria 2014-2020" Cooperation Programme.

Yet, there are examples from the two countries to show that there are good practices at hand and that they can successfully be followed by other companies in the sector as well.

Bizios Dairy

The company specializes in the production of cheese products. The factory is located in Greece. It has a daily capacity of processing 120,000 kg of milk. Recently, the factory proceeded to the construction of an anaerobic bioreactor unit that is able to process 565 m^3 of liquid waste that is produced on a daily basis and has a high COD charge. The bioreactor uses an innovative technology of membranes for the generation of 5,176 Nm^3 of biogas, with an electricity generation potential of 1.28 MW. The unit achieves waste decontamination of over 99%, allowing the direct disposal of the wastewater to a recipient for the purpose of irrigation. It is important to point out that by this approach the biological treatment of the liquid waste can be omitted, reducing dramatically the management and operating costs of the company.

Source: Energyindustry https://energy-industry.gr/πρότυπο-έργο-επεξεργασίας-αποβλήτων/

Atlas Agro Science

The Bulgarian company has created a 100% organic liquid plant stimulant based on seasoned anaerobically processed sediments from waste water treatment plants. The product can be used in agrarian business, including organic farming, in pastures, aquaponics and vertical farming, landscape design and floriculture. It can successfully reduce the need for costly mineral fertilisers, contribute to soil restoration, strengthen plant immunity and resistance to stress factors as well as increase crop's volume and quality. The company is intellectual property aware and took measures to protect its product via different mechanisms.

The production of the bio fertilizer started in 2020 and the main benefits for the company's clients include: ecologically clean production, competitive price, produce increase, restoration of soil micro flora and no need of additional fertilizers. The product can be used throughout the year and for a wide variety of cultures – corns, oil crops, vegetables, essential oil plants, perennials, grasses and decorative bushes and flowers, without a risk of overdosing or residual

toxic effect on the plants or soils. The interest by the by farmers to the bio stimulant is high and many of them already acknowledged its benefits on their test fields.

Source: Atlas Agro Science (https://atlasagro.eu)

➢ **Construction and demolition waste management –** having in mind the limited natural resources, one of the focuses of the CE falls on the utilization of waste. Therefore, one of the possible approaches of ambitious SMEs to become circular is to concentrate efforts on addressing waste issues: prevention of waste, re-use of products, recycling, composting, use of the waste for further exploitation (feed, fertilizers, generation of energy, etc.). It is even more important for the SMEs from the agri-food sector as far as a big amount of waste is connected with it - around 88 million tons of food are wasted annually in the EU at an estimated cost of €143 billion (KPMG, 2018). And although 50% of the food waste generated in the EU occurs at household level, the agri-food sector is still responsible for a serious amount of it with 19% of the food waste coming from the production of food.

In Greece, the distribution of food waste production is considered to be similar, but there is no precise data to prove it. There are no official statistics yet on the food loss for Bulgaria as well, but the situation is not very different - according to a study by the European commission, 670 000 tons of food is produced annually in Bulgaria in excess, a third of more than necessary to feed the entire population. Therefore, the adoption of CE models by the SMEs in the sector provides the opportunity to generate new business models and economic benefits.

The study held within the project AGROFFICIENCY asked the Greek and Bulgarian companies about the types of waste they generate. The results show that there is a serious potential for greening of businesses as the main percentage of companies have recyclable waste - about 78% of the Greek enterprises and 75% of the Bulgarian ones. Moreover, some of them already implement measures in this regard. 75% of the Greek companies have measures for waste recycling (either of packaging or other sources of waste) and 8% are interested to implement such measures. As concerns to their Bulgarian colleagues, the situation is less optimistic – about 10% have such measures and 25% are interested in relevant implementation.

The other perspective of the issue - the repurpose of waste (i.e. use of waste to produce another product) demonstrates a higher and unused potential for improvement. 15% of the Greek

enterprises have measures in this regard and 28% are interested to implement such ones. The potential before their Bulgarian colleagues is even higher with 8% of them implementing such measures and 31% having interest in this direction. The situation with the reused and recycle inputs is similar – 31% of the Greek companies have such measures and 43% are interested with their implementation compared to the 6% of Bulgarian enterprises with such measures and 39% with an interested in this regard, which is the highest field of interest for them.

Here are some examples to illustrate how SMEs can benefit from waste.

Kyklopas oil mill

Kyklopas is a family-owned olive mill, situated in Greece. The family owns 12,000 olive trees and 2,000 organically cultivated trees of the local Makri olive variety. They produce Kyklopas Extra Virgin Olive Oil, one of the most awarded Greek olive oils. Since 2004, the company applies sustainable management on every phase of the production.

On a daily basis, after oil extraction, the liquid waste is transferred to a biogas plant where electrical and thermal energy are produced. The residues of this process are then returned to the cultivation as fertilizer, after pasteurization. Part of the fallen leaves are used by animal breeders of the area as animal food. The rest of the leaves and pruned branches are used to make compost which is then returned to the olive groves. The olive kernels are partly turned into kernel oil and the rest are used for the heating of the oil mill. Finally, all the packaging is made of recyclable materials.

The benefits of these actions are both quantitative, as a result of fertilizer and energy saving and qualitive, as the products are free of chemical substances.

Source: Kyklopas Estates (https://kyklopas.com/)

ELDIA

ELDIA is a waste management and recycling industry established in Greece. The company provides solutions for issues concerning solid waste management and disposal of industrial

and commercial enterprises, local government and organizations of the public sector. The offered solutions are based on the principles of circular economy.

In particular, expired animal and plant-based food from food industries, wholesale and retail markets are firstly divided into two fractions: an organic fraction and mixed packaging materials. The organic fraction is then driven to bioreactors for the production of biogas, while the packaging materials after sorting are forwarded to recycling. The company converts used pallets and pruning residues into an alternative fuel source (i.e. biomass), utilizing special equipment such as crushers and sieves.

Through these actions, ELDIA aims to: reduce the volume of food waste ending up at landfills as an answer to the continuously increasing production of waste, maximize the utilization of materials deriving from waste sorting and use recyclable materials with significant financial gains for enterprises. ELDIA, in order to address these issues uses the latest methods and technologies.

Source: ELDIA (https://eldia.gr/)

Harmonica

The story of Harmonica began in 2006, when three friends started working with the first organic cow farms in Bulgaria. The concept for organic farming in the country was completely unknown at that time and public support for such an endeavor was non-existent. Harmonica started with organic yogurt, which became a successful product. The founders perceive agriculture and food production at the epicenter of the critical environmental problems faced by recent generations – loss of biodiversity, climate change, and pollution. Harmonica's team thus has the mission to contribute with solutions to those problems by its products and food production methods.

Harmonica's first circular economy project is to use bread from the shops, which is difficult to sell such as stale bread that would otherwise be thrown away as unusable. The company buys that stale bread and turns it into "liquid bread" – a craft beer, which is sold in 3 options: light ale, dark ale and wheat beer. "Out of nothing – something" is Harmonica's initiative for wholesome and quality food, made from "waste". 20% of all wheat in it is from bread, which

is used before it becomes unnecessary – as part of the initiative "Out of nothing – something" for wholesome and quality food made from "future waste". The company wants to find alternatives to re-use edible food with a short shelf life and bread is a daily example. Thus, instead of losing already produced food, they searched and found a way to give new life to several hundred kilograms of unsold bread in Sofia. Up next, the team will focus on using waste from the vegetable stock exchanges and by all other production places that they can discover and organize in an initiative for clean, tasty and quality food.

Source: Harmonica (https://harmonica.bg)

The field with the highest potential for the Greek enterprises, however, is the use of regenerative inputs (produced in ways to have a positive impact to nature) – 4% of companies have such measures and 46% have a relevant interest. As concerns to their Bulgarian colleagues, 2% have measures in this regard and 29% have such future interest. The use of upcycled inputs (from by-products that would have otherwise been wasted) is another direction of possible improvement. About 14% of the Greek companies have measures in this regard and 28% have such interests. As concerns the Bulgarian companies, the situation is not very different from the one connected with the regenerative inputs - 2% have measures in this regard and 27% have interest for future actions.

Another aspect of the same issue is the use of biofertilizers for production, which also showcases unused potential. About 7% of the Greek companies have such a practice, while 35% are interested to implement it in the future. Regarding Bulgarian enterprises, in contrast with their colleagues 33% already use biofertilizers while 6% more have an interest in them.

These results are most probably due to the lack of strategic approach to the waste management for most of the companies – the study also showed that the companies with a waste management plan are fewer. 18% of the Greek entrepreneurs have such a plan and 53% have an interest in this direction. The perspective of Bulgarian businesses is similar although at lower level – about 4% of them have such a plan and 25% have an interest in plan implementation.

There are some more examples showing the potential of waste utilization.

EVYP

EVYP is a Greek company in Thessaloniki that specializes in the production of fertilizers derived from the hydrolysis/extraction of exclusively plant origin non-GMO raw materials. The plants are hydrolyzed to extract L-amino acids and the final product is a highly concentrated liquid organic fertilizer. The product is unique because of high concentration of 16 L-amino acids of plant origin and is suitable for organic farming. The produced bio-stimulator and plant nutrition product, can be combined with all fertilizers and plant protection products and L-amino acids are directly absorbed by plants as the balanced correlation of L-amino acids is identical to plant's physiology.

But most importantly the product is environmentally friendly, self-decomposed, leaving no residue. The company in charge is Greek Industry of Hydrolyzed Protein LLP and the project has been developed in cooperation with Aristotle University of Thessaloniki. The raw materials come from farming residues (harvest, pruning) and vegetable residues (e.g. peas, green beans), gristmills residues, etc. of neighboring facilities and farmlands, introducing circular economy practices in the area. The final beneficiaries are citizens and farmers purchasing the product to use it for organic farming.

The product has been granted a European Patent in 2011 due to the innovative composition and production method. Also, 10% of annual revenue is invested in research. Its development in collaboration with the Aristotle University of Thessaloniki shows how private and public sector collaboration may lead to innovation.

Source: Kontogianni S., Malamakis S., Boemi S.N., Kiskini C., Moussiopoulos N., Good Practices for Biological Streams in Central Macedonia Region, BIOREGIO PROJECT, 2018.

BIO2CHP

The BIO2CHP unit is a power generator, at the size of a container, which converts organic residues into electric energy and heat. The energy production is accomplished by the combination of two technologies, gasification and gas engines, through an automated control system. Feedstocks that can be processed are solid agricultural residues, food industry residues, sewage sludge, etc.

A working pilot has been successfully developed using grape pomace, peach kernels, olive kernels and almond shells. The unit allows small and medium industries in the agro-food sector to dispose their waste sustainably and generate energy for the needs of their facility at a price 3-4 times lower than the national grid. The 25 kW_{el} unit produces on a yearly basis 187,500 kWh electrical & 502,500 kWh thermal energy, consuming a total of 187.5 t of solid organic residues. The system transforms waste into a valuable commodity for the on-site heat and power generation, minimizing both energy and waste handling costs. It is estimated that for every 20 kW_{el} unit approximately 62 t of CO_2eq are saved per year, equivalent to the electrification of 9 households. BIO2CHP shows how decentralized, bio-based circular economy can be achieved for small and medium-sized enterprises.

Source: BIO2CHP (http://www.bio2chp.com/)

Utilization of renewable waste from agriculture for the improvement of soil quality

The Institute of General and Inorganic Chemistry (IGIC) of the Bulgarian Academy of Sciences recently has focused on the challenge of transforming renewable wastes into value-added products within the circular economy paradigm, namely transformation of some agricultural wastes, such as rice, sunflower and einkorn husks, into soil amendment composite. The production of those species is a traditional sector in Bulgarian agriculture and is directly linked to the accumulation of big amounts of waste – more than 14 000 tons per year for the rice, over 515 000 tons for the sunflower and about 630 tons for the einkorn. These types of waste are by their nature unusable for the agriculture and livestock sectors so far, thus creating economic pressure on the producers as well as on the environment. Yet, from chemical point of view they have properties, which render them suitable for various purposes. The husks contain valuable ingredients for the plants such as carbon and silicon as well as some basic and micronutrient elements.

IGIC's team, together with their colleagues from the Institute of Soil Science, Agrotechnologies and Plant Protection "Nikola Poushkarov" of the Agricultural Academy, and with the financial support from the Bulgarian government developed and validated a complex technology for processing the husks. By thermochemical processes the husk is converted into various valuable products, incl. bio-fertilizers. In addition, on the basis of rice and einkorn husks processing bio

fuel could likewise be produced. The field tests made by the academic institutions proved that this bio-fertilizer improved the soil structural characteristics along with its water and nutritional reserves. The technological equipment is simple and inexpensive and allows for building small installations in the regions where the production and processing of the relevant cultures is concentrated.

The next steps for the researchers were to find farming partners to test the solution in real agricultural conditions and later on – to start using it in their regular activity. They deployed a mix of promotion channels for networking and outreach, amongst which publications in relevant data bases and editions, participation in suitable events, etc. As result the developers found a partner matching the profile sought – the Trakeya Ltd. company, a manufacturer of food supplements, producing also one of the main raw materials in its portfolio – einkorn. The company had previous track record of collaborating with the Bulgarian Academy of Sciences and the Agricultural Academy and hence further extending that collaboration was a good opportunity for all the parties involved.

Part of the einkorn fields of the company was used as a testbed and treated with the bio-fertilizer to validate its effect in real environment. The results of those tests are positive and might indicate further potential – higher activity is observed at each stage of the plants' development in the fields treated with the bio-fertilizer compared to the non-treated ones. Therefore, the developers are ready for the next stage of the innovation development – the commercialization of the solution and its consequential industrial application at both national and international levels.

A further step in this regard was the participation of the team in the "Science for Business" Innovation Forum in May 2022, organized by the Bulgarian Academy of Sciences and the Bulgarian Small and Medium Enterprises Promotion Agency with the support of the Ministry of Innovation and Growth, the Ministry of Education and Science, the Enterprise Europe Network at the Joint Innovation Center of the Bulgarian Academy of Sciences and the European Researchers' Night (K-TRIO). The event took place in John Atanassov Innovation Forum of Sofia Tech Park where besides the forum it also had an exhibition zone. Both the forum and the exhibition promoted series of new solutions and R&D results by the Bulgarian Academy of Sciences that were ready for commercialization and transformation into business success.

Source: Presentation by Assoc. Prof. Ivan Uzunov at the "Science for Business Forum", 19 May 2022, Sofia, and additional information provided by the scientific team for the purpose of this guide following a request by its developers (see the sources in the reference list at the end of the document).

➢ **Accessibility, digitalization and skills** – digital solutions can facilitate the transition to CE through adoption of new business models. Therefore, digitalization processes can support the access to new markets and open up new opportunities for SMEs to grow their business. Digital technologies can also facilitate product sharing/leasing as well as the monitoring of the state of products in order to optimize their maintenance and extend their lifetime. Horizontal aspect of this third focus of CE strategy is the dissemination of knowledge and innovation for the modernization of the agri-food sector.

Digital solutions that can be of help for the agri-food industry range from sensors, robots, communication tools, blockchain to computational decision and analytical tools and cloud-based technologies. More advanced tools are digital, mobile, internet of things (IOT), and cognitive technologies. Such solutions can lead to higher productivity, better resource efficiency and lower negative impact on the environment. They can help agri-food SMEs and mostly those specialized in agriculture to improve their risk management and access to markets thus allowing for the design of shorter value chains and minimized food losses.

Digital tools can be used by agri-food SMEs to improve traceability of their production and ensure value chain transparency with the corresponding impact on food safety. Digital solutions of more general nature such as smart financial technologies (e.g. payment and insurance products) can also be of great benefit for the SMEs in the sector. Another aspect of digitalization is connected with information generation and data processing at aggregate level for the agri-food sector. Digital technologies can also lead to better working conditions with the corresponding impact on productivity. Those are few, but not all potential benefits which digitalization can offer to agri-food enterprises. There are various opportunities and future innovations to come by having in mind the rapid ICT development and the creativity of both developers and users, who are looking for the right solutions for their activity.

Here are some examples that demonstrate the benefits of the digitalizated agri-food sector.

Smart Specialisation Platforms

In the Region of Central Macedonia (RCM), Greece agri-food is the thriving sector of Research and Innovation Strategies for Smart Specialisation (RIS3). RIS3 is an economic transformation agenda for agri-food and industrial modernization of EU regions and member states.

RCM supports networking and collaboration between academic and research institutes with businesses so as new knowledge can be transferred in the food industry and bio-based sectors. The main goal is to empower food entrepreneurship and innovation, foster interregional collaboration between a diversity of partners and strengthen competitiveness of industries in order to better respond to emerging consumer demands.

RCM is actively involved in three platforms and is currently developing a new one. The three existing platforms are: High tech farming, Nutritional ingredients, and Traceability and big Data and the one that is being developed focuses on Personalized Nutrition. Furthermore, RCM is an active member at the European Region for Innovation in Agriculture, Food and Forestry (ERIAFF). The initiative of the RCM to participate at S3Platforms and establish a new bio-economy network has proven to successfully maximize the exploitation of the research and innovation potential available in the region.

Source: RIS3 One Stop Liaison Office (https://www.ris3rcm.eu/)

Ondo Solutions

The Bulgarian company, created in 2020, developed a farm automation platform – a smart solution for automated management of agriculture allowing for precision in irrigation, fertilization, climate control and monitoring of the crops. It targets the efficiency, labor shortage and predictability issues of farmers and ensures sustainable agricultural production and profitability of the agricultural businesses in the long run.

The solution consists of a hardware installed in the farm and an integrated specialized software with remote control and user-friendly interface. Farmers can create their own irrigation and fertigation patterns and schedules and define their target temperature and humidity levels for the greenhouses only. The system then takes over the management and control of the

connected infrastructure so that the schedules get executed and the targets are met. Alarms are switched on in case of infrastructure malfunctions or other unexpected issues. It has functionalities for fertigation, irrigation (with or without fertigation) and climate control (for greenhouses only).

The economic benefits of the solution are visible from the first harvest – the farmers can save money on water, fuel, fertilizers, they can also reduce human errors. All this can lead to higher crop and financial results. More specifically, the technology can lead to: up to 85% less water usage thanks to precise water management and control; up to 50% less use of energy as a result of optimized and reduced use of electricity, diesel, gas and other fuels; up to 40% increase in crop yield whilst reducing the cost of fertilization and chemical treatment; up to 60% reduction of losses resulting from human factors. The numbers specified may vary depending on the farm equipment, crop, location, size, etc.

The advantages of the solution are: opportunity for integration with existing farming infrastructure, intuitive interface that any farmer can instantly use, package pricing that makes it suitable for small and mid-sized farmers, 24/7 support with guaranteed response times in emergency situations and easy and fast remote updates of the software.

The company has its systems installed and operational with clients in different regions in Bulgaria, and in Greece and North Macedonia as well. It also opened a representation office in South Africa. A few customers already completed a full crop cycle with the product and shared the results they achieved. The last are presented in detail in the published client case studies (with others forthcoming) – Greenhouses Nikol Agro (tomatoes, salad, lettuce, etc.), Greenhouse complex "Roseland" (roses, tomatoes, cucumbers, peppers), Greenhouse complex "Marjan-Mid", North Macedonia (tomatoes, peppers, eggplant, etc.), Berry farm "Otbrani" (raspberries, strawberries, blueberries, blackberries), Greenhouses Lazov (tomatoes), Greenhouse complex Angel Metlarov (berries, peppers, cucumbers, eggplant, etc.), Biodynamic farm Versol (potatoes, tomatoes, pepper, kale, eggplant, cucumbers, spinach, inca berry, alabash, etc.), Distillery Isperih (cornel cherry), Mountain farm "Uchitelski" (tomatoes, cucumbers, salads, etc.), Moschos Farm, Greece (alfalfa, corn), Orchard garden ARSI Fruit and another, very small farm (orchard trees, vineyards, berries).

Source: Ondo Solutions (https://ondo.io)

The use of digital technologies in the agri-food sector, however, requires different prerequisites and is not necessarily a straightforward process. On one hand, good relations with the ICT industry and academic community can help a lot for the development, adoption and/or efficient utilization of such solutions. On the other hand, the agri-food SMEs have to invest in such technologies, which can be financially burdensome for them and therefore can require from their management both cost-benefit analysis and search of funding sources together with budgetary solutions that are relevant to the needs. Moreover, digital knowledge and skills are also necessary for the efficient use of digital solutions and farmers do not necessarily possess such capacities in a sufficient extent. Intensive training is sometimes required in order to transform agri-food professionals into effective users of easy-to-work solutions that are adapted to the needs of the SME and local conditions, incl. the existing infrastructure.

Another aspect when talking about digitalization in the agri-food sector is related to risks associated with the digitalization process that must be managed accordingly in order to achieve the efficiency goals. Digitalization may lead to changes in human labour profile by the ICT technologies that usually concerns the less qualified workers that can be replaced by more qualified employees. This can create tension in the human resource management both from social and economic perspective by the need to recruit skilled workers with an affordable wages. Therefore, the issue must be addressed accordingly and with the necessary attention.

Another risk reflects the issue that although digitalization may lead to savings in the use of some resources, e.g. water and fertilizers, it can also create needs of new streams of resource, e.g. more energy for the utilization of those technologies and for the storage of relevant data. Moreover, it is quite possible that additional and/or different waste can be generated related to electronics or digital materials that can have negative environmental impact. Having in mind this risk, it's necessary to develop a preliminary analysis if in the specific case such one is at hand and if so – to appreciate if the potential negative effect from the integration of the digital solution would be lower than the negative effect of the problem it solves. Only if so, a decision for the adoption of the specific technology must be taken. If not, a solution must be sought for the neutralization or minimization of this negative effect in order to introduce the technology with the expected positive results for the activity of the agri-food SME.

The Project is co-funded by the European Regional Development Fund (ERDF) and by national funds of the countries participating in the Interreg V-A "Greece-Bulgaria 2014-2020" Cooperation Programme.

Some further examples can showcase the potential of digitalization in the agri-food sector where benefits prevail over some negative effects.

Pro Drone Sys

The Bulgarian company provides innovative products and custom-tailored solutions for the precision farming domain, also known as site specific crop management. Such solutions can help agricultural companies to decrease their input, increase their yield and keep the land in a good condition. In order to achieve this purpose, the enterprise developed a multispectral aerial camera that can be attached to a specially designed unmanned drone for soil analysis and vegetation measurement, for provision of digitalized agronomic recommendations and for the development of topographic/watershed maps.

The services offered by the company are: soil multispectral imaging using drone, soil sampling and chemical analysis, measurement of plant vegetation using drone, leaf sampling and chemical analysis, export variable rate application prescription map for nitrogen fertilization, export variable rate application prescription map for pre-sowing fertilization, export variable rate application prescription map for seeding, inspection of agricultural operations, data analysis with geographic information system and farm management planning.

Along with services, the company also offers for sale the technological solutions behind them: hexacopter (6 rotor drone) and camera for aerial photogrammetry. Apart form the direct use for the purposes of farming, the technologies can also be used in other directions – for damage evaluation (of damages from natural disasters and ones caused by boars), for the needs of mining sector and for orthophotoes.

Source: Pro Drone Sys (http://prodroneagro.com)

Production processes automation and robotization for an individualized molding of products for hydroponic growing of vegetables and flowers (AvroHip)

The Bulgarian company Chemical Products Ltd. was established in 1997 to develop its activity in two main directions – production and trade with thermal insulation materials, designed for construction, energy and industry. It is well situated both on the national market, with big

energy and construction projects, and on the international, with export of its products in Romania, Turkey, Austria, Switzerland, Bosnia, North Macedonia, Sweden, Denmark, Italy, etc. The company is certified for and applies integrated management system according to ISO 9001, ISO 14001 and OHSAS 18001.

On its way on expanding its activity the company had to manufacture products, necessary for the industrial production of customized forms for hydroponics to grow vegetables and fruits. Therefore, it had to develop a technology for the mass production of these forms hrough investments in automation and robotization of the manufacturing process.

An innovative project was therefore started for the development of compact, cheap and highly automated prototypes of such equipment to allow the lean manufacturing of hydroponic products of low price. Due to the lack of inhouse scientific, patent, practical and methodological information on the topic, the enterprise team approached its long-standing and successful partner, the Institute of Mechanics of the Bulgarian Academy of Sciences. By this cooperation, the company developed the necessary project proposal, which was approved and funded by the National Innovation Fund in Bulgaria.

The project helped to identify the newest technologies in the field of hydroponics around the globe. The state of the art analyses showed that the customized automation for hydroponics can be based on already known automatic management systems and equipment. The main characteristics of production process were defined. The task was to optimize the manufacturing process taking into consideration its specifics. Therefore, the relevant documentation for the project realization was prepared and based on it the necessary equipment for hydroponic products manufacturing was developed in three variants (of the types "cube", "mattress" and "salami"). Practical experiments and improvement followed for the achievement of higher speed and productivity.

Further experimentation and work took place in order to develop the right horizontal conveyor for the purposes of the manufacturing process. Therefore, the most economical variant was achieved allowing for high speed of the production process ending with automatic packaging. Thus, based on the available space, the equipment was automated and optimized. As a final result the labour costs for the manufacturing process were reduced together with the space

necessary for its realization while improving the quality of production and the efficiency of the production line. The new solutions have been integrated into the activity of the company after their adaptation according to the scale or size of the specific products. In such a way the innovative capacity of the company has been improved. Other results from the project are the development of technology for processing of secondary products from the hydroponic growing, for use for soil improvement and the cultivation of the partnership with the academic institution.

The developers of the technology are ready to offer it together with the relevant know-how for purchase and implementation by greenhouse manufacturers for whom it's very suitable. Therefore, they presented it on the "Science for Business" forum commented above. The example proves again the benefits of the joint efforts of businesses, academic community and public authorities for the green development of the agri-food sector.

Source: Presentation by Assoc. Prof. Margarita Natova at the "Science for Business Forum", 19 May 2022, Sofia, and additional information provided by the scientific team for the purpose of this guide following a request by its developers.

4 Practical Guidance

While considering a transition to the CE models, the agri-food SMEs need to be aware on the real environmental impact of their business activity together with the technological, social and economic effects stemming from this strategic decision. It can be a challenging, time and resource consuming task to assess the overall influence of the business on nature. In this context, a Carbon and Water Footprint Calculator has been developed within the project as a green transition support tool for the SMEs in the sector.

Carbon and Water Footprint Calculator

The solution has been developed by the Renewable Energy Sources Cluster (RESC), Bulgaria. The cluster unites representatives of the business, science and non-governmental sectors active in the domain of energy efficiency (EE) and renewable energy (RES). Its mission is foster

sustainable development of clean energy production, its efficient management and consumption as well as the development and introduction of innovations in the RES and EE domains. More specifically the cluster promotes EU environmental protection policies, supports transition to a green economy for the Bulgarian industry partners, fosters climate change mitigation practices and contributes to the national priorities and the new regulatory requirements towards the energy business sector.

Taking in consideration that an impact assessment of the environmental effects of current business activities is a key factor for companies to take effective actions and reduce harmful practices, RESC created a new tool customized to the SMEs in the agri-food sector. The Carbon and Water Footprint Calculator offers a mechanism for more effective balancing of SME's interaction with the environment and taking of nature-friendly decisions. The carbon footprint is measured in carbon dioxide equivalents (CO2e) taking into account that different greenhouse gases (carbon dioxide, nitrogen oxides, methane, etc.) have different global warming factors. Agriculture and agriculture-driven land usage contribute for around 17% of the global emissions, while 75% of the agricultural producers do not report their emissions.

The calculator on one hand considers the emissions from heating based on the quantity of use of different energy sources for its purposes – coal, diesel, propane butane gas, natural gas. On the other hand, it considers the emissions from transport based on the quantity of use of different energy sources for its purposes – gasoline, diesel, propane butane gas, electricity (for electric vehicles). Is also takes into consideration the emissions from electricity based on the quantities of different sources used – grid and own renewables. The next type of emissions considered are the ones from fertilizers, based on the amounts of their different types used in the SME's activity – ammonium nitrate/sulfate, urea and mineral fertilizers. The emission from waste are also calculated, based on the two possible variants – mixed waste and organic waste. A special attention is devoted on the emissions from livestock farming, according to the numbers of dairy cows, livestock, sheep, pigs, goats, horses, mules and donkeys raised.

The calculator does also reflect the water footprint of the agri-food SME activity based on the quantity of consumption from different sources/for different purposes – freshwater, harvested rainwater, own biofuel power plant, own hydro power plant. The quantity of wastewater

produced is considered as well together with the water recycling and/or reuse and wastewater treatment.

Based on all mentioned criteria, the calculator makes an assessment about the overall carbon and water footprints of the agri-food SME compared to the average values in the sector (the percentage of positive or negative deviations from the average rates).

Source: Carbon and Water Foortprint Calculator (available at https://www.res-cluster.com/en/2022/05/12/try-using-our-co2-and-water-footprint-calculator-of-your-agri-food-activities/)

After taking the information based decision for greening its activity, among the main issues which are considered being problematic from the perspective of SMEs' ambitions to become circular are the lack of information about or access to relevant technological solutions in this regard and the lack of partners with whom to cooperate on their way to CE. There are different approaches to address those issues, some relevant to only one of them and others – to both.

One of the approaches of SMEs to solve their problems on the way to circularity is to use consulting services. As already mentioned, the study realized within the frames of the project showed that the SME respondents did not do this actively enough, claiming as a main reason for this the lack of funds to finance the use of such services. The other approach, from the perspective of desire to achieve cost savings, is the use of services of business support organizations. However, as analysed before, the study also showed, that SMEs did not use their services actively enough as

well. But let's see more information on their answers in this regard before continuing with the practical advices.

The companies which participated in a **business support** structure differ in the prevalent type of structure most commonly addressed, according to the country – the Greek SMEs usually preferred chambers of commerce and industry (with 47%) while their Bulgarian colleagues – the Union of agricultural enterprises (with 50%). Yet, the most of companies from the two countries were unanimous that they did not receive any support from those structures (with 85% of the Greek SMEs against 90% of the Bulgarian ones). Regarding the companies that received some kind of support from them, the most often type of this support was the representation of the SME on relevant fairs (local, regional, national, transnational or specialized ones), with 41% of the Greek enterprises and 34% of Bulgarian ones having answered so.

The last shows that the companies lack personalized approach on the part of those structures and that their membership in such ones doesn't necessarily guarantee personal attention. Moreover, the SMEs claim to be open to achieve synergies with other agri-food stakeholders (with 80% of the Greek companies and 59% of Bulgarian ones answered so).

Having in mind all this, we would recommend the agri-food SMEs to approach for support the experts of Enterprise Europe Network (EEN), offering free and personalized consultation and services on questions related to business activity and partnership. More information about the EEN and its services follow.

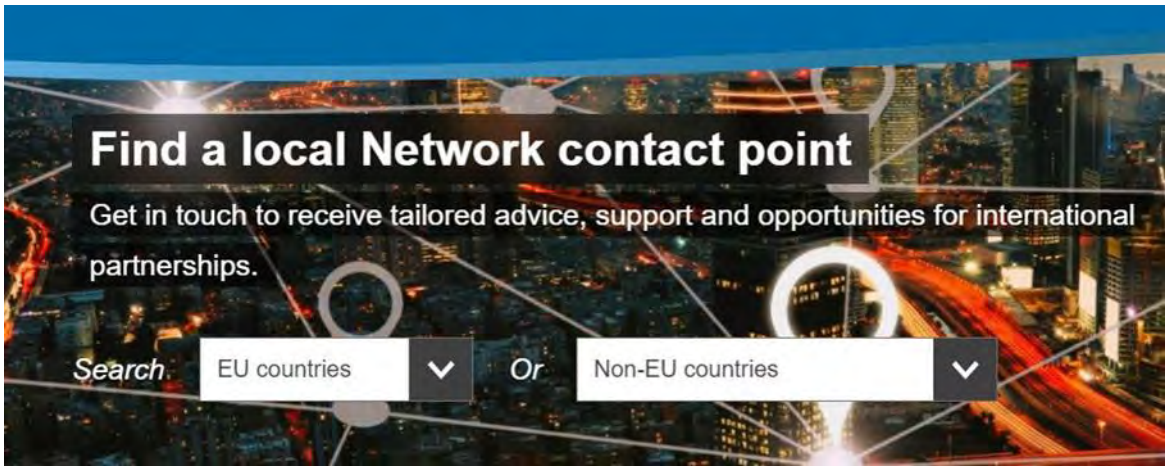
EEN

EEN is a key instrument in the EU strategy for encouraging the economic growth and the creation of new workplaces. It helps businesses innovate and grow on an international scale. It is the world's largest support network for SMEs with international ambitions.

Its mission is to assist the SMEs to take maximal advantage of the opportunities for business and innovative development on the EU single market and beyond.

If SMEs are looking for international partners, but do not know where to start from, if they want to upgrade their activity, but lack access to new ideas, if they need funding, but they also

need guidance across the various European and national programmes, EEN is close to them to help – they can get in touch with the local contact point by selecting their country and the city closest to their business at its website: https://een.ec.europa.eu



EEN maintains a vast data base and powerful communication tools to contact with any point of the network close to the place of interest for the business. Over 600 organizations work together for years in order to provide a full range of business services accessible for SMEs after a brief call or communication exchange.

EEN can help SMEs take advantage of the EU single market as the big players do. It can help them find international partners for business, new technologies and funding by the EU and advise them on a variety of issues such as intellectual property protection, European legislation, EU standards, etc. The experienced experts of the network offer combined information and consultancy services on the language of business about the access to markets, access to finance, new technologies, digitalization, sustainable development, etc.

Since its

- helped almost 3 million SMEs to innovate or achieve international growth
- assisted 280 000 SMEs to realize 785 000 business contacts on the Network's brokerage events
- supported 20 000 SMEs with advises how to step on the market with their innovations

- provided information and training to over 2 million SMEs in the field of international expansion

- won the trust of 475 000 SMEs, which received personalized consulting support. creation in 2008, the network:

EEN – services

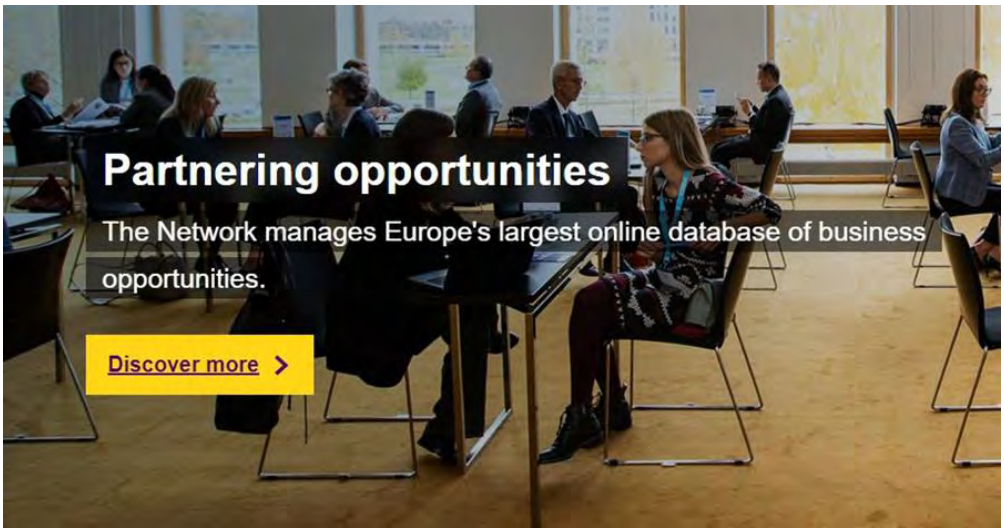
Among the main services of EEN is its support in finding international partners for the SMEs – for research, technological or business partnerships. This can take place in two basic ways – via the profiles of its clients published on its website or via their participation in the brokerage and other relevant events, organized by it. And although the network started as an intitiative at EU level (of the Directorate-General "Enterprise and Industry" of the European Commission) co-financed via the framework programmes of the EU for competitiveness of the SMEs and for research (Single Market Programme - COSME), nowadays it supports the search of international business and project partners in over 60 countries.

As concerns the first option – the profiles, SMEs can benefit from them in two main directions:

- to search in the database of the published profiles ones relevant to their interests – the database consists of three types of profiles, for business, technological and research and development cooperation. Both business and technological profiles have two types on their part – offers and requests, while the R&D profiles are connected with the search of partners

for the development and submission of joint application for R&D funding under relevant programmes. Therefore, if the SME wants to get advantage of the offers of products, services or technologies, published in the database or of the requests of other companies, looking for products, services or technologies of the kind it has, they have to contact the nearest local contact point which will assist it to express its interest in any of the published profiles and to get into contact with the organization behind the profile for the purposes of further negotiations. The SMEs should follow the same approach if they find in the database partner search for joint proposals for funding of R&D projects. The EEN experts can also help the SMEs in the process of negotiations, respectively project proposal development, if necessary. There are different criteria based on which the SMEs can search in the database, e.g. type of the profile (business, technological or R&D, offer or request), country of origin of the profile, keyword, etc. The SMEs can mine this database at the following address: https://een.ec.europa.eu/partners

- to have its profile published in the database – in case the SME wants to offer its products, services or technologies or to publish its request for such ones in the database and gather the interests coming for its profile, it must again contact the EEN organization closest to its location and to delelop its profile with its support. The same refers if the SME is looking for partners for joint R&D project proposal and can not find relevant existing profile in the database to express its interest.



Regarding the second option – events, the network organizes such ones regularly. Although they can be of different types – brokerage events, company missions or conferences and

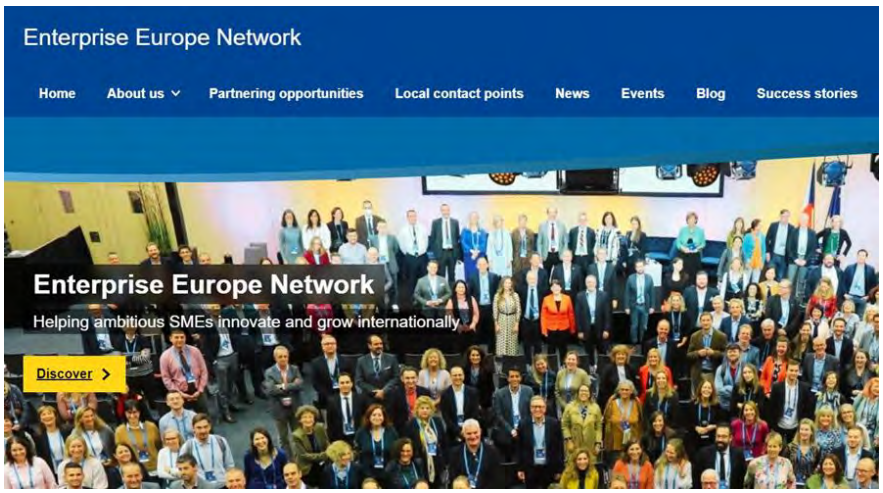
workshops, they are anyway business-oriented in one way or another and may become the first step towards the SMEs' finding international partner. The main focus, however, should fall on the brokerage events and company missions the main purpose of which is to help in finding international partners:

- the brokerage events gather on one place companies from different countries working in a specific field to present their products, services and expertise in order to find parthers from other places around Europe and the world based on preliminary defined agenda of bilateral meetings. As a preparation the companies have to register themselves on the platform of the specific event, publish information about its activity and plan meetings with other participants relevant to its business. Since 2020 the brokerage events take place predominantly online or in a hybrid format to respond to the pandemic's conditions;

- as concerns the company missions, their purpose is that usually a group of companies from one country visits another country to meet their collegues there, to mutually exchange information about their businesses and to look for opportunities for partnering.

The events of the network are free for participation usually, as all the other services of EEN. They are published on the network website and can be mined based on different criteria – type of the event, place of organization of the event, date and keywords.

The list of network events can be found at:
https://een.ec.europa.eu/events?f%5B0%5D=field_eventstartdate:next_year



If the SME looks for relevant solutions for transforming its activity into a circular one, it can also search in the **patent data bases** where information about technologies applied for patenting or already patented is published. It's information about new technologies in fact as far as the patent system requires from applicants that technologies have absolute world novelty, inventive step and industrial application in order to have a patent issued for them. Very often information about new technologies cannot be found anywhere else, but in patent documents, although the percentage of this information varies according to the field of technology. The patent databases are nowadays accessible not only in the libraries of the patent offices as before, but also online. There SMEs while looking for a technology relevant to their activities can benefit from the published information in the following ways at least:

- when the SME identifies the relevant technology and there are valid patent rights on it for the territory/territories of its activity, it can also identify its owner in order to address it for buying a license for its utilization or eventually for buying the very property rights on this technology;
- when the SME identifies the relevant technology and the patent rights on it are valid on a territory/territories different from the one where the SME realizes its activity, it can use the patent description in order to directly use the technology into its activity without the need of permission or payment. If additional know-how is necessary on the part of patent owner for the effective use of the invention, the SME can address the patentee to get this information;
- when the SME identifies the relevant technology and the patent rights on it are no more valid, it can use the patent description in order to directly use the technology into its activity without the need of permission or payment. If additional know-how is necessary on the part of patent owner for the effective use of the invention, the SME can address the patentee to get this information.

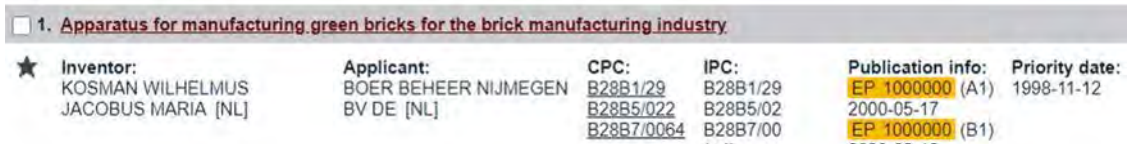
Espacenet

It is a database very suitable for such searches and user friendly as well. It's administered by the European Patent Office and contains over 130 million patent documents from more than 100 countries. It offers options for smart search, classification search (according to the type of

technology) and advanced search. The last allows for search based on any of the following criteria or a combination thereof:

- keywords in the title of invention
- keywords in the title or abstract of invention
- publication number
- application number
- priority number
- publication date
- name of the applicant
- name of the inventor
- field of technology of the invention according to the Cooperative Patent Classification (CPC)
- field of technology of the invention according to the International Patent Classification (IPC)

The database search tool (in its advanced variant) can be found at this address: https://worldwide.espacenet.com/advancedSearch?locale=en_EP. The search result appears in a short form first, containing the names of invention, inventor and applicant (with their countries of origin), the type of technology (the relevant codes according to the CPC and IPC), the info about the publications for the invention realized within the patent procedure and the date of priority of the patent application.


1. Apparatus for manufacturing green bricks for the brick manufacturing industry

Inventor:	Applicant:	CPC:	IPC:	Publication info:	Priority date:
KOSMAN WILHELMUS JACOBUS MARIA [NL]	BOER BEHEER NIJMEGEN BV DE [NL]	B28B1/29 B28B5/022 B28B7/0064	B28B1/29 B28B5/02 B28B7/00 (+4)	EP 1000000 (A1) 2000-05-17 EP 1000000 (B1) 2003-02-12	1998-11-12

The result can then be followed in its detailed variant, containing bibliographic information and abstract, description and claims, illustrative materials (mosaics), original document (in the original language of the application), documents cited by the application or citing it, legal status of the application/patent, patent family (related applications/patents for other countries).

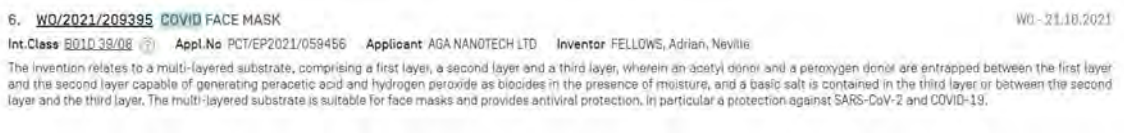
The other free patent database with a broad geographical coverage is PATENTSCOPE. Further information about it follows.

PATENTSCOPE

The database is administered by the World Intellectual Property Organization. It contains 105 million patent documents, incl. 4,4 million published international patent applications (PCT-applications). It offers options for simple search, advanced search, search based on field combination, cross-lingual expansion and search for chemical compounds. The search allowing for use of many criteria is the one based on field combination. It offers the opportunity to search according to many criteria simultaneously which can be chosen from a falling menu. The operators "and" or "or" can be used.

The database search tool (in its field combination variant) can be found at this address: https://patentscope.wipo.int/search/en/structuredSearch.jsf

The search result appears in a short form first, containing the numbers of the application and its publication, the names of invention, inventor and applicant, the type of technology (the relevant codes according to the IPC), the date of the publication and the abstract of invention.


6. WO/2021/209395 COVID FACE MASK WO - 21.10.2021

Int.Class B01D 39/08 Appl.No PCT/EP2021/059456 Applicant AGA NANOTECH LTD Inventor FELLOWS, Adrian, Neville

The invention relates to a multi-layered substrate, comprising a first layer, a second layer and a third layer, wherein an acetyl donor and a peroxygen donor are entrapped between the first layer and the second layer capable of generating peracetic acid and hydrogen peroxide as biocides in the presence of moisture, and a basic salt is contained in the third layer or between the second layer and the third layer. The multi-layered substrate is suitable for face masks and provides antiviral protection, in particular a protection against SARS-CoV-2 and COVID-19.

The result can then be followed in its detailed variant, containing bibliographic information and abstract, description and claims, national phase information (for the international applications), drawings (again for the international applications), patent family (again for the international applications), notices (again for the international applications) and documents (relevant for the procedure).

The Project is co-funded by the European Regional Development Fund (ERDF) and by national funds of the countries participating in the Interreg V-A "Greece-Bulgaria 2014-2020" Cooperation Programme.

The patent databases of the national intellectual property offices are very often also available online. Their advantage is that they give access to the patent applications and other relevant information in the respective national language. As concerns the new solutions necessary for the sector, the databases for industrial designs and plant varieties and animal breeds can also be relevant.

The databases for industrial designs with broadest international scope are DesignView (administered by the European Union Intellectual Property Office and containing over 19 million designs across the EU and beyond, accessible at https://www.tmdn.org/tmdsview-web/welcome#/dsview), Global Design Databse (administered by the World Intellectual Property Organization and containing more than 14 million industrial designs registered internationally under the Hague System and/or participating in national or regional collections, accessible at https://www3.wipo.int/designdb/en/index.jsp) and Hague Express Database (administered by the World Intellectual Property Organization and containing the international design registrations, accessible at https://www3.wipo.int/designdb/hague/en/).

The only database of registered plant varieties with significant territorial scope from the perspective of EU SMEs is the EU Plant variety database. It offers a search tool for all the agricultural and vegetable plant varieties whose seed can be marketed throughout the EU. It has opportunities for search in two fields – agricultural plant species and vegetable species. More

information about the database and its use is available at https://ec.europa.eu/food/plant/plant_propagation_material/plant_variety_catalogues_databases/search/public/index.cfm.

The contacts with the **scientific community** is another way for agri-food SMEs to find both partners and relevant solutions on their way to CE. The mutual benefits from such relations can be realized in different ways, e.g.:

- the SMEs can implement into their activity the technologies already developed by the research institutions (based on buying of a license from the institution or purchasing the very technology);
- the SMEs can test the solutions already developed by the academic institutions to help for their validation in real activity. Based on this, the enterprises can later invest in the implementation of the technologies into their regular business;
- the SMEs and the research institutions can jointly develop solutions relevant to the SMEs' business;
- the SMEs can commission the academic institutions to develop for them the necessary technologies;
- the SMEs and the research institutions can jointly develop project proposals for public funding for the development of the solutions necessary for the business of the enterprises, etc.

On the other hand, as far as one of the challenges faced by the SMEs is the lack of relevant expertise in the domain of CE or of a sufficient number of employees with such knowledge and skills, the relations between them and the academic community can be of mutual benefit from this perspective as well:

- the SMEs can welcome as interns the students of the academic institutions with expertise relevant to their ambitions for CE transition;
- the academic institutions can take care of the training of SMEs' employees in the same domain, either on a regular or on a post-graduate basis;

- the companies and the research institutions can jointly develop educational programmes for practical training of students at different levels (Bachelor's, Master's, Doctroral) in the activity of real enterprises or even plan industrial PhD programmes, etc.

Such intersectorial relations can take place based on different strategies on the part of SMEs. On one hand, they can visit events, organized by such institutions, or events where they take part for the purposes of presentation of their already developed solutions. On the other hand, the SMEs can follow the publications of relevant academic institutions to get acquainted with their production, which can be relevant for use in the activity of the enterprises. On third hand, the SMEs can make searches in the relevant data bases about the patenting activity of academic institutions in order to find more information about the solutions developed by them and suitable for implementation into their business operations. Direct communication with the academic institutions is a further approach in case of identified specific necessities of the SMEs together with the relevant academic organizations which can be of help in finding of solutions for them.

But let's now have some examples to show how beneficial can be the relations between agri-food businesses and research and educational institutions working in the same domain. The activity of the first one – the American Farm School (AFS), goes beyond the academic education also covering training for kids and further through all the educational stages. Another good example is the forum "Science for business" aiming to bring closer the academic and business communities with the support of the relevant national authorities although it has passed through some challenges.

American Farm School

AFS is an independent, nonprofit educational institution of all levels located in Thessaloniki, Greece, since 1904. The mission of AFS is to educate people of all ages in the latest aspects of agriculture, science and the food industry, while preparing them for prominent roles in community life. This mission is accomplished by teaching sustainable agricultural and business practices. It is the first institution in Southeastern Europe for education and research in agriculture, food systems, environmental studies and other life sciences associated with sustainability.

AFS owns a large-scale **Educational Farm**, which serves as a laboratory for hands-on education and applied research. The farm includes the Holstein Friesian dairy herd; a poultry unit using the newest methods; greenhouses; vegetable gardens; vineyards; fruit and olive trees. Moreover, AFS has extensive field crops at its satellite farm. AFS implements handling practices to address the matter of waste treatment, especially in a peri-urban area, minimizing the environmental impact. A holistic model to treat and recycle solid and liquid waste generated from the production is employed. AFS has accomplished to spend very little on manure management since a biogas company takes it under a mutually beneficial agreement.

Other **sustainable practices** are the use of recycled water for fertigation from May to September and recycling of plastic, glass, aluminum and paper. In addition, fertilizer is produced by composting plant material and returned to the fields for the enrichment of soil in nutrients and organic matter. The innovative processes followed at the AFS can assist to reduce carbon footprint of agricultural and bio-stream activities. Also, it is proved that innovation can effectively contribute to the development of green services and numerous green jobs.

Source: Kontogianni S., Malamakis S., Boemi S.N., Kiskini C., Moussiopoulos N., Good Practices for Biological Streams in Central Macedonia Region, BIOREGIO PROJECT, 2018.

"Science for Business" forum

The Bulgarian Academy of Sciences (BAS) together with the Bulgarian Small and Medium Enterprises Promotion Agency (BSMEPA) joined their efforts in 2020 for the organization of the first of its type event where the latest innovative projects of the Academy ready for transformation into successful businesses had to be presented. The purpose of the event was to show Bulgarian businesses that BAS gave birth to many products and technologies ready to enter the market or to be implemented in manufacturing for the process optimization in enterprises. Its mission accordingly was to put a further step on the way of building of sustainable institutional environment for cooperation between the Bulgarian science and business.

The event had to take place in March 2020 in "John Atanasoff Innovation Forum" at Sofia Tech Park to bring representatives of the institutes, laboratories and the Joint Innovation Center of BAS together with many Bulgarian entrepreneurs and company owners. Unfortunately, the event had to be postponed because of the COVID-19 pandemics. All the registered over 400 participants kept their registrations for the new date of the event.

Luckily, in spite of the pandemics, the postponed event took place at last – in March 2021, although it happed in an entirely online format in real time from a virtual studio because of COVID-19. The event was opened by the President of the Academy Julian Revalski and D-r Boyko Takov, Executive Director of BSMEPA. The Deputy Ministers of Education and Science and of Economy – Ms. Karina Angelieva and Mr. Stamen Yanev, welcomed the over 500 participants. At the event the first public presentation of the national vaccine against COVID-19 of the Institute of Microbiology at BAS took place.

Together with it, other projects of the Academy connected with the pandemics were also presented – PCR kit for patogene detection of the Institute of Molecular Biology, as well as a specialized device for air disinfection from viruses and bacteria of the Central Laboratory of Applied Physics, Plovdiv.

A special technology of bioceramics for the purposes of endoprosthesis developed by the Space Research and Technology Institute of BAS and used by the International Space Station was presented and a demonstration of a robot giving opportunity of transportation of goods in factories and enterprises was made. Technologies for cryoconservation of living material (sperm) of the Instutite of Solid State Physics of BAS were also presented. Within the forum joint projects of BAS and Bulgarian enterprises with a successful market realization were presented together with products realized in a partnership and research and applied projects of the Academy under development.

Among the presented projects were ones for the purposes of: viticulture, winemaking, ecology, energy efficiency, hydrogen technologies, electricity and heat production, energy storage, optimization of industrial tasks, 3D digitalization, medicine, virusology, pharmacy, etc. The participants understood more about the newest products developed by the institutes of BAS and had the opportunity to establish contacts with respresentatives of the Academy and

BSMEPA within the session for question and answers. The event took place with the support of Enterprise Europe Network – Bulgaria. The organizers planned to turn the initiative into tradition.

The environment gave them the opportunity to make the next successful step in this direction in **May 2022**, a year after the first edition of the forum – this time offline and with a special expo zone where a number of interesting prototypes of the Academy were presented (e.g. systems of generation, storage and utilization of clean energy, autonomous dirigible, robot for UV disinfection, carbon soot functioning as activator of human sperm). The event was opened by the Minister of Innovation and Growth Daniel Lorer, the Minister of Education and Science Nikolai Denkov and the President of the Academy Julian Revalski.

Again, successful examples of joint initiatives of BAS and businesses were presented among the other relevant projects of the Academy, such as innovative drone with longer flying time and higher scope. Other presented solutions were: integrated system of distance determination of agricultural crops' state, use of bio coal made of agricultural waste for the improvement of crop quality, electrode materials for natrium-ion batteries, ceramic accumulator, tactile thermometer for visually impaired persons with application in the household, sensors, etc.

A new moment in the program of the event this year was the participation of representatives of 3 branch organizations – the National Grain Producer Association, the Bulgarian National Association of Essential Oils, Perfumery and Cosmetics and the Automotive Cluster Bulgaria, which addressed the challenges to be solved from the scientists of BAS. In contrast to the first edition this year the presented projects were at a higher technology readiness level, which is a precondition for a faster and easier transfer to businesses.

An opportunity for contact establishment between academics, enterprises and public authorities was at hand in the network zone and during the cocktail as well. The participation in the event and the access to the expo zone were free. Now all the interested communities are eager for the next edition of the forum.

Source: Bulgarian Small and Medium Enterprises Promotion Agency (at https://www.sme.government.bg/?p=53475), Bulgarian Academy of Sciences, Joint

Innovation Centre of the Bulgarian Academy of Sciences (https://www.jic-bas.eu/index.php/news/267-news) and media

In order to further illustrate the reality of the forum an example of a solution presented on its last edition follows.

Integrated system of remote sensing determination of agricultural crops' state

The system is developed, experimentally tested and intellectual property (patent and utility model) protected by the Space Research and Technology Institute at the Bulgarian Academy of Sciences (SRTI-BAS). It's applicable in the domain of precise agriculture for a remote sensing monitoring of crops at local level.

The system uses data received from multichannel sensors for remote sensing observation of Earth from satellites, airplanes and unmanned aerial vehicles (UAVs). A set of biometric, biophysical and biochemical parameters connected with the productivity of plants and the quality of agricultural production is used as basic indicators for regular assessment of the state of agricultural crops. The system ensures as final products geo-referenced raster maps and graphics both of a set of crop parameters and of the overall state of the relevant agriculture. Those products give an opportunity for constant control on the impact of measures implemented for the improvement of the state of agricultural crops. Informed decisions on the farmers' side can be taken on this base.

The tests of the system, together with the team from the Institute of Soil Science, Agrotechnologies and Plant Protection "N. Poushkarov" – Agricultural Academy, realized on 12 fields with winter wheat in the region of Pleven, showed very good results. All the tests were based on the measuring of equivalent crop parameters based on data received from multichannel sensors for remote sensing observations. Field measurements and monitoring were also realized as well as gathering of samples for laboratory analysis for the purposes of products' validation. The data used came from the satellite mission Sentinel 2 of the European space agency and the UAV senseFly eBee Ag with a multichannel camera Parrot Sequoia. It's level of readiness is TRL 5.

The systems known up to now, which use remote sensing multichannel data, give as final products only vegetation index images. The geo-referenced raster maps based on them are not suitable for agricultural producers because of not offering assessment neither from the perspective of quality nor quantity of the registered crop parameter. Those systems do not also offer a solution for qualitative determination of the overall crop state based on different parameters and assessment maps. All these problems are solved by the presented system, which was awarded from the International Technical Fair Plovdiv, Agra International Agricultural Exhibition 2020.

The system can replace in a significant extent the integral approach for crop assessment used in the practice, which is labour intensive and requires long time for gathering, processing and analysis of many field samples. Moreover, the field monitoring only reflects the crop state in specific points, thus not giving information about its overall development as well as opportunity for creation of precise maps for the whole agricultural plot.

The system is ready for licensing to interested SMEs or spin-offs which can support the developers in the improvement of its characteristics, with an option for applying for new patents. Relevant partners are companies from the IT and automation fields (for the purpose of hardware realization of the system). The final purpose of cooperation would be the system's implementation for practical use.

Sources: Presentation by Prof. Georgi Jelev at the "Science for Business Forum", 19 May 2022, Sofia, and additional information provided by the scientific team for the purpose of this guide following a request by its developers (see the sources in the reference list at the end of the document).

The Project is co-funded by the European Regional Development Fund (ERDF) and by national funds of the countries participating in the Interreg V-A "Greece-Bulgaria 2014-2020" Cooperation Programme.

Date, Phenological development phase	Assessment score	Unit 1 Area (%)	Unit 1 ARLww	Unit 2 Area (%)	Unit 2 ARLww	Unit 3 Area (%)	Unit 3 ARLww	Unit 4 Area (%)	Unit 4 ARLww	Unit 5 Area (%)	Unit 5 ARLww	Unit 6 Area (%)	Unit 6 ARLww
Agricultural year 2016/2017													
Assesmant map 31.10.2016, Tiller production	Poor	16%		7%		51%		1%		24%		84%	
	Fair	79%		69%		42%		81%		74%		16%	
	Good	5%		24%		7%		19%		2%		0%	
Assesmant map 19.04.2017, Stem elongation	Poor	10%		30%		34%		2%		0%		23%	
	Fair	17%		29%		11%		20%		9%		77%	
	Good	73%		41%		56%		77%		91%		0%	
Agricultural year 2017/2018													
Assesmant map 31.10.2017, Tiller production	Poor	1%		2%		8%		41%		6%		2%	
	Fair	77%		74%		91%		58%		71%		66%	
	Good	22%		24%		0,1%		1%		23%		32%	
Assesmant map 30.03.2018, Stem elongation	Poor	1%		12%		3%		26%		3%		0,3%	
	Fair	15%		84%		68%		74%		52%		40%	
	Good	85%		4%		29%		1%		45%		60%	
Assesmant map 14.04.2018, Stem elongation	Poor	2%		3%		4%		27%		1%		1%	
	Fair	10%		31%		41%		72%		51%		28%	
	Good	88%		65%		55%		1%		49%		71%	
Assesmant map 29.04.2018, Inflorescence emergence	Poor	1%		4%		1%		40%		1%		0%	
	Fair	8%		14%		16%		55%		45%		25%	
	Good	91%		83%		83%		5%		54%		75%	
Assesmant map 29.05.2018, Grain milk stage	Poor	2%		4%		1%		63%		0,3%		0,3%	
	Fair	10%		32%		31%		29%		40%		32%	
	Good	88%		64%		67%		8%		60%		68%	

As far as a very common argument of SMEs for the delay of their transition to CE is the lack of sufficient financial resources necessary for the realization of this transition, another step of the agri-food businesses is to address specialized **public instruments, incl. funding ones**, which can support them on their way to CE. The main EU instruments in this regard, which are relevant to the agri-food SMEs and can be beneficial to enterprises from different EU countries, directly or indirectly, are:

- Horizon Europe – it's the successor of Horizon 2020 and the current EU's key funding programme for research and innovation with a budget of 95.5 billion Euro tackling the climate change, helping to achieve the UN's Sustainable Development Goals and boosting the EU's competitiveness and growth. In this regard, it's important to mention the European Innovation Council acting under the programme with the purpose to support innovations with potential breakthrough and disruptive nature and scale-up potential that may be too risky for private investors (with 70% of the budget for SMEs). The programme can support the agri-food SMEs from the perspective of solutions necessary for the greening of their activities. More information about it is available at: https://ec.europa.eu/info/research-and-innovation/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe_en

- LIFE programme – it's the EU's funding instrument for the environment and climate action working for 30 years already. Apart from supporting public authorities, NGOs and research organizations, the programme also helps SMEs looking for support to develop their green products, technologies, services and processes and bring them to the market – via the so called close-to-market projects launching innovative, demonstrative solutions that offer clean environmental and/or climate benefits, e.g. in the fields of waste management, circular economy, resource efficiency, water, air or climate change mitigation. The programme offers co-funding of the projects together with expert support for commericialization based on a set of services, e.g. business plan development advice, business coaching, presentation guidance (for communication with potential investors), expert connections (connecting projects with intellectual property experts, as well as with external debt financing institutions). More information about it is available at: https://cinea.ec.europa.eu/programmes/life/life-close-market-projects_en
- COSME – it's the EU programme for the competitiveness of SMEs, funding many initiatives that help businesses access new markets. Its support is concentrated in the following domains: access to finance (for all the phases of the SMEs' lifecycle and in different variants – guarantees, loans and equity capital), opening markets (helping the access to markets in the EU and beyoud via its instruments – Enterprise Europe Network – see above for more information, Your Europe Business portal – providing practical information on doing business within Europe and IP SME Helpdesks – providing support in the field of intellectual property), entrepreneurship education, mentoring, guidance, etc. for specific groups (such as young people, women and senior entrepreneurship) as well as help for businesses to access opportunities offered by digital technologies, improving business conditions based on reduction of administrative and regulatory burden on SMEs and encouraging SMEs to adopt new business models and innovative practices. More information about the programme is available at: https://ec.europa.eu/growth/smes/cosme_en
- European Fund for Strategic Investments – its aim is to overcome the current investment gap in the EU by mobilising private financing for strategic investments which the market cannot face alone, focusing on infrastructure and innovation (via the European Invenstment Bank - EIB), as well as risk finance for SMEs (via EIB and the European Investment Fund, for equity or guarantee instruments). Among the key areas of support

are: renewable energy and energy efficiency; education and training, health, R&D, ICT, innovation; SMEs; infrastructure (transport, energy, digital, environment, urban and social sectors). More information is available at: https://ec.europa.eu/info/strategy/priorities-2019-2024/economy-works-people/european-fund-strategic-investments_en#:~:text=The%20EFSI%20aims%20to%20overcome,risk%20finance%20for%20small%20businesses.

- European Structural and Investment Funds – their purpose is to invest in job creation and a sustainable and healthy European economy and environment focusing on 5 areas: research and innovation, digital technologies, supporting the low carbon economy, sustainable management of natural resources and small businesses. They are jointly managed by the European Commission and the EU countries. Over half of the EU funding is channelled through those funds:

  ➢ European Agricultural Fund for Rural Development (EAFRD) – it provides funding via the rural development programmes based on co-financing by national budgets and under the management of national and regional authorities, focusing on six priorities – innovation and knowledge transfer in agriculture, forestry and rural areas; innovative farm technologies and sustainable forest management, viability and competitiveness of all types of agriculture; food chain organization, animal welfare and risk management in agriculture; resource efficiency and shift towards a low-carbon and climate resilient economy in the agriculture, food and forestry; ecosystems related to agriculture and forestry; social inclusion, poverty reduction and economic development in rural areas. The EAFRD acts as a source for loans, microcredit, guarantees and equities through its financial instruments, available to recipients in agriculture, forestry and rural areas, who are undertaking financially viable projects which support the mentioned priorities. More information about it is available at: https://ec.europa.eu/info/food-farming-fisheries/key-policies/common-agricultural-policy/rural-development

  ➢ European Regional Development Fund (ERDF) – its purpose is to strengthen economic, social and territorial cohesion in the European Union by correcting imbalances between its regions. Again, the funding is a shared responsibility with national and regional authorities in Member States and is under their management. The funding priorities for

2021-2027 are investments in a more competitive and smarter (via innovation and support to SMEs together with digitalization and digital connectivity), greener (low carbon and resilient), more connected (via enhancing mobility) and more social Europe (via support of effective and inclusive employment, education, skills, social inclusion, equal access to healthcare and enhancing the role of culture and sustainable tourism) that is closer to its citizens (via support for locally-led development and sutainable urban development). More information about it is available at: https://ec.europa.eu/regional_policy/en/funding/erdf/

Here is an example about the CityZen project funded by ERDF under the Interreg Europe programme that is focused on urban farming as a successful driver for economic and social transformation.

CityZen and urban farming

CityZen is an Interreg Europe project that aims to foster urban farming practices and their key role for better resource efficiency in cities. Agriculture in urban settings is already a global and rapidly growing trend that offers great potentials for green, social and technological innovation. This is the area where eight CityZen partners from five EU regions led by the Applied Research and Communications Fund (ARC Fund) as coordinator, have joined efforts to enhance support measures and innovations for urban farming.[4]

Urban farming, as demonstrated by the entire CityZen experience, has great potential to minimize many of the negative effects of urbanized life towards more sustainable cities. The benefits range from the more adaptive and efficient use of land, space, water, energy and costs,

[4] CityZen partnership: Applied Research and Communications Fund (BG) - lead partner, Sofia Development Association (BG), Institute for Rural Development Research at Goethe University Frankfurt/Main (IfLS) (DE), Regional Development Fund of Central Macedonia on behalf of the Region of Central Macedonia (EL), Higher Technical School of Agrarian Engineering - University of Valladolid (ES), Natural Heritage Foundation of Castilla y León (ES), Municipality of Beja (PT), CIMBAL - Baixo Alentejo Intermunicipal Community (PT).

to smarter management of food waste and re-engineering of local environments to deal with heat and air pollution. Urban farming also provides a solution to reduce food waste by shortening or even turning down to zero the supply chain as in cities more than half of the food wastage happens at the retail, storage and consumer stage. Tools, networks and circular economy practices linked to urban farming preserve many natural assets in cities and keep biodiversity.

Vertical gardens can be an alternative to urban dwellers that do not have easy access to land and open space but want to produce their own food. Four 'Do-It-Yourself' models for mini vertical gardens were co-designed by ARC Fund, Sofia Development Association and SOfiaGreen by the help of local stakeholders within the CityZen pilot action in Sofia. The aim of the action was to foster citizens and employees at residential, public and private buildings to practice urban gardening all year round. Although suitable for small-scale projects, these mini gardens can thrive with leafy greens, herbs, spices and berries by using proper plant varieties and know-how for indoor use. Vertical gardens are also very close to their users which is a great motivation for beginners to start urban farming without the need to travel and big maintenance efforts. The models are available on internet together with a step-by-step Manual, technical schemes and useful tips. The "DIY vertical urban gardens" are further extended by a recent call of the Sofia Municipality to finance vertical urban gardens at schools and kindergartens in Sofia. Beneficiaries can apply for a fixed amount of 125 EUR within the call to build a mini vertical garden together with seeds, seedlings and composted soil for planting offered by the municipality.

Composting practices that turn organic wastes into nutrient-rich soil are in the grounds of sustainable urban farming and is widely practiced by each CityZen site. Taken at municipal level, food waste reduction and composting is not only reducing food scraps in the landfills but also fosters innovative waste management activities. For example, Sofia Municipality composting facility "Han Bogrov" is a plant for biological treatment of food waste coming from restaurants and stores that is converted to biogas. It also transforms green waste collected from public parks and gardens into compost. Citizens with paid waste taxes can take free of charge up to 10 kg of compost, or buy larger quantities at low price. The facility also supplies the vertical garden school and kindergarten projects with composted soil for urban gardening.

- European Maritime and Fisheries Fund – its purpose is to help fisherman to adopt sustainable fishing practices and coastal communities – to diversify their economies, improving quality of life along European coasts in compliance with the new (2021) approach for a sustainable blue economy in the EU adhereing to the Recovery Plan for Europe and the European Green Deal. The fund for example (with a budget of 5 billion Euro for 2021-2027) will continue to provide financial support for fisheries to retrieve and collect litter and lost fishing gears and to apply other measures in the domain of CE (e.g. tackling pollution from plastic, nutrients and contaminants and underwater noise, together with ship recycling). Another green dimension of the blue economy is marine biodiversity based on marine protected areas, which also lead to larger fish stocks and contribute to climate mitigation and resilience, thus extending the opportunities to both fisheries and coastal economies, e.g. in the domains of sustainable tourism and bio-technology. The closest green blue economy dimension to the agri-food sector, however, is sustainable food requiring responsible fishing (in order to bring stocks to sustainable level), sustainable aquaculture and new sources of food and feed (e.g. from algae production) – as far as proteins from them have much smaller carbon footprint than land-based animal proteins. Other dimensions are adaptation activities (e.g. developing green infrastructure in coastal areas and protecting coastlines from the risk of erosion and flooding to help for the preservation of biodiversity and landscapes while benefitting tourism and coastal economy) and decarbonisation of maritime transport and fishing (with its relevant effect on the greenhouse gas emissions, air and water pollution and underwater noise), utilization of energy from oceans (which is unlimited and lacks greenhouse gases), etc. More information about the fund is available at: https://oceans-and-fisheries.ec.europa.eu/index_en

BIOGEARS: bio-based materials for sustainable European aquaculture

In offshore mussel farms, mussels are grown on long ropes, suspended underwater. However, the ropes used in aquaculture are made from plastic, threatening marine ecosystems, if discarded or not disposed of correctly. At the same time, as the aquaculture sector experience increasing demand, more ropes are needed. To solve this conundrum, the EU-funded BIOGEARS project aims to provide the aquaculture sector with innovative bio-based ropes that contribute to a more sustainable aquaculture sector.

Launched in 2019, the BIOGEARS consortium develops prototypes of bio-based ropes for use in mussel and seaweed culture. BIOGEARS builds on knowledge generated by previous projects. Also partly EU-financed, these have been instrumental in understanding both the volume and type of marine litter generated by aquaculture and their impact on the marine environment, and the growth, production yield and quality of mussels, when cultured on conventional plastic ropes.

Aiming to replace or complement oil-based plastics, the consortium has produced compostable plastics from natural components derived from renewable biomass. The goal is to obtain a plastic that does not decompose at sea, but instead turns into compost, when it is no longer of use. The bio-based ropes developed by BIOGEARS are tested at sea, under different environmental conditions. Technical, environmental and economic sustainability assessment of the bio-gears is carried out, including its degradability at sea and the composting conditions.

BIOGEARS has three main objectives: a positive impact on sustainability of the aquaculture industry by developing eco-friendlier ropes and aquaculture systems; a positive economic impact by supporting a circular economy, through the development of new bio-based products and value chains; a societal impact by supporting public policies to reduce plastic littering at sea, by fostering new employment, quality products and responsible production and consumption.

The EU-funded BIOGEARS project is in line with the vision for a sustainable blue economy under the European Green Deal and contributes to European policies on plastics and microplastics. It also underpins other key policies such as those set out in the EU's Bioeconomy Strategy and the European Farm to Fork Strategy. Beyond this project, the bio-based ropes can be adapted for other aquaculture and fisheries needs, contributing more widely to the sustainable transformation of the sector.

Source: https://oceans-and-fisheries.ec.europa.eu/news/biogears-bio-based-materials-sustainable-european-aquaculture-2021-12-22_en

- European Social Fund Plus (ESF+) – it's the EU's main instrument for investing in people with a budget of 99,3 billion Euro for 2021-2027. It will provide contribution to the EU's employment, social, education and skills policies. As part of cohesion policy, it will

also support economic, territorial and social cohesion in the EU to reduce the disparities between Member States and regions. ESF+ brings together four funding instruments (separate in 2014-2020): the European Social Fund, the Fund for European Aid to the most Deprived, the Youth Employment Initiative (implemented by Member States, with the Commission playing a supervisory role) and the European Programme for Employment and Social Innovation (implemented by the European Commission). More information about the fund is available at: https://ec.europa.eu/european-social-fund-plus/en/what-esf

- Cohesion Fund – it provides support to the EU Member States with a gross national income per capita below 90% of the EU-27 average (Bulgaria, Czechia, Croatia, Cyprus, Estonia, Greece, Hungary, Latvia, Lithuania, Malta, Poland, Portugal, Romania, Slovakia and Slovenia) to strengthen the economic, social and territorial cohesion of the EU through investments in the field of environment and trans-European networks in the area of transport infrastructure. 37% of the overall financial allocation of the fund for 2021-2027 are expected to contribute to climate objectives. Again, it provides funding in a shared responsibility between the European Commission and the national and regional authorities of the Member States and under the operative management of the last. More information about the fund is available at: https://ec.europa.eu/regional_policy/en/funding/cohesion-fund/

Apart from financial instruments, **non-financial tools** are also envisaged at EU level to support the SMEs' transition to CE, which are also relevant to agri-food companies:

- EU Eco-Management and Audit Scheme – it's a premium management instrument developed by the European Commission allowing for evaluation, reporting and improvement of the environmental performance. The instrument supports companies in finding the right tools to improve their environmental performance. Third party verification is envisaged to guarantee the credibility of its results and publicly available information for them is further provided, which can be beneficial both from the perspective of communication and relations with external parties and for internal purposes as well (e.g. for the sake of the company's employees motivation). More information about the tool is available at: https://ec.europa.eu/environment/emas/index_en.htm

- Product Environmental Footprint and Organisational Environmental Footprint – they are methods designed to measure and communicate the life cycle environmental performance of products and organizations respectively. The calculation based on them gives quantitative information on the impact of the product or organization, taking into consideration the entire value chain, i.e. following a life cycle approach – starting from raw materials and all the activities connected with their acquisition and pre-processing to pass through manufacturing in all its stages to reach the distribution with the impact of transportation and storage and finish with the influence of consumption and the end of life of the product with its impact on the environment in all the possible aspects (collection, transport, dismantling, sorting, processing into recycled material, landfill, incineration, etc.).

  More information about the methods is available at: https://ec.europa.eu/environment/eussd/smgp/ef_pilots.htm, and https://ec.europa.eu/environment/eussd/smgp/pdf/EF%20simple%20guide_v7_clen.pdf

- EU Ecolabel – it's the official EU voluntary label for environmental excellence certifiying products with a guaranteed, independently-verified low environmental impact and recognized across Europe and around the world. In order to get such a label, the products and services should meet high environmental standards throughout their entire lifecycle. The label also encourages companies to develop innovative products that are durable, easy to repair and recyclable. By using the label, the SMEs give the consumers the opportunity to make informed choices and buy eco-friendly alternatives to conventional products. In 2022 the label officially turned 30 years. More information about the label is available at: https://environment.ec.europa.eu/topics/circular-economy/eu-ecolabel-home_en

- EU Environmental Technology Verification – it helps technology developers to gain credibility for their environmental technologies thereby facilitating their market reach. The technologies are validated by independent third parties. They use the test results to assess the claims about the performance and issue a verification statement. The relevant solutions that can pass through such a certification are: environmental technologies in agriculture, soil and groundwater monitoring and remediation, cleaner production and processes, materials, waste and resources, water treatment and monitoring, energy technologies, air pollution monitoring and abatement. Funding schemes are at hand.

  More information about the instrument is available at:
  https://ec.europa.eu/environment/ecoap/etv_en
  https://ec.europa.eu/environment/ecoap/sites/default/files/pdfs/etv-a4-v4_3_0.pdf

- European Resource Efficiency Knowledge Centre – its purpose is to help European companies, especially SMEs, save energy, material and water costs via providing tools, information and business opportunities showing new and better ways for resources efficiency and CE. Being an initiative of the European Commission, the centre gives SMEs the opportunities for: access to knowledge on the best available technologies and business models and to information on funding sources and technology providers, return on investment upon the adoption of resource efficiency measures, building a green image enabling the targeting of new customers, etc.

  More information about the centre is available at:

  https://circulareconomy.europa.eu/platform/en/dialogue/existing-eu-platforms/erek-european-resource-efficiency-knowledge-centre and

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