Interreg
Greece-Bulgaria
ENGINE-HUBs
European Regional Development Fund

EUROPEAN UNION

Creating "Circular Business" by young ENGINEers at the cross-border area of Greece-Bulgaria

D.4.2.1 – Market and GAP Analysis Report
Deliverable: Market Analysis Report

The contents of this document are sole responsibility of the TEE/TKM and can in no way be taken to reflect the views of the European Union, the participating countries the Managing Authority and the Joint Secretariat.

Partner Responsible for the deliverable:

SBE

SBE 1915 FEDERATION OF INDUSTRIES OF GREECE

November 2022

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

CONTENTS

ABBREVIATIONS **4**

1 CIRCULAR ECONOMY IN BRIEF **5**

1.1 INTRODUCTION 5

1.1.1 The three principles of the Circular Economy *8*

1.1.2 Circular Economy and its benefits for Europe *9*

1.1.3 Circular Economy and its benefits for Greece *11*

1.1.4 Objective of the report *13*

1.2 LEGAL AND INSTITUTIONAL FRAMEWORK 14

1.2.1 Legal and institutional framework in Europe *15*

1.2.2 Legal and institutional framework in Greece *19*

2 TYPES OF RESOURCES - CIRCULAR ECONOMY OPPORTUNITIES **25**

2.1 TYPOLOGY OF WASTES AND CURRENT STATUS 25

2.1.1 Packaging waste *25*

2.1.1.1 Perspectives for increased circularity 27

2.1.2 Excavation, construction and demolition waste *30*

2.1.2.1 Perspectives for increased circularity 31

2.1.3 Waste Electrical and Electronic Equipment (WEEE) *33*

2.1.3.1 Perspectives for increased circularity 34

2.1.4 End-of life vehicles (ELVs) *35*

2.1.4.1 Perspectives for increased circularity 35

2.1.5 Waste lubricating oil *36*

2.1.5.1 Perspectives for increased circularity 37

2.1.6 Agro-food waste *39*

2.1.6.1 Perspectives for increased circularity 40

3 MARKET NEEDS - MARKET ANALYSIS **43**

3.1 GENERAL OVERVIEW OF THE AREA OF INTERVENTION 43

3.1.1 General introduction *43*

3.1.1.1 Greece 43

3.1.1.2 Central Macedonia region 44

3.1.1.3 Western Macedonia region 46

3.1.1.4 Eastern Macedonia and Thrace Region 46

3.1.2 Regional unit of Thessaloniki *47*
3.1.3 Regional unit of Serres *48*
3.1.4 Regional unit of Drama *49*
3.1.5 Regional unit of Kavala *50*
3.2 RESEARCH ON THE WASTE MANAGEMENT OF INDUSTRIES IN THE AREA 52
3.2.1 Methodology on waste registry collection data - Circular economy questionnaire *52*
3.2.1.1 General introduction to the questionnaire 52
3.2.1.2 Methodology for the development of the questionnaire 53
3.2.2 Results of the survey *54*
3.2.2.1 Sample identity 54
3.2.2.2 Current situation regarding waste management 55
3.2.2.3 Other actions to promote circularity 60
3.2.2.4 Mapping the needs of circularity for SMEs 61
3.2.2.5 Motives to support circular economy 65
3.2.3 GIS mapping of circular economy industries *70*
4 CIRCULAR ECONOMY PRIORITIES AND RECOMMENDATIONS 72
4.1 DE-SILOING AND STRENGTHENING ENVIRONMENTAL GOVERNANCE 72
4.2 KEY RECOMMENDATIONS FOR BOOSTING CIRCULAR ECONOMY IN THE AREA OF STUDY 73
4.2.1 Horizontal recommendations *73*
4.2.2 Sectoral recommendations *77*
4.2.2.1 Packaging waste 78
4.2.2.2 Excavation, construction and demolition waste 82
4.2.2.3 Waste Electrical and Electronic Equipment 85
4.2.2.4 End-of life vehicles 87
4.2.2.5 Waste lubricating oil 89
4.2.2.6 Agro-food waste 91
4.3 IDENTIFICATION OF MARKET OPPORTUNITIES 96
4.3.1 Opportunities: Recycle *96*
4.3.1.1 Packaging materials 96
4.3.1.2 Various Plastics 97
4.3.1.3 Electrical equipment 100
4.3.1.4 Metals 101
4.3.1.5 Food 102

4.3.1.6 Waste from fabrics 104

4.3.2 Opportunities: Remanufacture and Reuse 105

4.3.2.1 Electrical equipment 105

4.3.2.2 Packaging material 107

4.3.2.3 Fabrics and textile 108

LITERATURE 109

ANNEX I: MARKET ANALYSIS QUESTIONNAIRE 110

QUESTIONNAIRE - GENERAL INTRODUCTION 110

PART A': GENERAL COMPANY DETAILS (OPTIONAL) 111

PART B: CURRENT STATUS OF CIRCULAR ECONOMY 112

OTHER MEASURES TO PROMOTE "CIRCULARITY" 117

PART C: MAPPING NEEDS OF BUSINESSES WITHIN THE FRAMEWORK OF IMPLEMENTATION OF CIRCULAR ECONOMY ACTIONS 117

PART D: INCENTIVES FOR IMPROVING "CIRCULARITY" 120

PART E: OBSERVATIONS and COMMENTS 122

Abbreviations

Acronyms	Definitions
AD	Anaerobic digestion
CE	Circular Economy
ECDW	Excavation, Construction and Demolition Waste
ELVs	End-of life vehicles
EPR	Extended Producer Responsibility
EU	European Union
EWC	European Waste Catalogue
GG	Government Gazette
JMD	Joint Ministerial Decision
MSW	Municipal Solid Waste
NAPCE	National Action Plan for Circular Economy
NWMP	National Waste Management Plan
PW	Packaging Waste
R&D	Research and Development
SME-SMEs	Small-Medium Enterprises
WEEE	Waste Electrical and Electronic Equipment
YPEN	Ministry of Environment and Energy

1 CIRCULAR ECONOMY IN BRIEF

1.1 INTRODUCTION

Circular economy (hereinafter CE) is the convergence of three concepts: **economy**, **environment** and **society** (Nobre and Tavares, 2021[1]). A systemic change is needed for the transition from a linear to a circular economy where inter-ministerial and inter-territory cooperation will be essential, as well as the sustained collaboration between the public and private sectors, in order to support and promote the exchange of information between researchers, public administrations and businesses and industries, social stakeholders and any kind of organisations and associations committed to the environment, sustainable development and growth, recycling and other pillars of the Circular economy principles.

There is no standard definition of a circular economy, as made clear by for example (Kirchherr *et al*., 2017) who reviewed over 100 different definitions of a circular economy. It is hence challenging to tease out what precisely the circular economy concept does and does not entail. Rather than an academically well-defined concept, circular economy may be seen as a visionary policy concept of a more resource efficient and sustainable economic development. It is perhaps best understood by what it is not: circularity is defined in contrast to the "linear" economy in which products start in a mine and end up in landfills as waste.

"Towards the Circular Economy[2]" report made by the Ellen MacArthur Foundation, world leader in this field, defines CE as:

> "An industrial economy that is restorative by intention and tries that products, components and materials retain their maximum utility and value at all times, distinguishing between technical and biological cycles. This new economic model tries to decouple global economic development from the consumption of finite resources".

In 2015, the European Commission published in its Action Plan for CE[3] the following:

[1] https://www.sciencedirect.com/science/article/abs/pii/S0959652621021910

[2] https://www.ellenmacarthurfoundation.org/es/economia-circular/concepto

[3] COM (2015) 614 final: "Closing the Loop: An EU action plan for the Circular Economy". https://eur-lex.europa.eu/legal-content/ES/TXT/PDF/?uri=CELEX:52015DC0614&from=ES

"The transition to a more CE, where the value of products, materials and resources is maintained in the economy for as long as possible, and the generation of waste minimized, is an essential contribution to the EU's efforts to develop a sustainable, low carbon, resource efficient and competitive economy".

While a definition of CE appears for the first time in 2018 in a proposal for a Regulation of the European Parliament and of the Council, it is not until 2020 that a legal definition of Circular Economy[4]is adopted and exists at EU level, defining it as:

"The transition to a more circular economy, where the value of products, materials and resources is maintained in the economy for as long as possible, and the generation of waste minimized, is an essential contribution to the EU's efforts to develop a sustainable, low carbon, resource efficient and competitive economy".

Similarly, the National Circular Economy Strategy[5] suggests that: "*Circular Economy is both an opportunity and a need for Greece. It is part of the relevant European strategy - which is developing rapidly - and corresponds to the features of the Greek economy. Circular Economy is a major and imperative necessity because Greece is lagging behind significantly, its available resources are limited and the country is characterized by particular geographical aspects (e.g. insularity, remote - mountainous areas). Circular economy can play a catalytic role for productive reconstruction and has a clear regional dimension. It is based on the rational use of resources, the concept of recycling-reuse and the industrial symbiosis model. It aims at and encourages the use of secondary materials and waste as productive resources and useful materials, attributing a sustainable dimension to the productive model.*"

As depicted in the new EU Circular Economy Action Plan 2020[6], one of the central parts of the European Green Deal, the transition to a circular economy "**aims to boost sustainable growth and resource efficiency and paves the way for a cleaner and more competitive economy within EU**".

In this direction, the new National Action Plan on Circular Economy 2021-2025[7], which is aligned with the new EU Circular Economy Action Plan 2020 and its key

[4] https://eur-lex.europa.eu/legal-content/ES/TXT/PDF/?uri=CELEX:52018PC0353&from=EN
[5] https://circulareconomy.europa.eu/platform/sites/default/files/national_circular_economy_strategy.pdf
[6] https://environment.ec.europa.eu/strategy/circular-economy-action-plan_en
[7] https://ypen.gov.gr/wp-content/uploads/2021/03/NEO_SXEDIO_DRASIS_KUKLIKH_OIKONOMIA.pdf

product value chains (e.g., plastics, packaging, electronics, textiles, batteries, vehicles, construction) suggests that "**Greece has set CE in the core of its development strategy, since the transition to a circular model is a requirement for the country to step into a sustainable course**".

In its simplest form, the term circular economy refers to an economy which is more "circular" than today's "linear" economy. The "linearity" of an economy means that materials flow in one direction: from extraction, production, use and final waste disposition. The circular economy instead implies that resources flow in a circular way – instead of being disposed as waste, resources are put back into the material flows through different loops and thus, enters several life cycles. Geissdoerfer *et al*. (2017) define circular economy as "a regenerative system in which resource input and waste, emission, and energy leakage are minimized by slowing, closing, and narrowing material and energy loops." Viewing waste as a resource constitutes a central part in the circular economy. The following figure illustrates how material flows can become more circular through different measures:

Figure 1.1 - *Circular economy measures in a product's life cycle (Source: European Parliament, 2015[8])*

[8] https://www.europarl.europa.eu/news/en/headlines/economy/20151201STO05603/circular-economy-definition-importance-and-benefits

1.1.1 The three principles of the Circular Economy[9]

Principle 1: Preserve and enhance natural capital by controlling finite stocks and balancing renewable resource flows. "This starts by dematerializing utility – delivering utility virtually, whenever optimal. When resources are needed, the circular system selects them wisely and chooses technologies and processes that use renewable or better-performing resources, where possible. A Circular Economy also enhances natural capital by encouraging flows of nutrients within the system and creating the conditions for the regeneration of, for example, soil."

Principle 2: Optimize yields by circulating products, components, and materials at the highest utility at all times in both technical and biological cycles. "This means designing for remanufacturing, refurbishing, and recycling to keep technical components and materials circulating in and contributing to the economy. Circular systems use tighter, inner loops (e.g., maintenance, rather than recycling) whenever possible, thereby preserving more embedded energy and other value. These systems also maximize the number of consecutive cycles and/or the time spent in each cycle, by extending product life and optimizing reuse. Sharing in turn increases product utilization."

Principle 3: Foster system effectiveness by revealing and designing out negative externalities. "*This includes reducing damage to systems and areas such as food, mobility, shelter, education, health, and entertainment, and managing externalities, such as land use, air, water and noise pollution, and the release of toxic substances*."

[9] 1 Ellen Macarthur Foundation, 2015, Towards a Circular Economy: Business Rationale for an accelerated transition

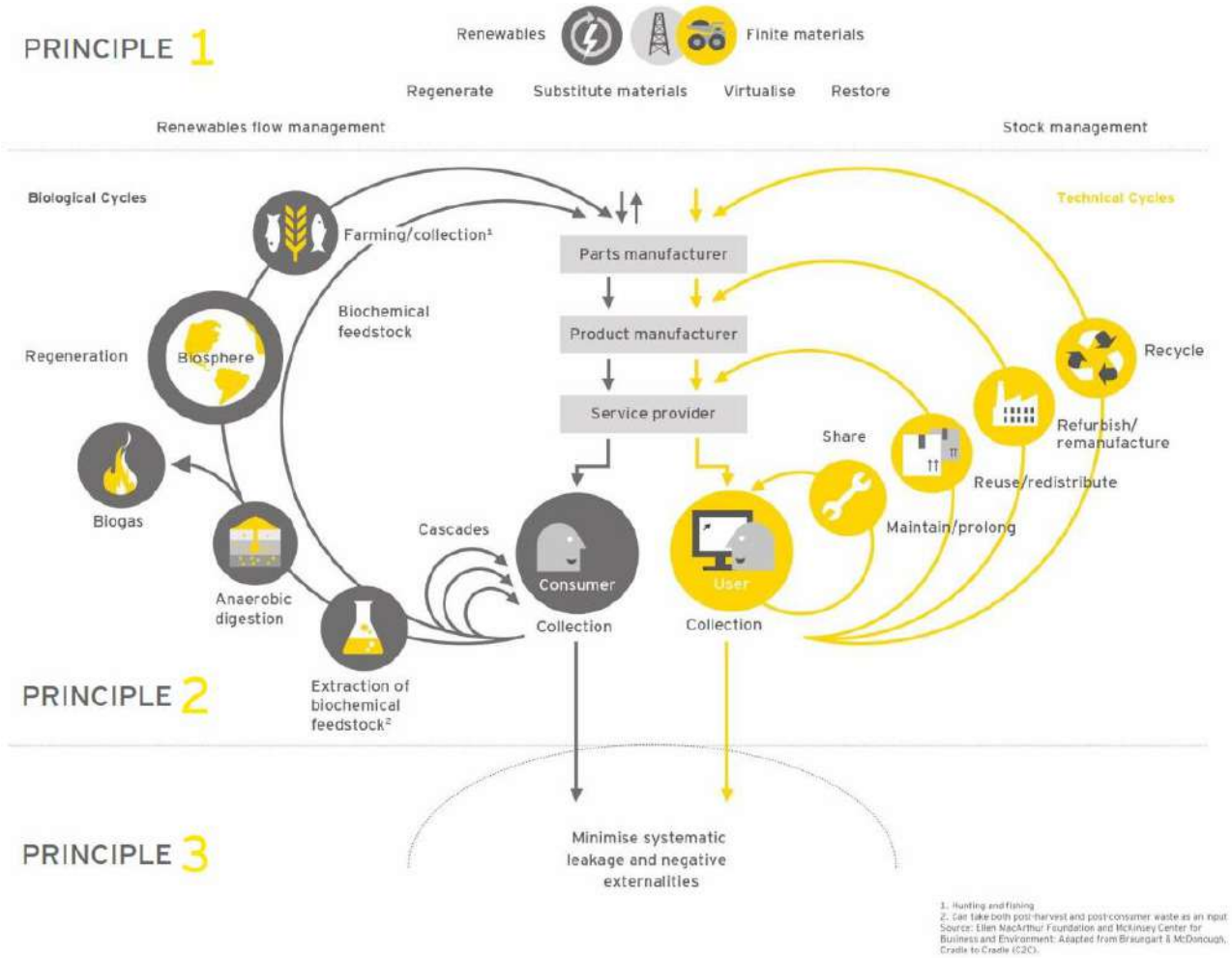


Figure 1.2 - *The butterfly diagram visualizing the circular economy (Source: Ellen Macarthur Foundation, 2015)*

1.1.2 Circular Economy and its benefits for Europe

The Ellen MacArthur Foundation[10] suggests that CE aims to enable effective flows of materials, energy, labor and information so that natural and social capital can be rebuilt. It seeks to reduce energy use per unit of output and accelerate the shift to renewable energy by design, treating everything in the economy as a valuable resource. The final objective is an economy that sustains the value of its products, materials, and resources for as long as possible, while at the same time minimizes the generation of waste throughout production and consumption.

[10] https://ellenmacarthurfoundation.org/

Although the CE is often bracketed together with recycling, these two are very distinct and different and should not be seen as synonymous. Materials that have been jumbled up in the waste stream or have been contaminated lose much of their value, and the recycling process to clean and convert them into usable products can itself consume a large amount of energy. In the CE the emphasis is on designing goods to be long-lasting, easy to repair and reuse, easy to disassemble and easy to remake into items that are as good as, if not better than, their virgin equivalents.

The CE is more than squeezing more life from a fixed stock of resources that have been dug from the ground at the expense of the environment. According to the Ellen MacArthur Foundation2, benefits for Europe from a transition to the Circular Economy could be summarized as follows:

- A Circular Economy could result in overall benefits of €1.8 trillion by 2030, or twice the benefits seen on the current development path (€0.9 trillion)
- By adopting Circular Economy principles, Europe can take advantage of the technology revolution and increase average disposable income for EU households by €3,000, or 11% higher than the current development path
- This would further translate into an 11% GDP increase by 2030 versus today, compared with 4% in the current development path
- The circular model would also benefit households in other ways. For example, compared to the current development path, the cost of time lost to congestion would decrease by 16% by 2030, and close to 60% by 2050
- Carbon dioxide emissions would halve by 2030, relative to today's levels (48% reduction of carbon dioxide emissions by 2030 across the three basic needs studied, or 83% by 2050)
- Primary material consumption measured by car and construction materials, real estate land, synthetic fertilizer, pesticides, agricultural water use, fuels, and non-renewable electricity could drop 32% by 2030 and 53% by 2050, compared with today
- 65 reviewed academic papers indicate that "existing studies point to the positive employment effects occurring in the case that the Circular Economy is implemented".

1.1.3 Circular Economy and its benefits for Greece

Greece suffers from a sustained economic recession and a contemporary energy crisis, which in addition to fiscal measures requires significant structural and regulatory reform, to create a favorable environment for investment. Combined with a trend for divestment, along with the continuing brain drain that diminishes human capital and innovation potential, handicaps Greece's prospects. The Circular Economy model could help leap frog to a next transformational stage that will enable Greece's return to sustainable growth. By addressing technical and biological product life cycles, both upstream and downstream, across key industrials sectors, the Circular Economy could help shift the way our entire economy works, boost job creation, and enable investment.

the Circular Economy could stimulate the necessary dialogue for resolution of chronic confrontational topics, such as waste management including reuse, storage, and treatment. A dialogue of transformation with the State, regional and local government authorities, but also businesses, industry and the civil society, is necessary to change mindsets on the issue of wastes, both municipal and industrial, waste treatment, the location of landfills, avoiding EU penalties levied against unpermitted or dysfunctional waste facilities and landfills, and other dysfunctions of the current context.

In this direction, Greece's Governmental Economic Policy Council endorsed a National Action Plan on Circular Economy in early 2018 to set the country on a path towards the long-term adoption of circular economy principles. This further supports Greece's economic strategy in its key quest to "Green" the economy in a way that creates jobs[11], especially for women and youth, and supports long-term equitable and inclusive growth based on resource efficiency, promotion of SMEs, innovation and investment in new technologies, and strengthening of the "social economy" potential. The long-term (2030) goals of the National Action Plan on Circular Economy can be summarized as follows:

1. Moving up the waste hierarchy by focusing on preventing waste and improving recycling

2. Supporting circular entrepreneurship by promoting "industrial symbiosis" and business clusters

3. Supporting circular consumption patterns of re-using, re-storing and re-pairing rather than buying new products, especially for electrical and electronic devices

[11] https://circulareconomy.europa.eu/platform/en/strategies/national-action-plan-circular-economy

4. Enhancing multi-stakeholder partnerships across industry, academia, and civil society

5. Monitoring progress towards a circular economic model through SMART (specific, measurable, achievable, relevant and time-bound) indicators.

Priority actions for 2018 include:

- **lifting barriers** to a circular economy **through regulatory and legislative interventions**, e.g. integrating circular economy considerations and criteria in the Environmental Impact Assessment and Strategic Impact Assessment requirements for sites and projects as well as in the environmental permitting process or elaborating new legal definitions for wastes, by-products and re-fuse materials after first use intended for re-use, declassification of waste and quality standards for secondary raw materials

- **Earmarking existing funds** to implement the aforementioned interventions and fund demonstration projects

- **Further enhancing knowledge**, understanding, education, awareness and communication

- **Improving governance structures** by setting up an inter-ministerial Executive Secretariat for the Circular Economy to oversee implementation and related Observatory to monitor progress

Prior to this, Greece has already adopted a new Law on Recycling in November 2017 to fully align existing waste legislation with circular economy principles and taken effective measures to reduce the consumption of single-use plastic bags with a ministerial decision in August 2017 that introduced merchant responsibility and set fees for consumers. With these measures and the actions set out in the National Circular Economy Action Plan, Greece aims to achieve the following by 2020:

- ✓ Achieve a radical reduction of the per capita produced waste

- ✓ Increase reuse and recycling of wastes, with a separate collection of recyclable waste and of bio-waste, to reach 50% of total municipal solid waste produced from a 25% where it stands today

- ✓ Reach a 74% recovery and less than 30% disposal of total municipal solid waste produced from the current 82% disposal

- ✓ Create around 15,900 new jobs and the increase of the annual turnover of the waste management related businesses.

1.1.4 Objective of the report

The objective of this report is to conduct a market analysis for the Greek side of the Interreg V-A «Greece-Bulgaria 2014-2020» and especially the regional units of Thessaloniki, Serres, Drama and Kavala. In this framework the following will be researched and developed:

- A horizontal analysis of different types of waste that constitute a major part of industries as well as an integral part of CE. The overall status of circularity will be appreciated
- For each Regional Unit, a survey of industries and SMEs active in the field of CE will be conducted. The aim is to record their business profile and map the dynamic and opportunities for their respective sectors.
- Finally, the perspectives and opportunities from the survey will be recorded extending to the provision of investment opportunities, as a catalyst towards sustainable growth.

The report is based on documentation and analysis of the current legislative and regulatory framework regarding the Circular Economy at EU and national level, as well as on documentation and analysis of the current business approach and perspectives, for selected sectors, based both on primary and secondary research.

On a broader level, the current CE dynamic initiative needs to be well mapped and understood, so that it can be integrated into the policy thinking of Greece in the future. The main objectives of this work could eventually lead to:

- ✓ Use the opportunity to possibly help the long-awaited investment cycle recommence for business in Greece, as and when the needed fiscal and structural reforms take place in Greece,

- ✓ Provide information and benchmarking to Greek businesses to explore transformational initiatives as opposed to simply replicating past experience, by using the incentives and directions inherent in these programs and finally

- ✓ Transform the issue of waste management, recycling of wastes, storing and reusing of wastes, from a field of confrontation to an area where cooperation and win-win solutions can be established.

This report is the final version of the "Market Analysis Report". Therefore, following the approved draft version, delivered in 2022.

1.2 Legal and institutional framework

Legislation provides a general framework for finance and funding conditions as well as for intellectual property rights, which set important principles for stepping ahead with safety and promote innovation.

Regulation is important for entrepreneurs and investors since it provides stability and certainty.

Standards deliver a design and performance benchmark for producers while they inculcate confidence for the consumer. Perhaps most importantly, regulation and standards underpin legal obligations and thereby bound liability for all parties.

Legislation and regulation can play an essential role in shaping markets, influencing behavior, and removing barriers that inhibit progress. Legislating and regulating is an impactful policy lever that is often used in conjunction with other policy levers such as public procurement, urban planning, and fiscal measures. Coherent, symbiotic and planned management of all interventions in waste management, relevant infrastructure and CE is crucial in maintaining safety for the coming steps in the field of CE.

Circularity in production processes

Circularity is an essential part of a wider transformation of industry towards climate-neutrality and long-term competitiveness. It can deliver substantial material savings throughout value chains and production processes, generate extra value and unlock economic opportunities. In synergy with the objectives laid out in the Industrial Strategy[12], the Commission will enable greater circularity in industry by:

- Assessing options for further promoting circularity in industrial processes in the context of the review of the Industrial Emissions Directive[13], including the integration of circular economy practices in upcoming Best Available Techniques reference documents[14].

[12] 16 COM(2020) 102: https://ec.europa.eu/info/sites/default/files/communication-eu-industrial-strategy-march-2020_en.pdf

[13] Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control),OJ L 334, 17.12.2010, p. 17.

[14] https://eippcb.jrc.ec.europa.eu/reference/

- Facilitating industrial symbiosis by developing an industry-led reporting and certification system, and enabling the implementation of industrial symbiosis;
- Supporting the sustainable and circular bio-based sector through the implementation of the Bioeconomy Action Plan[15].
- Promoting the use of digital technologies for tracking, tracing and mapping of resources
- Promoting the uptake of green technologies through a system of solid verification by registering the EU Environmental Technology Verification scheme as an EU certification mark[16].

The new SME Strategy[17] will foster circular industrial collaboration among SMEs building on training, advice under the Enterprise Europe Network on cluster collaboration, and on knowledge transfer via the European Resource Efficiency Knowledge Centre.

1.2.1 Legal and institutional framework in Europe

The EU has developed a portfolio of directives to protect the environment, human health and regulate the water cycle. However, there are gaps in implementation that prevent the existing legislation from achieving its objectives.

More analytically, the European Commission launched the first European Circular Economy Action Plan in 2015[18]. The second "Circular Economy Action Plan: for a Cleaner and more Competitive Europe" from 2020[19] forms an important part of the EU Green Deal[20], the new growth strategy for EU, which aims to "*transform the EU into a fair and prosperous society, with a modern, resource-efficient and competitive economy where there are no net emissions of greenhouse gases in 2050 and where economic growth is decoupled from resource use*." A transition of European industry to a cleaner and more circular industry is a key element of the "Green Deal", which is implemented through several specific strategies. The chemicals strategy for sustainability addresses a toxic-free environment and aims to protect citizens and the environment from hazardous chemicals. The Industry

[15] COM(2018) 763: https://ec.europa.eu/regional_policy/sources/tender/pdf/official/2018_financing_decision_ta.pdf
[16] https://green-business.ec.europa.eu/eco-innovation_en
[17] COM(2020) 103: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2020%3A103%3AFIN
[18] https://environment.ec.europa.eu/topics/circular-economy/first-circular-economy-action-plan_en
[19] https://environment.ec.europa.eu/strategy/circular-economy-action-plan_en
[20] https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en

Strategy and the new Circular economy action plan jointly address how to transform the European industry into a climate neutral, circular and digital industry[21].

The main document related to CE is the **Action Plan towards Circular economy (2020)**, which indicates that waste management plays a central role in the transition to a circular economy. The plan requires the Commission to take measures:

- Revise waste targets (proposal adopted in December 2015)
- Communication on waste to energy (adopted in January 2017)
- Disseminate good practices on 4 separate collections (specific study available on DG Environment website)

It also presents measures to:

- Make sustainable products the norm in the EU
- Empower consumers and public buyers
- Focus on the sectors that use most resources and where the potential for circularity is high such as: electronics and ICT; batteries and vehicles; packaging; plastics; textiles; construction and buildings; food; water and nutrients
- Ensure less waste
- Make circularity work for people, regions and cities,
- Lead global efforts on circular economy.

Historically, active steps in the framework of CE have been taken in the European Union since 2014, though relevant aspects appeared in EU regulations as early as in the 1970s. The following may be cited as examples:

[21] Other strategies in the Green Deal include, e.g., the Farm to Fork strategy, which aims to design a fair, healthy and environmentally friendly food system; the Biodiversity strategy for 2030, with global targets to protect biodiversity and address the main causes for biodiversity loss within EU; and the European strategy for Plastics in a Circular Economy, which aims to transform plastics in accordance with circular principles such as recyclability and reparability and promote and develop more sustainable materials.

EU Body	Type of regulation and title	Link
Waste Management		
European Parliament: Council of the European Union.	Directive 94/62/EC on packaging and packaging waste; European Parliament and Council of the European Union: Brussels, Belgium, 1994.	https://eur-lex.europa.eu/legal-content/PL/TXT/?uri=celex%3A31994L0062
The Council of the European Communities	Council Directive 75/442/EEC on Waste; The Council of the European Communities: Brussels, Belgium, 1975	https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A31975L0442
The Council of the European Communities	Council Regulation (EEC) No 259/93 on the supervision and control of shipments of waste within, into and out of the European Community; The Council of the European Communities: Brussels, Belgium, 1993	https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=celex:31993R0259
The Council of the European Communities	Council, Directive 85/337/EEC on the assessment of the effects of certain public and private projects on the environment; The Council of the European Communities: Brussels, Belgium, 1985	https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A31985L0337
The Council of the European Communities	Council Directive 1999/31/EC on the landfill of waste; The Council of the European Union: Brussels, Belgium, 1999	https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A31999L0031
Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions	COM(2005) 666 final Thematic Strategy on the prevention and recycling of waste: Taking sustainable use of resources forward: A Thematic Strategy on the prevention end recycling of waste	http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52005DC0666
Assessment of the impact of public and private undertakings on the environment		
The Council of the European Communities	Council Regulation (EEC) No 259/93 on the supervision and control of shipments of waste within, into and out of the European Community; The Council of the European Communities: Brussels, Belgium, 199	https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A31985L0337
Recycling of end-of-life vehicle		
European Parliament; Council of the European Union	European Parliament; Council of the European Union	https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32000L0053
The adopted Sixth Environment Action Programme		
European Parliament and of the Council	Decision No 1600/2002/EC laying down the Sixth Community Environment Action Programme, European Parliament and Council of the European Union: Brussels, Belgium, 2002.	https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32002D1600&from=EN
Roadmap to a Resource Efficient Europe		
European Commission	Roadmap to a Resource Efficient Europe - COM(2011) 571 Final; European Commission: Belgium, Brussels, 2011.	https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2011:0571:FIN:PL:PDF

EU Body	Type of regulation and title	Link
Monitoring framework for the Circular Economy		
European Commission	Measuring Progress Towards Circular Economy in the European Union—Key Indicators for a Monitoring Framework; European Commission: Strasbourg, France, 2018	https://publications.jrc.ec.europa.eu/repository/handle/JRC110701
EU Action Plan for the Circular Economy		
Commission of European Communities	Closing the Loop—An EU Action Plan for the Circular Economy; Communication No. 614; (COM (2015), 614); Commission of European Communities: Brussels, Belgium, 2015	https://eur-lex.europa.eu/resource.html?uri=cellar:8a8ef5e8-99a0-11e5-b3b7-01aa75ed71a1.0012.02/DOC_1&format=PDF
European Parliament; Council of the European Union	"A New Circular Economy Action Plan. For a Cleaner and More Competitive Europe" (2020)	https://environment.ec.europa.eu/strategy/circular-economy-action-plan_en
Regulations and Directives		
European Parliament and of the Council	Regulation (EU) 2018/848: Regulation (EU) 2018/848 of the European Parliament and of the Council of 30 May 2018 on organic production and labelling of organic products and repealing Council Regulation (EC) No 834/2007	https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX:32018R0848
European Parliament and of the Council	Directive (EU) 2018/849: Directive (EU) 2018/849 of the European Parliament and of the Council of 30 May 2018 amending Directives 2000/53/EC on end-of-life vehicles, 2006/66/EC on batteries and accumulators and waste batteries and accumulators, and 2012/19/EU on waste electrical and electronic equipment (Text with EEA relevance)	https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32018L0849
European Parliament and of the Council	Directive (EU) 2018/850: Directive (EU) 2018/850 of the European Parliament and of the Council of 30 May 2018 amending Directive 1999/31/EC on the landfill of waste	https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32018L0850
European Parliament and of the Council	Directive (EU) 2018/851: Directive (EU) 2018/851 of the European Parliament and of the Council of 30 May 2018 amending Directive 2008/98/EC on waste	https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32018L0851
European Parliament and of the Council	Directive (EU) 2018/852: Directive (EU) 2018/852 of the European Parliament and of the Council of 30 May 2018 amending Directive 94/62/EC on packaging and packaging waste	https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:32018L0852
Europe 2020 Strategy		
European Commission	Europe 2020 Strategy: A strategy for smart, sustainable and inclusive growth	https://ec.europa.eu/eu2020/pdf/COMPLET%20EN%20BARROSO%20%20%20007%20-%20Europe%202020%20-%20EN%20version.pdf

1.2.2 Legal and institutional framework in Greece

National Strategy for Circular Economy

Greece has adopted a **National Strategy for Circular Economy** since December 2018. It aims at promoting circular economy in Greece and it aligns with the development strategy of the country. It includes a series of actions such as development of strategy for green public procurement, reduce of food waste, promotion of circularity in industrial processes, increase of water reuse, finalization of the legislative framework on waste management, development of circular economy standards and indicators for monitoring of the circular economy strategy implementation etc.

Important lessons learnt from the National Strategy for Circular Economy include the increase of awareness of relevant Ministries, local authorities, regions and municipalities, businesses, consumers, and professional organizations on circular economy issues. Also, circular economy principles have started to be a component of the development strategy planning at public (national and local level) and at private sector. Furthermore, an Interministerial Committee and a National Council for circular economy (a board of involved national professional producers) have been developed and are in operation in order to support the Ministry for the Environment for planning strategies and taking decisions and measures on circular economy issues.

A number of actions have been finalized such as the adoption of the National Plan for Green Public Procurement, the National Plan for Waste Management, the legislation on Single Use Plastics. Additionally, a number of actions are ongoing such as the use of certain waste for alternative fuels, increase of circularity in industrial processes, promotion of industrial symbiosis and implementation of the Extended Producer Responsibility (EPR) for certain waste streams according to the EU legislation.

Other actions include the National Plan for Waste Prevention, the legislative framework on Waste Packaging, the development of national standards and indicators for circular economy. Moreover, following the new EU Circular Economy Action Plan (March 2020), Greece has developed a New Circular Economy Action Plan with a corresponding Roadmap. The new National Circular Economy Action Plan aims at fostering the shift towards a circular sustainable development model by boosting competition and protecting the environment.

Circular Economy and Waste Management

The regulatory framework for waste management in Greece comprises of several pieces of legislation that are based on EU Law. The main driver has been Directive

2008/98/EC on waste, which has been transposed into Greek legislation with Law 4042/2012 on Waste Management.

Throughout the last decade, a significant number of Directives and Decisions regulating specific problems on waste management have been adopted at a national level. Recently, Law 4685/2020 on the modernization of the environmental legislation incorporated into Greek legislation, Directives (EU) 2018/844 and 2019/692.

In terms of waste management, Law 4685/2020 provides for the National Waste Management Plan (NWMP), which is approved by the Ministerial Council, following a proposal by the Minister of Environment and Energy. The new NWMP applies for the implementation period 2020-2030 and has been drafted in line with the provisions of art. 22 and 35 of Law 4042/2012, as amended by art. 83 of Law 4685/2020.

The new national plan on waste management is oriented to the following targets:

- ✓ The reduction of the amount of waste being buried in landfills to below 10% by 2030.
- ✓ The implementation of the separate collection for waste and bio-waste materials. In particular for bio-waste, article 41 of Law 4042/2012, as replaced by par. 2 of article 84 of Law 4685/2020, stipulates that from 31 December 2022, biological waste will be either separated and recycled at source, or collected separately and not mixed with other types of waste. Therefore, the separate collection of biological waste becomes mandatory as of 31 December 2022.
- ✓ The development of a network for the collection of organic waste (coffee bin) by the end of 2022.
- ✓ The recovery of energy from the treatment of organic waste (biomass) and also the production of secondary materials (compost).
- ✓ The construction and operation of Waste Treatment Plants and Bio-Waste Treatment Plants.

In the context of the new national plan, waste management responsibilities for packaging producers and producers of Electric and Electronic Equipment are also highlighted, whereas the creation of new systems of extended responsibility for the producers of specific categories of municipal waste such as furniture, mattresses, greenhouse waste and others are also provided.

In addition, Ministerial Decision no. 99398/6484 (Government Gazette 4656 B'/2020) was issued in relation to the "*Classification of public and private projects and activities in categories and subcategories, according to article 1 par. 4 of Law 4014/2011*". By virtue of this Decision, Processing Facilities (recovery and disposal) of Municipal Solid Waste (MSW) are elevated from sub-category A2 (projects and activities that are likely to cause significant impact on the environment) to sub-category A1 (projects and activities that are likely to cause very significant impact on the environment).

The Ministerial decision contributes to the establishment of a unified and stricter legislative framework in terms of the environmental licensing for Waste Processing Facilities, whereas at the same time provides for the shortening of the relevant procedures and guarantees a high level of environmental protection.

Main regulatory documents for Circular Economy

The main regulatory documents for Greece are:

1. The **National Strategy for Circular Economy** (YPEN, 2018[22])
2. The operational **new National Action Plan on Circular Economy 2021-2025** (YPEN, 2021[23]), which is aligned with the new EU Circular Economy Action Plan 2020 and its key product value chains (e.g. plastics, packaging, electronics, textiles, batteries, vehicles, construction).
3. The **National Waste Management Plan** (NWMP, 2020[24])
4. The **National Waste Prevention Program** (NWPP, 2022[25])
5. The **Framework law on waste** (L. 4819/2021 – Official Gazette A' 129)**.**
6. The **Law on single-use plastics** (L. 4736/2020 – Official Gazette A' 200).
7. The **Joint Ministerial Decision on landfill** (JMD/90439/1846/2021)

Other national plans of high relevance to the implementation of circular economy

[22] https://ypen.gov.gr/wp-content/uploads/2020/10/%CE%95%CE%B8%CE%BD%CE%B9%CE%BA%CE%AE-%CE%A3%CF%84%CF%81%CE%B1%CF%84%CE%B7%CE%B3%CE%B9%CE%BA%CE%AE-%CE%93%CE%B9%CE%B1-%CF%84%CE%B7%CE%BD-%CE%9A%CF%85%CE%BA%CE%BB%CE%B9%CE%BA%CE%AE-%CE%9F%CE%B9%CE%BA%CE%BF%CE%BD%CE%BF%CE%BC%CE%AF%CE%B1.pdf

[23] https://ypen.gov.gr/wp-content/uploads/2022/03/SXEDIO-DRASHS-KO-8.pdf

[24] https://ypen.gov.gr/wp-content/uploads/2021/02/%CE%B5%CE%B3%CE%BA%CF%81%CE%B9%CF%83%CE%B7-%CE%95%CE%A3%CE%94%CE%91.pdf

[25] https://www.myota.gr/wp-content/uploads/2022/05/apovlita_programma.pdf

- The **National Green Public Procurement Action Plan** (GPP, 2021[26])
- The **National Plan for Energy and Climate** (NPEC, 2019[27])

The waste sector is a key pillar for the implementation of circular economy, included in the EU Action Plan for Circular Economy, revised in March 2020 COM(2020)98 , which under the slogan "Less waste, more value" focuses on disconnecting waste generation from economic development, linking product policies and waste policies to the prevention of waste generation, as well as developing the market for secondary raw materials in order to achieve circular use of materials and resource efficiency. In particular, the implementation of the national waste policy is applied through the NWMP, which was ratified by a Cabinet Act on August 31, 2020 (A' 185) and the NWPP, which was approved by the Cabinet in June 2021 and ratified on April 24 2022 (A' 83). These plans set out the strategic priorities and targets until 2030 for the implementation of the new EU waste legislation based on circular economy principles.

Greece's national development strategy recognizes that the transformation of the economy from a linear to a circular model presents significant development potential that supports entrepreneurship, investment and employment, while adding a sustainable dimension to growth. This policy is mainly implemented through the National Strategy for Circular Economy adopted in December 2018, which is implemented through its operational action plan 2018-2019, which was revised in November 2021 and ratified on 29 April 2022 (A' 84). The National Action Plan for Circular Economy (NAPCE) is a road map with a four-year duration (2021-2025) and includes 71 actions that will allow the country's economy to become sustainable and at the same time competitive. This plan is fully aligned with the directions of the revised EU circular economy action plan and it is compatible with national waste planning and related development policies at sectoral and national level, taking into account all relevant waste legislation launched in 2020-2021. The aim of these actions is to contribute substantially to, the transformation towards a circular economy, the development of new business opportunities and the strengthening of existing entrepreneurship, the creation of new markets for certain products and the establishment of rules, incentives and

[26] https://www.mindev.gov.gr/wp-content/uploads/2021/03/%ce%a6%ce%95%ce%9a466%ce%92_08022021_%ce%91%ce%a0%ce%9f%ce%a6%ce%91%ce%a3%ce%97_%ce%95%ce%93%ce%9a%ce%a1%ce%99%ce%a3%ce%97-%ce%a3%ce%a7%ce%95%ce%94%ce%99%ce%9f%ce%a5-%ce%94%ce%a1%ce%91%ce%a3%ce%97%ce%a3_%ce%a0%ce%a1%ce%91%ce%a3%ce%99%ce%9d%ce%95%ce%a3-%ce%94%ce%97%ce%9c%ce%9f%ce%a3%ce%99%ce%95%ce%a3-%ce%a3%ce%a5%ce%9c%ce%92%ce%91%ce%a3%ce%95%ce%99%ce%a3.pdf

[27] https://ypen.gov.gr/wp-content/uploads/2020/11/%CE%A6%CE%95%CE%9A-%CE%92-4893.2019.pdf

funding tools in order to develop the economy towards a new and more sustainable direction.

On the institutional level, the General Secretariat of the Ministry of Environment & Energy (YPEN) is the coordinating authority on circular economy issues. YPEN presides over the Inter-ministerial Committee and the National Council – Advisory Committee of Productive and Social Agencies for Circular Economy, which are expected to be permanent bodies and will contribute to the formulation of policies for circular economy.

Financial tools for Circular Economy

The National Action Plan includes a series of concrete actions to be implemented over the period 2021 – 2025, with the specification of the key entity in charge for their implementation. These actions cover circular economy issues such as production, consumption, waste management as well as horizontal issues related to governance and administration arrangements.

In more detail, the concrete time-bound actions included, focus on:

- Production, consumption, waste management and horizontal issues related to governance and administration;
- Products and services which are resource intensive and where the potential for circularity is high, such as: electronics and ICT; batteries and vehicles; packaging; plastics; textiles; construction and buildings; food waste and water use.

In particular, the General Secretariat for Industry within the framework of the National Action Plan for Circular Economy, in accordance with the European Plan Action Plan for Circular Economy and the requirements of the UN Agenda 2030 for sustainable Development, aims to promote circular economy through:

- Financial tools and aids
- Reduction of administrative burdens and red tape barriers.
- Design and establishment of regulatory framework
- Actions for the efficient association of SMEs and society with technological innovation and developments. Provision of support to pilot circular economy projects.

Within the New Industry Policy, Circular Economy is regarded as business opportunity, at the same time promoting the achievement of targets set in the National Waste Management Plan.

During the previous National Operational Framework period the General Secretariat for Industry provided financial aid for SMEs through three "state-aid" programmes (namely "*Green infrastructures*", "*Green enterprise*" and "*Relocation of entreprises to industrial areas and business parks*") aiming to promote recycling and reuse of waste materials, and to improve the environmental fingerprint of industries. The total budget for these programmes was over 17,000,000 euros of which public expenditure was 6,818,000 euros.

In the current National Operational Framework, the "state-aid" programme « *Environmental Infrastructures*» is currently on going. The programme provides financial aid to SMEs for new investments in the field of reuse and recovery of materials from all waste streams, thus promoting circular economy and creating added value materials. The total public expenditure allocated for this ongoing project is 40,000,000 euros. The programme addresses both new and existing companies. The minimum budget for an individual project is 400,000 euros and the maximum 3,000,000 euros. The maximum percentage of public expenditure varies depending on the size of the company (very small, small, medium) and on the district of the investment and can be up to 55%. So far, up to 70 companies have submitted proposals for the programme. Within the same scope, state-aid programmes are currently under consideration for the coming National Operational Framework. These programmes aim to encourage enterprises to adopt an environmental approach to their activities, to reinforce recycling/ reuse and material recovery from waste, especially in waste streams where Greece falls behind the national targets, to benefit from high added value recovered materials, and to promote products made from recycled / refuse derived materials or alternative raw materials especially in the plastic manufacturing industry.

2 TYPES OF RESOURCES - CIRCULAR ECONOMY OPPORTUNITIES

Each product is made up of its own information depending on the system in which it is distributed, therefore knowledge of its technical properties is necessary. More specifically, these properties include the business or consumer model that determines the product life cycle, the societal and governance factors and constraints that determine the product life cycle, and the macro-scale effects of similar product life cycles on specific area.

According to the European Commission, to promote and transition to a circular economy, we must take into account all actions that support the value chain of the business. An organization's internal operations must adopt the circular economy at every step of the chain, from production to consumption, repair and remanufacturing, waste management and secondary raw materials that are re-entered into the economy.

2.1 Typology of wastes and current status

2.1.1 Packaging waste

The definition for Packaging Waste (PW) refers to "*any product, made of any kind of material from raw materials to processed materials and intended to be used to contain goods for the purpose of their protection, handling, disposal and presentation from the producer to the user or consumer*". All single-use or multiple-use items used for the harmonization of national measures regarding packaging and packaging waste and the prevention or reduction of their impact on the environment, the European Union has eventually proceeded to issue Directive 1994/62/EC on 'packaging and packaging waste', which also takes into account the following EU Directives:

a) Directive 2004/12/EC, mainly with regard to the quantitative targets for the recovery and recycling of packaging waste and Annex I,

b) Directive 2013/2/EU with regard to Annex I

c) Directive 2015/720/EU with regard to reducing the consumption of lightweight plastic carrier bags.

The EU directives on packaging waste were transposed into national law by means of the following legislative acts:

1. Law 2939/2001 on 'packaging and alternative management of packaging and other products – establishment of a national organization for alternative management of packaging and other products and other provisions thereof',

2. Joint Ministerial Decision 9268/469/07 on 'the modification of the quantitative targets for the recovery and recycling of packaging waste in accordance with Article 10 (paragraph A1, last section) of Law 2939/2001 (Government Gazette Issue 179/A), and other provisions thereof',

3. Joint Ministerial Decision 54461/1779/E.103 on 'the replacement of Annex I of Article 4 of Joint Ministerial Decision 9268/469/2007 (Government Gazette Issue 286B), in compliance with the provisions of Directive 2013/2/EU',

4. Joint Ministerial Decision 180036/952/2017 on 'laying out measures and rules for reducing the consumption of plastic carrier bags, in compliance with Directive 2015/720/EU' .

Meanwhile, as of 2013, Joint Ministerial Decision 8197/90920, on establishing a National Action Plan for the implementation of Directive 2009/128/EC and the protection of human beings and the environment, had come into effect, and Article 29 thereof determines the requirements for the management of empty agrochemical containers.

Finally, Law 4496/2017 on the amendment of Law 2939/2001 on the alternative management of packaging and other products, adjustment to Directive 2015/720/EU, regulation of Hellenic Recycling Agency issues and other provisions thereof brought about fundamental changes to the provisions on alternative management in general and on the alternative management of packaging waste in particular, with a view to improving performance and efficiency, enhancing transparency and keeping the public informed. or the same purpose are considered packaging.

Eurostat data on packaging waste for the EU-15 (for which there is a longer series of data) suggests an increasing use of plastic and paper/cardboard and a (marginal) decrease in the use of metal and glass. While the amount of metal and glass packaging has decreased very slightly, these decreases are offset by increases in plastic and paper/cardboard. On the other hand, the packaging industry in Greece is developing. The production of packaging waste was estimated at 814,700 tons for the year 2018, a total increase of 4% compared to

2017. According EOAN[28] the recycling rate of packaging waste reached 63.6% in 2018, although it still remains below the EU average (67.5% in 2017) with the exception of paper and cardboard, which reached a recycling rate of 91.5%. These recycling rates are not calculated based on the new calculation points as defined by the European Commission, so they appear relatively high. The minimum national recycling target rates per packaging material by weight, are the following (over time):

Recycling by weight (b.w.)	Minimum Target for 2005-2010	Recycling targets by 2020 (NWMP 2010-2020)	Recycling targets by 2025 (NWMP 2020-2030)	Recycling targets by 2030 (NWMP 2020-2030)
Recycling % of the total	25% - 45%	55%	65%	70%
Glass	15%	60%	70%	75%
Paper/cardboard	15%	60%	75%	85%
Metal / ferrous metal	15%		70%	80%
Metal / Aluminium	15%	50%	50%	60%
Plastic	15%	22.5%	50%	55%
Wood	15%	15%	25%	30%

2.1.1.1 Perspectives for increased circularity

Packaging in a circular economy means that all wastefulness is eliminated from the packaging chain and that no raw materials are lost. According to the Netherlands Institute for Sustainable Packaging[29], this means:

- Minimizing the use of raw materials by using fewer materials for the development of packaging materials, but also wasting less product;
- Ensuring that the raw materials used for packaging materials come from renewable sources whenever possible. It is important that these sources are properly managed, so important nutrients are preserved for the environment;
- Designing product-packaging combinations, materials, and processes in such a way that raw materials continue to cycle. This is realized by reusing

[28] https://www.eoan.gr/
[29] https://kidv.nl/packaging-in-a-circular-economy

packaging materials whenever possible and recycling materials in a lasting manner;

- Designing product-packaging combinations in such a way that all negative aspects are eliminated. This mainly concerns negative effects on our food supply, health, water supply, land usage, and air pollution.

More specifically, the packaging industry in Greece has made progress in integrating Circular Economy elements into its value chain:

Production phase

- Preventing waste at source: Preventing waste at source is now a common practice across the packaging industry, ensuring that less waste ends up in landfill by reducing or preventing it during the production phase.

- Hiring/leasing equipment from suppliers: It is noted that the leasing of equipment from suppliers is increasing and becoming a common practice, reducing medium- and long-term capital costs.

- Water minimization/recycling measures: In the majority of packaging production facilities, water consumption reduction and water reuse indicators have been set (or should be set), which are monitored on an annual basis to ensure a closed loop system is implemented.

Packaging design/ procurement contracts

Low weight: The largest materials and packaging industries continue to reduce the weight of packaging of all kinds wherever possible, both to reduce costs and impact on carbon emissions. Positive examples from the industry in Greece include significant weight reduction in glass packaging, plastic packaging (e.g., water bottling companies), aluminum packaging as well as replacing glass with plastic.

Design/specification for recyclability: Some of the major packaging producers in Greece focused mainly on the design of plastic packaging in order to facilitate sorting and recycling. In this context they focus on monomer-polymer designs, for example 100% PP bags or 100% PET trays.

Avoidance of hazardous substances (design/specification): Avoidance of hazardous substances and "problematic" materials remains high on the priority list when it comes to packaging, and especially in relation to packaging food. For example, *oxo biodegradable plastics* are now banned by law in the EU from 2021

due to the amount of microplastics that are released into the environment at the end of life of the product.

Innovation and Materials Technology: Various examples at the national level testify to a shift towards innovation and technology, such as PureCycle Technologies[30], NaturALL Bottle Alliance and other practices.

Collaborations: AGMPM[31] (Association of the Greek Manufacturers of Packaging & Materials) started its collaboration with EUROPEN[32] (European Organization for Packaging and the Environment) in the framework of the Circular Economy.

Overall, it appears that packaging producers in Greece are working more closely with their suppliers to improve their supply chain and set contract specifications that meet EU product targets and standards.

Plastics

Waste prevention: Preventing waste at source is now a common practice throughout the plastics industry in Greece, ensuring that less waste is sent to landfill.

Use of recycled content: The frequency of use of recycled material content is increasing in the plastics industry focusing on PP/PC/PE packaging solutions for the food and chemical/paint sectors, including recycled polypropylene (rPP).

Recycling (Open / Closed Loop): Recycling is common practice in the plastics industry, through the utilization of production residues as feed to the production plant (e.g. reprocessing) and to produce good quality PE (LDPE, HDPE), PP, PS, PET and PVC for use in other applications.

Circular economy business model: Regarding the circular economy business models in the plastics industry there is the EuCertPlast certification[33]. EuCertPlast's specifications focus on the traceability of plastic materials (throughout the recycling process and supply chain). The certification system itself operates according to the European Standard EN 15343: 2007.

Cooperation: The Association of Hellenic Plastics Industries (AHPI) is a member of Plastics Europe and works closely with the Association and its members. Specifically, it takes part in the effort of the European Plastics Industry

[30] https://www.purecycle.com/
[31] https://www.pac.gr/?lang=en
[32] https://www.europen-packaging.eu/
[33] https://www.eucertplast.eu/

Association, through "*Plastics 2030 -Voluntary Commitment*"[34] issued by Plastics Europe. Other similar, key partnerships include: the participation of companies in the CEFLEX[35] European consortium, a European consortium of flexible packaging and plastics value chains, the participation in Plastics Recyclers Europe[36] and the creation of the "Plastics for People (PfP)[37]".

Research and Development (R&D): Continues to grow in the plastics industry in Greece.

2.1.2 Excavation, construction and demolition waste

The definition for Excavation, Construction and Demolition Waste (ECDW) refers to "*any material or object from excavations, constructions and demolitions that is considered as waste*" within the meaning of article 2 (item a) of no. 50910/2003 GG, in conjunction with par. 4 of article 2 of Law 2939/2001 and included in Appendix I of article 17 of GG 36259/1757/E103/2010. (par. 1, article 3, GG 36259/1757/E103/2010).

The main national legislative act for the alternative management of excavation, construction and demolition waste (ECDW) is JMD 36259/1757/E103/2010 (GG 1312/B/24-08-2010) on measures, terms and programmes for the alternative management of excavation, construction and demolition waste (ECDW), as supplemented by Article 181, Mining and quarry operations within forests and forested areas, of Law 4001/2011 (GG 179/A/22-08-2011) and Article 40 on issues relating to the excavation, construction and demolition of waste of Law 4030/2011 (GG 249/A/25-11-2011) as amended and replaced by Article 51 of Law 4280/2014 (GG 159/A/08-08-2014) on the 'environmental upgrade and private urban development – sustainable development of settlements – forestry legislation and other provisions', but also Article 17 of Law 4067/2012 (GG 79/A/09-04-2012), New Building Regulation.

ECDW managers are considered to be the contractors of public or private projects (constructors, contractors of technical and building works, equipment rental organizations and providers of WEEE temporary storage, collection and transfer services) or the project owner if the project has not been assigned to a contractor.

[34] https://plasticseurope.org/media/european-plastics-producers-call-for-a-mandatory-eu-recycled-content-target-for-plastics-packaging-of-30-by-2030-3/
[35] https://sustainablepackaging.org/circular-economy-flexible-packaging-ceflex/
[36] https://www.plasticsrecyclers.eu/
[37] https://www.facebook.com/plasticsforpeople/

Article 12 of Joint Ministerial Decision 36259/1757/E103/2010 (Government Gazette Issue 1312/B/24-08-2010) sets quantitative targets for the utilization of construction and demolition waste (CDW), which is updated and reinforced by Article 27 of Law 4042/2012 (Government Gazette Issue 24/A/13-02-2012). According to the above, targets are set for the preparation for reuse, recycling, recovery of other materials (including backfilling operations where waste is used to substitute other materials) of non-hazardous construction and demolition waste, excluding materials found in nature under **code 17 05 04** of the European Waste Catalogue (EWC i.e., ECDW), as follows:

- ✓ **by 2020, recovered ECDW must amount to 70% of the total weight of CDW generated in the country**

Other, qualitative targets include:

- ✓ Recycling and recovery of other materials, including backfilling operations using waste to replace other materials by 2020,
- ✓ Increasing geographical coverage (through systems alternative management,
- ✓ EPR-Extended Producer Responsibility),
- ✓ Enforcement of the legal framework or relevant procedures, where required, regarding the mandatory proper management of ECDW for private and public projects, and
- ✓ Improvement of the operation and economic performance of EPR systems.

2.1.2.1 Perspectives for increased circularity

Around the world, ECDW policies and legislation adopt the 3R or 4R waste minimization system, i.e., reduce, reuse, recycle, and recover:

Figure 2.1 - *Waste Management Hierarchy*

In this direction, the following strategies for the management of CDW are adopted:

Reduce ECDW: The ECDW is identified and quantified in order to decide what treatments are necessary for its separation and recycling. For reduction, prevention and finally collection, a construction life-cycle study is carried out in the design phase, which demonstrates opportunities for the use of prefabricated and recycled materials and modern construction methods. In addition, success in managing ECDW is achieved via adequate logistics and innovation in the practices of handling and storage of the materials.

Reuse ECDW as primary material: The main action is focused in their use as alternative materials in the cement industry. Specifically, the local cement industry can co-process further quantities of aggregates of materials from ECDW, replacing limestone (key element of clinker) and to enable the simultaneous recovery of larger quantities of ECDW produced.

Reuse ECDW as alternative fuels: The use of ECDW as alternative fuels is a well know "*Best Available Technique*" in the cement industry. The use of waste as well as ECDW as an alternative fuel for energy production can make sense if this waste cannot to be recycled and then it only makes sense if this offers the better environmental result overall.

ECDW recycling: According to estimates, the recycling rate of ECDW in Greece it ranged between 12% and 15% in 2015. Considering that the geographical coverage of existing alternative management systems gradually increases from 2015, it is expected that the recycling rate of ECDW in Greece is currently higher

than 15%, but the current rate of recycling/reuse cannot be precisely determined, due of the fact that the calculation of the quantities of CDW produced in the country is mainly based on estimates.

2.1.3 Waste Electrical and Electronic Equipment (WEEE)

The definition for Waste Electrical and Electronic Equipment (WEEE) refers to "*Electrical and electronic equipment that is considered waste*", within the meaning of article 11 paragraph 1 of Law 4042/2012, including all components, assembled parts and consumables, which constitute part of the product at the time of its disposal (para. 1 e), article 3, Official Decree of the US 23615/651/E.103/2014). As of 15 August, 2018, WEEE is categorized as follows:

- Heat exchange equipment;
- Screens, monitors, and equipment containing screens having a surface greater than 100 cm2;
- Lamps;
- Large equipment (any external dimension over 50 cm) including, but not limited to: Household appliances, IT and telecommunication equipment, consumer equipment, lighting equipment, equipment reproducing sound or images, musical equipment, electrical and electronic tools, toys, leisure and sports equipment, medical devices, monitoring and control instruments, automatic dispensers, equipment for the generation of electric currents. This category does not include equipment included in categories 1 to 3.
- Small equipment (no external dimension over 50 cm) including, but not limited to: Household appliances, consumer equipment, lighting equipment, equipment reproducing sound or images, musical equipment, electrical and electronic tools, toys, leisure and sports equipment, medical devices, monitoring and control instruments, automatic dispensers, equipment for the generation of electric currents. This category does not include equipment included in categories 1 to 3.
- Small IT and telecommunication equipment (no external dimension over 50 cm).

The recycling of WEEE is of great significance, both with regard to the recovery of the materials the appliances consist of and with regard to the management of hazardous materials contained in many of them. The European legislation on alternative WEEE management is determined pursuant to Directive 2012/19/EU,

repealing Directive 2002/96/EC. The transposition of the Directives on WEEE into Greek Law, was initially affected by virtue of Presidential Decree 117/2004, replaced by Joint Ministerial Decision (our ref.) 23615/651/E.103/2014 (Government Gazette Issue 1184/B/9-5-2014), which constitutes the existing institutional framework setting the rules, terms and conditions for the alternative management of WEEE. The targets that are set with regard to the collection of WEEE are the following:

1. **From 2006 to 2015**: As of 2006, there was to be achieved a minimum separate collection rate of WEEE from private households, of at least four (4) kg, on average, per resident and per year. Until 31 December, 2015, either a separate collection rate of WEEE from private households of at least four (4) kg, on average, per resident and per year, or alternatively, the same weight as the average amount of WEEE collected in Greece in the three preceding years, shall continue to apply, depending on which of the two figures is highest.

2. **From 2016 to 2018**: As of 2016, the minimum collection rate to be achieved annually is set at 45%, calculated on the basis of the total weight of WEEE collected in a given year. It is expressed as a percentage of the average annual weight of electrical and electronic equipment (EEE) put on the market in the three preceding years.

3. **As of 2019**: The minimum collection rate to be achieved annually is set at 65% of the average annual weight of EEE put on the market in the three preceding years, or alternatively at 85% by weight of WEEE produced.

2.1.3.1 Perspectives for increased circularity

WEEE recycling in a circular economy perspective should entail the maximization of resource extraction from waste, while pursuing the reduction of the related environmental impacts. To this end, both the improvement of WEEE recyclability and recycling process upgrade can play a key role and can be regarded as the main challenges in this field. The utilization of hazardous substances in WEEE should be more and more limited, so as to enhance the environmental compatibility of the subsequent recycling process.

It is worth pointing out that some potentially hazardous substances have already been replaced in WEEE manufacturing processes, but both heavy metals and organic pollutants are still present. As already discussed for the valuable fractions, the scarce information about WEEE characterization in terms of hazardous materials can represent an obstacle in setting up innovative recycling technologies that are intended to be also environmentally-friendly.

2.1.4 End-of life vehicles (ELVs)

The definition for End-of life vehicles (ELVs) refers to «*a vehicle which constitutes waste*» within the meaning of article 11 par. 1 of Law 4042/2012, including its components/components. (par. 3, article 2, PD 116/2004).

The management of ELVs is regulated by Presidential Decree 116/2004 which was issued in harmonization with Directive 2000/53/EC by the Council of European Communities. According to Presidential Decree 43/1983, vehicles are considered to be those vehicles used for carriage of passengers, comprising not more than eight seats in addition to the driver's (M1) and those vehicles used for the carriage of goods and having a maximum mass not exceeding 3.5 tones (N1).

The management of ELVs commences upon the delivery of a vehicle to a collection point or a depollution center. The vehicle may be delivered under the responsibility of the relevant municipality where the vehicle has been abandoned, or under the responsibility of its owner. Then, the relevant certificate of receipt is issued.

Pursuant to Article 11 of Presidential Decree 116/2004, as of 1 January, 2015, the target for the recovery and reuse of products originating from the management of ELVs is a rate of 95% by weight and reuse and recycling must be at a minimum of 85% by average weight, per vehicle and per year.

2.1.4.1 Perspectives for increased circularity

ELV recovery is defined as the final productive use of the parts and materials embedded in ELVs. Cars reaching their end of-life can be valuable resources as spare parts or raw materials.

In order to extract these valuable parts and materials from ELVs, different techniques exist today. The preferred treatment route depends on the infrastructure in place and the potential profitability:

- Parts may be dismantled, refurbished or remanufactured and then reused in in-life vehicles and potentially in new vehicles;
- Materials may be either dismantled before being sent to recycling, shredded, sorted and incinerated with or without energy recovery, and finally landfilled if the material cannot take any of the recovery routes.
- Recovery of energy through chemical or thermo-chemical conversion and through thermal energy recovery.

2.1.5 Waste lubricating oil

The definition for Waste lubricating oil refers to "*mineral oils or synthetic lubricants or industrial oils that are no longer suitable for the use for which they were originally intended, such as used internal combustion engine oils, gear oils, lubricating oils, turbine oils and hydraulic oils*" (par. 3, article 11, Law 4042/2012).

The management of waste lubricating oil is regulated by Law 2939/2001, as amended by Law 4496/2017 and currently in force, and specifically by Presidential Decree 82/2004 on measures and terms for the management of waste mineral oils.

Waste oil is subject to alternative management and therefore all companies that produce or import lubricating oils in the Greek market, are obliged to organise an alternative waste oil management system. Any dumping or deposition of waste oil in the environment is prohibited, while provision is made for the development of a controlled collection system and priority is given to its regeneration to produce lubricants of equal quality to the primary ones. In the event that regenerating the waste oil for the production of basic lubricants is not technically feasible, then it can be utilised in other ways, including incineration for heat recovery, under the conditions of the relevant legislation (Joint Ministerial Decision 2487/455/99, Government Gazette Issue 196/B/1999, measures and conditions for the prevention and abatement of pollution from incineration of hazardous waste and Directive 2000/76/EC on waste incineration). In any case, the method of waste oil utilisation depends on its composition and on existing impurities.

The national targets for the alternative management of Waste Lubricating Oil are determined in Article 9 of Presidential Decree 82/2004, as follows:

As of 1 January 2007, a minimum collection rate of 70% by weight of all waste lubricating oil and of that, a minimum regeneration rate of 80% by weight. The waste lubricating oil that is not regenerated is directed towards other disposal operations (including use as fuel).

Lubricating oils are technical products that separate moving parts, reduce friction, remove dirt and debris, transfer heat and prevent corrosion. Demand for lubricating oils is high across the board Europe. In Greece, about 80,000 tons of lubricants were consumed in 2018 for various applications, such as in automobiles (e.g. vehicle repair), industry (e.g. petrochemical manufacturing, engine lubrication) and shipping (engine lubrication). The national export activity in the oil sector was particularly important in 2018, making it 1st in national exports. In

2018, national oil exports amounted to 27,500 tons. Imports of finished oils in 2018 amounted to 35,213 tons (ICAP[38]).

The Commission currently examines the data on waste oil provided by Member States in order to consider the feasibility of measures for the treatment of waste oil, including quantitative targets for the regeneration of waste oil and any further measures to promote the regeneration of waste oil. Member States report to the Commission the data on minerals or synthetics lubricants or industrial oils placed on the market and waste oil collected and treated for each calendar year. The European Association of Refining Industries (GEIR[39]) is currently developing a reference standard for member states.

2.1.5.1 Perspectives for increased circularity

The following figure illustrates the concept of a circular economy related to the management of lubricant oils. Aspects of economy activity since the design of lubricant oil, crude refining to yield base oil, production of virgin lubricants, usage/consumption, generation of waste lube oils (WLO), ending with the collection and recycling are covered. The disposal must be minimized (zero if possible) since it corresponds to a negative externality.

[38] https://dir.icap.gr/acci/EBEAmeleti.pdf
[39] https://www.geir-rerefining.org/

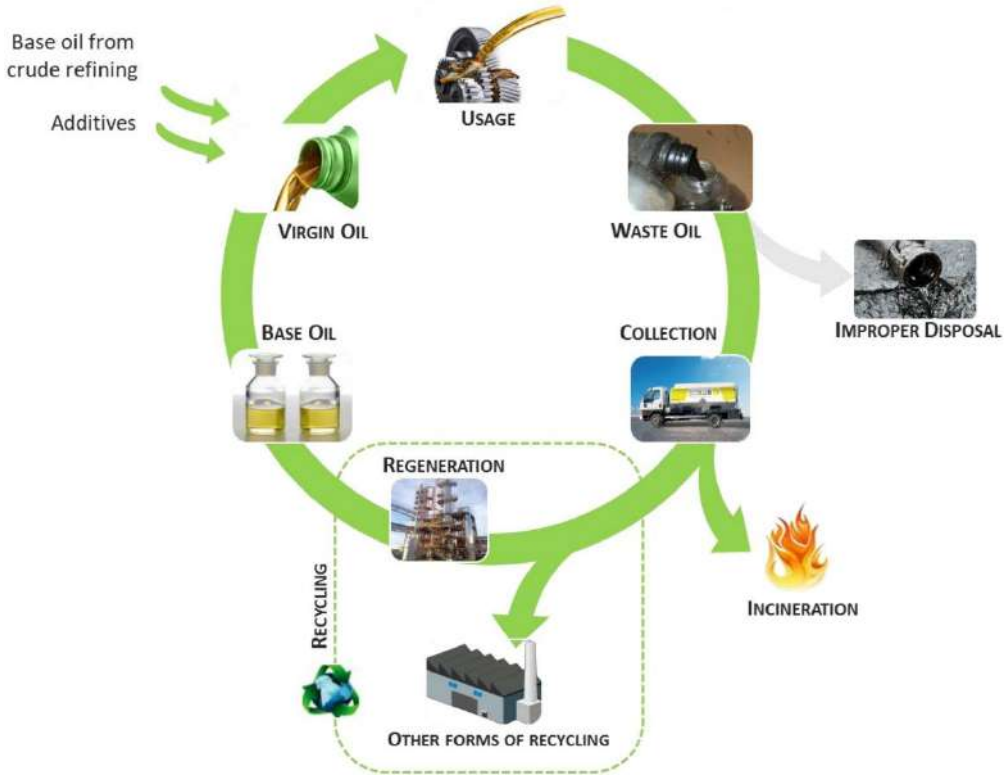


Figure 2.2 - *Lubricant oil Waste Management cycle*

Handling, storage and collection

- Waste oils are collected separately unless this is not technically feasible;
- waste oils are treated, giving priority to regeneration or alternatively to other equivalent recycling operations;
- waste oils of different characteristics are not mixed, and waste oils are not mixed with other kinds of waste or substances, if such mixing hamper regeneration or another recycling operation;

Treatment and disposal

- Laundering and reclaiming are suitable for recovery industrial lubricants
- Direct burning of WLO without any pretreatment can be employed for energy recovery
- Mild reprocessing is a simple treatment process to remove water and sediments from heavy polluted WLO

- Regeneration involves the production of base oil from WLO after the removal of contaminants, oxidation products, and additives, for further manufacture of lubricant products.
- Thermal cracking
- Regeneration technologies: regeneration means any recycling operation whereby base oils can be produced by refining waste oils, in particular by removing the contaminants, the oxidation products and the additives contained in such oils.

EPR (Extended Producer Responsibility) for petroleum-oil waste

The collection and refining targets set by the EPR system in the country are being met and Greece was recognized as the ***best case***[40] among EU member states in 2016. Specifically, according to data from the EPR system in Greece, approximately 60% of everything purchased[41] (60,000 tons, 2017) will become petroleum waste (36,000 tons in 2017) and of these approximately 70% corresponds to the collected petroleum waste (25,570t in 2017)[42]. The oil waste recovery target (20,160m, 2017) set in the country is 80% which was achieved and exceeded (25,250m in 2017).

2.1.6 Agro-food waste

The definition for agro-food waste falls under the classification of *"green waste" as "biowaste"*. The definition of bio-waste is given in Directive (EU) 2018/851 of the European Parliament and of the Council of 30 May 2018 amending Directive 2008/98/EC on waste (Article 1(3)(b)). This states that biowaste comprises biodegradable garden and park waste, food and kitchen waste from households, offices, restaurants, wholesale, canteens, caterers and retail premises and comparable waste from food processing plants. It helps to think of two major fractions, namely garden & park waste and food & kitchen waste. However, for the objective of this report, agro-food waste produced from farms and industries is mainly researched.

According to the National Circular Economy Strategy (2018), which includes actions for minimizing agro-food waste, it is stated that biowaste management is "a major and imperative necessity" and identifies that the country has great

[40] https://www.geir-rerefining.org/wp-content/uploads/GEIRpositionpaperWFD_2016_FINAL.pdf
[41] Thus, it can be assumed that approximately 40% of the lubricating oils purchased and consumed in Greece are lost during use.
[42] Waste oil that is technically feasible to collect.

potential for a number of reasons, including large quantities of untapped secondary resources and waste; a primary sector with growth potential that requires modernisation and reduction of production costs.

Today, a high proportion of biowaste is landfilled. Under law 4042/2012 separate biowaste (including agro-food waste) collection must rise from 5% of total weight of biowaste to 10% by 2020. The Action Plan on Circular Economy has identified the need to clarify the distinction between waste and products, in order to encourage a more circular economy, which relies on the transfer of raw materials between businesses and sectors. According the to the Action Plan on Circular Economy it is believed that "the vague definition of waste and the lack of criteria concerning the end of life of products limit and complicate management, transport and trade of materials destined for recycling at the end of their use". There are a number of plans in this area, including the standardisation and harmonisation of definitions of by-products and development of criteria to determine the end of waste. Of particular relevance to the FLW agenda is the legislation concerning the use of former food and by-products as animal feed.

2.1.6.1 Perspectives for increased circularity

The revised Waste Framework Directive[43] requires a separate biowaste collection or recycling at the source by 31 December 2023 (Directive 2018/851/EU, §10). This means that all municipalities must plan and implement separate biowaste collection schemes. They can do this by organising door-to-door collection of this organic fraction, or they can supply a number of biowaste collection points where citizens can drop off their biowaste. Alternatively, or in addition, municipalities can encourage citizens to dump their biowaste directly into home or community composting units (this is the meaning of "biowaste recycling at source") so that it does not end up in the public collection system.

By 31 December 2021, Member States shall submit a report to the Commission on the implementation of separate collection as regards bio-waste, including on the material and territorial coverage of separate collection and any derogations. In addition, the same Directive sets the EU target to recycle 65 % of municipal waste by 2035.

Biowaste accounts for a third of municipal waste in the EU, thus representing the largest single component of municipal waste. Therefore, it has become practically impossible for municipalities to reach the 65% recycling target without addressing the biowaste challenge. The Directive also states that separately collected bio-

[43] https://environment.ec.europa.eu/news/waste-framework-directive-revision-2022-02-14_en

waste cannot be incinerated. Further constraints come from the revised EU Landfill Directive (EU) 2018/850, which mandates that no more than 10% of municipal waste may end up on landfills by 2030 and prohibits landfilling of separately collected waste fractions.

Two mainstream treatment methods are available for biowaste:

Composting

Composting is a process that involves the degradation of plant and animal residues into a stable, sanitised product called compost. Compost is the end product of the composting process and is a valuable soil improver as it contains stable organic carbon that can help maintain or increase the content of soil organic matter. It also contains a diverse range of microorganisms that form an essential part of a healthy soil ecosystem[44].

Composting is the dominant form of recycling of bio-waste in the EU at present. Over 90% of the separately collected agro-food and similar waste is processed into compost. Composting is a rather straightforward process that requires a modest amount of capital investment upfront.

Anaerobic digestion (AD)

Alternatively, biowaste can first be put through an anaerobic digestion process to harvest the renewable biogas and the remaining material after the digester (called digestate) can then be composted. Two process steps are naturally more costly than only one, but AD provides the added value of renewable gas generation in addition to the material recovery aspect given with composting.

Anaerobic digestion means the bacterial breakdown of organic materials in the absence of oxygen. This biochemical process produces a gas, called biogas[45].

For biowaste treatment to count towards the recycling targets, it must result in material recycling. The amount of municipal biodegradable waste that enters aerobic or anaerobic treatment may be counted as recycled where that treatment generates compost, digestate, or other output with similar quantity of recycled content in relation to input, which is to be used as a recycled product, material or substance. Where the output is used on land, it may only be considered as recycled if resulting in agriculture or ecological improvement. End-of-waste materials to be used as fuels or other means to generate energy, be incinerated, backfilled or landfilled, cannot be counted towards the recycling targets. The

[44] https://www.compostnetwork.info/
[45] https://www.eubia.org/

separate collection obligation must be viewed in the context of the subsequent treatment. Most experts are convinced that only separate collection of bio-waste results in sufficiently pure organic materials streams (free of plastics and other non-biodegradable materials) to ensure compliance with quality standards for compost and digestate.

Moreover, the EU taxonomy[46] is a classification system, establishing a list of environmentally sustainable economic activities. It provides appropriate definitions to companies, investors and policymakers on which economic activities can be considered environmentally sustainable, thus creating security for investors, protecting private investors from greenwashing, helping companies to plan the transition, mitigate market fragmentation and eventually helping shift investments. The summary tables of the Taxonomy Report's Annex[47] clearly classify Anaerobic digestion from bio-waste as economic activity that substantially contributes to climate change mitigation both in the short and in the long-term (the activity is not considered transitional). This includes the activity in the sectors already at near-zero carbon level that must be expanded in line with the commitments under the EU Green Deal and with the expected climate law. Investing in this activity is recognized as not creating any lock-in effects in the mid-term, meaning the activity is in itself climate-friendly even in the long-term.

[46] https://finance.ec.europa.eu/sustainable-finance/tools-and-standards/eu-taxonomy-sustainable-activities_en

[47] https://ec.europa.eu/info/sites/default/files/business_economy_euro/banking_and_finance/documents/200309-sustainable-finance-teg-final-report-taxonomy-annexes_en.pdf

3 MARKET NEEDS - MARKET ANALYSIS

3.1 General overview of the area of intervention

3.1.1 General introduction

3.1.1.1 Greece

Municipal solid waste (MSW) management in Greece is not yet as developed as in many EU-15 countries. Land disposal is still the predominant method for managing MSW. Of the total amount of municipal solid waste, approximately 8% is recycled at the source and the remaining 92% is disposed without prior treatment. Of the disposed waste, 40% is dumped in non-engineered sites, whereas the remaining 52% is disposed in sanitary landfills. Of household waste, 85% is subject to organized collection and transportation; the other 15% is generated in the mountainous and island areas where collection and disposal are not performed properly (Papaioannou and Economopoulou, 2004). Municipalities are mostly responsible for collection, treatment and final disposal of the MSW.

The quantity of solid waste generated in Greece continues to be somewhat lower than in other European countries, reflecting less intense consumption patterns (Papaioannou and Economopoulou, 2004). In 2000, approximately 4.6 million ton of MSW was generated in Greece, which is an increase of 50% compared to 1990. The greater area of Athens contributed approximately 39%, and the city of Thessaloniki contributed approximately 9% of the total amount of MSW generated in Greece (Papaioannou and Economopoulou, 2004).

According to the National Waste Management Planning, MSW in 2000 consisted of 47.0% organic material, 20.0% paper, 8.5% plastic, 4.5% metal, 4.5% glass and 15.5% other waste (National & Regional Solid Waste Planning, 2003). In the same year, the quantity of recyclable materials (potentially available for separate collection) was estimated at 1.5 million ton, corresponding to 37.5% by weight of the total MSW, 21% of which (i.e., ~975.000 ton) was packaging material (Ministerial Act 50910/2727, 2003).

Presently, the main policy orientation in Greece is the maximization of material recovery through the implementation and extension of recycling programs with source separation in all the large municipalities of Greece, in addition to the construction of material recovery facilities. Absolute priority is given to the gradual phasing out of the non-engineered and uncontrolled dumpsites and the remediation of the major ones. Construction of new sanitary landfills, as in Thessaloniki, is already under way.

3.1.1.2 Central Macedonia region

For Central Mecadonia, the waste management in the region is currently performed at the following establishments according to the latest Regional Waste Management Plan[48]:

- Eleven (11) sanitary landfills (SL) (Kilkis, Mavrorachi, Almopia, Palaiokastro, Katerini, Litochoro, Kassandra, Edessa, Giannitsa, Anthemous, Polygyros),
- Five (5) transhipment stations (TS),
- Seven (7) recyclables sorting centers (RSCs) (Thermi, Ionios, Kallithea, Sindos, Tagarades, Katerini, Serres),
- One (1) rehabilitated waste disposal site (WDS) in Tagarades with one waste leachate treatment plant and
- one (1) Municipal Solid Waste Plant for electricity production, that utilizes biogas.

Seventy (70) more WDSs are in the process of rehabilitation. Additional transhipment stations and an integrated mechanical/biological/recyclable sorting facility and sanitary landfill in Serres are envisaged in the Management Plan.

As far as recycling is concerned, the national "blue bin" recycling scheme is also applied; in the blue bin materials such as paper, (clean) plastic, aluminum, glass are discarded.

An additional separate glass-only bin is also in force with the exception of Kilkis prefecture.

In 2014, approximately 9.2% (w/w) of produced Municipal Solid Waste were recycled through RSCs for Thessaloniki, 7.1% for Imathia, 5% for Kilkis, 10.8% for Pella, 7% for Pieria, 12.8% for Serres and 5% for Chalkidiki.

This performance was significantly improved if recycling material collected directly from market and industrial establishments was included. The residual fraction of recycled material after the separation phase in RSCs is quite high (31.9–42.2%) for 2014 and it is also subsequently landfilled. No separate collection for biowaste

[48] Fodsa, K.M. Review of Regional Waste Management Plan of Central Macedonia and Strategic Environmental Impact Assessment; Regional Association of Organizations of Waste Management of Central Macedonia (FODSA KM): Thessaloniki, Greece, 2016.

is performed on a large scale except for Thessaloniki where modest house composting takes place:

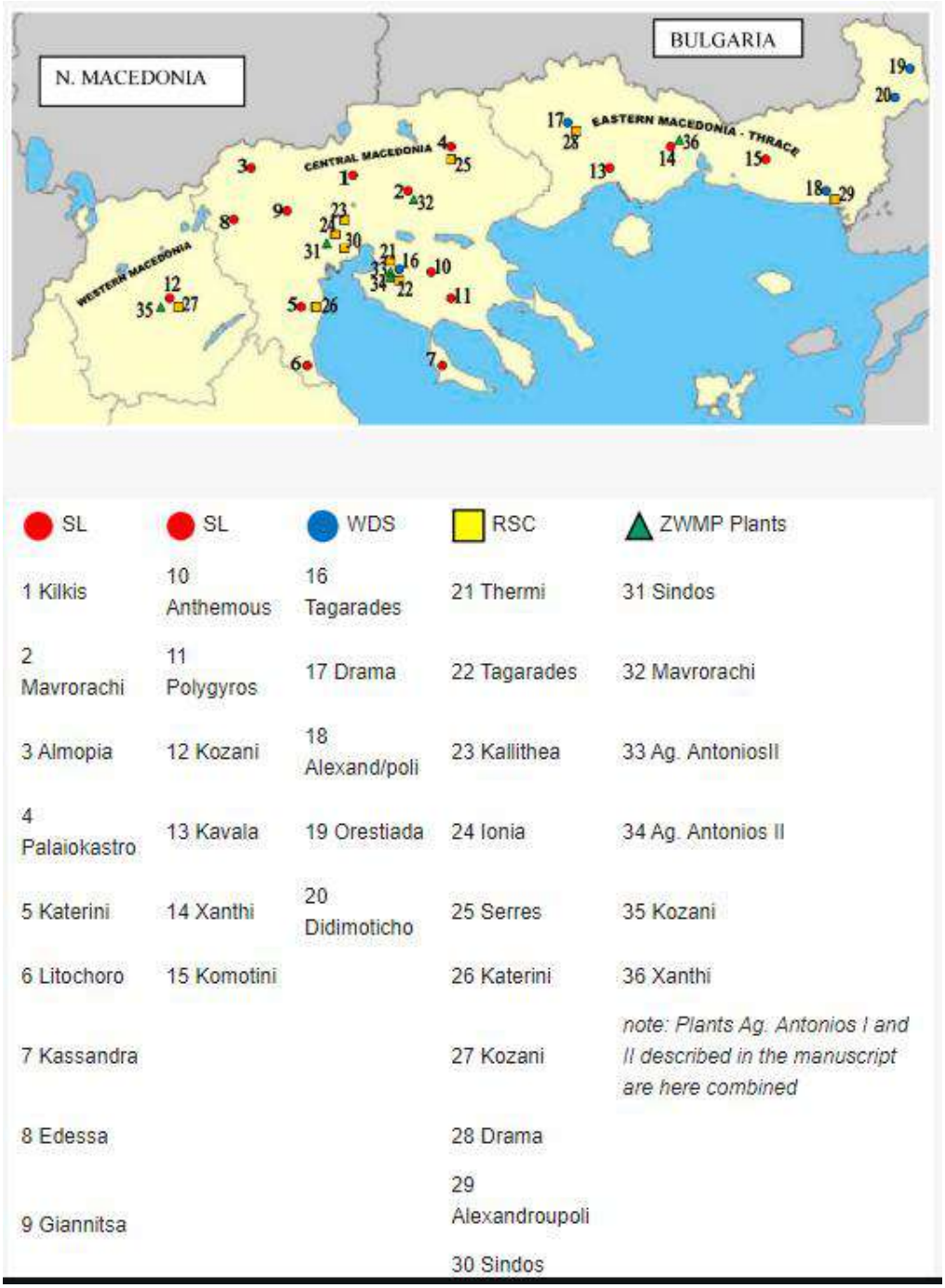


Figure 3.1 - *Proposed distribution of sanitary landfills (SL), waste disposal sites (WDS), recyclable sorting centers (RSC) and zero-waste mortar production (ZWMP) plants in Northern Greece.*

3.1.1.3 Western Macedonia region

The solid waste management in this region is currently performed at the following establishments according to the latest Regional Waste Management Plan[49]:

- One (1) SL (Kozani),
- Ten (10) TS and
- One (1) RSC (Kozani).

Various recycling schemes throughout the region and an integrated mechanical/biological/recyclable sorting facility in the proximity of the SL in Kozani are under design and planning.

As far as recycling is concerned, the national "blue bin" recycling scheme is applied; the glass-only blue bin and the paper-only collection system were nascent in 2014 with only 115 and 1000 collection points, respectively, for the whole prefecture.

In 2015, approximately 5.2% (w/w) of produced MSW were recycled through RSCs. This performance was significantly improved if an additional percentage of 6.6% (w/w), collected directly from market and industrial establishments, was included. The residual fraction of recycled material after the separation phase in RSCs is quite high (30%) for 2014 and it is also subsequently landfilled. No separate collection for biowaste is performed on a large scale.

3.1.1.4 Eastern Macedonia and Thrace Region

The solid waste management in this region is currently performed at the following establishments according to the latest Regional Waste Management Plan[50] :

- Three (3) SL (Kavala, Xanthi, Komotini),
- Six (6) rehabilitated WDSs,
- Five (5) RSCs (Drama, Komotini, Xanthi, Alexandroupoli, Didymoteicho) and

[49] DIADYMA. Regional Waste Management Plan of West Macedonia; Waste Management of West Macedonia, S.A. (DIADYMA): Kozani, Greece, 2016. (In Greek)

[50] DIAAMATH. Update of Regional Waste Management Plan of the Prefecture of Eastern Macedonia and Thrace; Organization of Waste Management of Eastern Macedonia and Thrace (DIAAMATH): Komotini, Greece, 2016. (In Greek)

- Thirteen (13) TS.

Various recycling schemes throughout the region, additional SL (Alexandroupoli, Samothraki, Thasos, Evros) and three large integrated mechanical/biological/recyclable sorting facilities (Kavala, Alexandroupoli, Evros) are designed. Data from 2015, as far as recycling is concerned, show that the national "blue bin" recycling scheme is applied, and the glass-only bin is applied with 500 bins for the whole prefecture. In 2015, approximately 4% (w/w) of produced MSW were recycled through RSCs for Evros, 6% for Rodopi, 2.5% for Xanthi, 2% for Kavala and 5.3% for Drama. This performance was significantly improved if recycling material collected directly from market and industrial establishments was included. No separate collection for biowaste is performed on a large scale, but it is envisaged soon

3.1.2 Regional unit of Thessaloniki

Thessaloniki is the second largest city in Greece located in the northern part of the country. The population in the greater Thessaloniki area is approximately 1,100,000, with a high population density in most of the municipalities. The entire area is served by one sanitary landfill, which has been operated by the Association of Local Authorities of Greater Thessaloniki for the last 25 years. The landfill is located 35 km southeast of Thessaloniki.

Waste management

Calculation on the quantities of the produced mixed municipal waste in Thessaloniki include[51]:

Year	Mixed municipal waste (tn/yr)	Recycled material (packaging) (tn/yr)	Batteries (tn/yr)	WEEE	Construction
2011	121.193	4.404		181,57	8.695
2012	112.891	9.785		147,98	7.088
2013	110.297	9.547		124,66	5.817
2014	107.607	10.526	47,69	93,53	6.312
2015	105.816	11.182		140,21	7.913

[51] https://thessaloniki.gr/wp-content/uploads/2016/12/topiko-sxedio-diaxeirisis-apovliton.pdf

3.1.3 Regional unit of Serres

Serres is one of the regional units of Greece, in the geographic region of Macedonia. It is part of the Region of Central Macedonia. Its capital is the city of Serres. The total population reaches just over 175,000. The regional unit borders on Thessaloniki to the southwest, Kilkis to the west, North Macedonia with the Novo Selo Municipality to the northwest, the Blagoevgrad Province of Bulgaria to the north, Drama to the northeast and Kavala to the east. The Strymonian Gulf lies to the south along with the Strymonas delta. Lake Kerkini was a lake located in the southern portion which is now drained. 41% of the regional unit are arable and most of the lands are near the Strymonas river which flows from Bulgaria and empties into the Strymonian Gulf.

Waste management

The Municipality of Serres is responsible for the collection of the solid waste of the Postal Code. Ano Vrontous, Captain Mitrousiou, D.E. Lefkona, P.K. Orinis, D.E. Serron and D.E. Skutareos. In terms of quantities:

- The collected amount of mixed waste sent for burial in the year 2015 was 25,593 tons.
- The amount of recyclables in the year 2015 was calculated at 3,538.96 tn, with corresponding residue returned for burial 905.50 tn.
- In particular with regard to the separate collection of other waste streams in the Municipality of Serres, the available data on the collected quantities are listed below:
    - WEEE: According to data from the Municipality, the collected quantities of lamps, lighting fixtures and small appliances for the Municipality of Serres are estimated at 2,221 tn for 2014.
    - Glass. According to the EEAA data, the collected quantities of glass in 2014 are 58.68 tn.
    - Green waste. For green waste, the Municipality's estimates reduce the total quantity collected in the year 2015 at 2,376 tn.
    - Construction waste. According to data from the Municipality, the quantities of bulky waste estimated that are collected separately for the year 2015 is about 280 tn.

- Others waste. According to data from the Municipality, the quantities of inert waste that estimated to be collected separately for the year 2015 is about 1,405 tn.

3.1.4 Regional unit of Drama

Drama is one of the regional units of Greece. It is part of the Region of East Macedonia and Thrace. Its capital is the town of Drama. The regional unit is the northernmost within the geographical region of Macedonia and the westernmost in the administrative region of East Macedonia and Thrace. The total population reaches 45,823.

Drama is surrounded by the regional units of Xanthi to the east, Kavala to the south, Serres to the southwest and to the west, and the Bulgarian provinces of Blagoevgrad and Smolyan to the north. Arable lands are located in the southern and the westcentral portion of Drama.

Waste management

Calculation on the quantities of the produced waste from households in Drama include[52]:

Type of waste	Quantity (tn/yr)
Mixed municipal waste	21.220
Green (cleaning of roads, gardens etc)	300
Construction and furniture	1200
WEEE	180
Tires	225
Accumulators	135
Batteries	190
Lamps	19
Oils-lubricants	116

The waste synthesis is presented here:

Material	% w.w	Quantity (tn)
Organic	45.8%	9.719
Paper	15.3%	3.247

[52] https://dimos-dramas.gr/wp-content/uploads/2016/12/tsdad_dramas.pdf

Plastic	16.5%	3.501
Metal	3.4%	721
Glass	4.3%	912
Wood	6%	1.273
Other	8.7%	1.846

3.1.5 Regional unit of Kavala

Kavala is one of the regional units of Greece. It is part of East Macedonia and Thrace. Its capital is the city of Kavala. Kavala regional unit is the easternmost within the geographical region of Macedonia.

The neighboring regional units are Serres to the west, Drama to the north and Xanthi to the east. The river Nestos flows along the eastern border. Arable lands are located along the coastline, in the north and in the east. The total population reaches just over 115,974.

Figure 3.2 - *Administrative boundaries of the Municipality of Kavala*

Waste management

The quantities of waste produced by households in Kavala, are presented in the following table[53]:

Year	Quantity (tn)	Permanent population	Non-permanent population	Total population	Waste production (kgr/resident/yr)
2015	974,22	70.089	791	70.880	14
2016	2.206,82	69.627	776	70.403	31
2017	2.510,63	69.335	812	70.147	36
2018	2.999,19	69.098	875	69.973	43
2019	3.189,02	68.922	901	69.823	46
2020	3.259,30	68.620	240	68.860	48
Average	***2.523.30***				***40.8***

The waste synthesis is presented here:

Material	Synthesis
Glass	13.2%
Plastic	25.1%
Paper	49.4%
Metal	12.3%

Further information on the produced quantities, are presented here:

Year	Glass Waste production (kgr/resident/yr)	Fabric Waste production (kgr/resident/yr)
2015	0.9	
2016	1.0	
2017	1.1	
2018	1.	0.9
2019	1.6	1.7
2020	1.2	1.5
Average	***1.3***	***1.4***

53 https://kavala.gov.gr/getattachment/o-dimos/Stratigikos-Sxediasmos/sxedio-diaxeirisis-apovlitwn/%CE%A4%CE%A3%CE%94%CE%91-(1-0_10-2021)-digitally-signed.pdf

3.2 Research on the Waste Management of industries in the area

3.2.1 Methodology on waste registry collection data - Circular economy questionnaire

3.2.1.1 General introduction to the questionnaire

The Market Analysis is focused on actions at the level of a market analysis for the Greek side of the Interreg V-A «Greece-Bulgaria 2014-2020» and especially the regional units of Thessaloniki, Serres, Drama and Kavala, with the main objective of strengthening the competitiveness of SMEs through the integration-adoption of circular economy actions and good practices through the targeted market analysis.

Its implementation aims to provide critical data and influence, to the extent possible, futire policy tools, so that SMEs of the area can make the most of the benefits of the circular economy. For this reason, and because the main objective of the SBE is the formulation of the Market & the Gap Analysis to emerge through collaborative processes, the point of view of the potential beneficiaries of the project, namely the SMEs of the Region, was taken into account. With the aim of outlining the main characteristics, needs, possibilities and wishes of the potential beneficiaries as well as the involved bodies, a specific questionnaire was created, at an earlier stage of the Project, which is sent to the SMEs of the area described before.

Before formulating the questions, the research objective was defined and specified. Then the data collection method was chosen. Since the questionnaire was to be completed by the respondents themselves, without the intervention of a researcher, emphasis had to be placed on its technical perfection and on the clarification, through written explanations, of points that are likely to be misinterpreted.

Understanding the characteristics of the partcipants in the survesy was also very important in order to make it more comprehensive. Therefore, the questions were adjusted accordingly and very technical questions that would not be easily understood were avoided, after thorough review of the SBE team.

Another factor that played an important role in the formulation of the questionnaire was the time it would take to complete it. Usually, an effective

questionnaire should be short as questionnaires that extend to a large number of questions tire the respondent or make them feel that they will waste a lot of time and are likely to not be completed. This applies to a greater extent when the questionnaire is to be completed by the respondent himself, as in the present case. Thus, an effort was made, in addition to completeness, clarity, coherence, and appropriate structure, to make the questionnaire relatively short but at the same time, capable to capture the opportunities and gaps that the novel model of circular economy provides.

3.2.1.2 Methodology for the development of the questionnaire

For the collection of data about the circularity of the companies of the area a digital questionnaire has sent at Google Forms™ format from the Federation of Industries of Greece (SBE) to a certain list of relative industries (for security reasons related to GDPR, this list cannot be shared). The questionnaire contained seven (7) sections and a total of forty-three (43) questions in various formats (multiple choice, scoring, free text, etc.). The primary form of the Questionnaire is presented in **ANNEX I**. The filled questionnaires were finally eight (8).

The purpose of the questions developed in the questionnaire of this work was to answer effectively to the topic's question, which is the exploration the circular market needs and business opportunities of industries as well as the project's partners, regarding circular economy.

The developed questions include the following formats:

- Open-ended question questions. Open-ended questions differ from other types of questions used in questionnaires in a way that open-ended questions can produce unexpected results, which can make research more original and valuable. However, it is difficult to analyze the results of the findings when the data is obtained through the questionnaire with open questions.

- Multiple choice questions. Respondents are offered a set of responses from which to choose. The small size of the multiple-choice questionnaire is that if there are too many answers to choose from, it makes the questionnaire confusing and discourages the respondent from answering the questionnaire.

- Dichotomous questions. The dichotomous question is a question that can have two possible answers. Dichotomous questions are usually used in a survey that asks for a Yes/No, True/False, Fair/Unfair or Agree/Disagree

answers. They are used for a clear distinction of qualities, experiences, or respondent's opinions.

- Closed questions: They indicate a series of values (possible answers) from which the respondent chooses (one or more). Closed questions are mostly used because they allow for quantitative analysis. The problem that often exists in their adoption and application is that the set of their values may not express the set of possible answers that the respondents would like to give. That is why it is very important to design the questions correctly and to record all the possible answers. It is a fact that to counteract this difficulty, the researchers use the category "other". This category includes those who are not covered by the other existing answer categories, thus creating a set of diverse answers with the general name "other".

in order to better understand the current situation of businesses in the circular economy sector, as well as gaps and opportunities. These sections are:

- Introduction
- General company details
- Current status of circular economy
- Other measures to promote circularity
- Mapping needs of businesses within the framework of implementation of circular economy actions
- Incentives for improving circularity
- Observations & Comments

3.2.2 Results of the survey

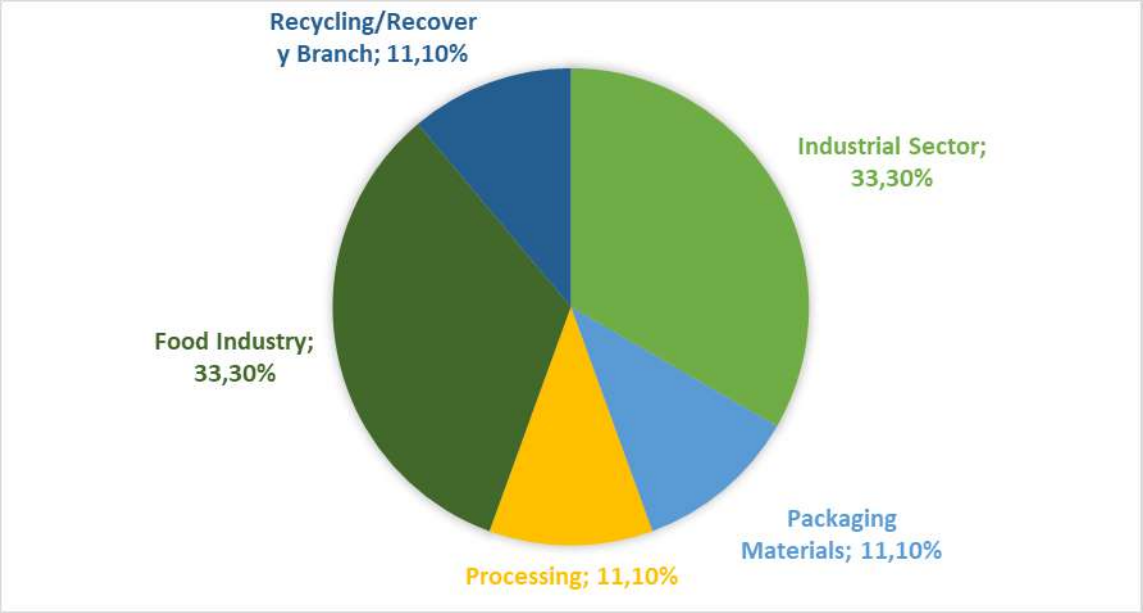
3.2.2.1 Sample identity

The questionnaire was sent by SBE to the selected SMEs. Given the time restrictions and the change of the year, 8 SMEs responded. All of them employed at the moment more than 50 workers, thus depicting the magnitude of importance of their participation.

Number of employees for each SME: More than 50 workers**.**

The sectors to which the companies belong are:

- Industrial Sector
- Packaging Materials
- Processing
- Food Industry
- Recycling/Recovery Branch

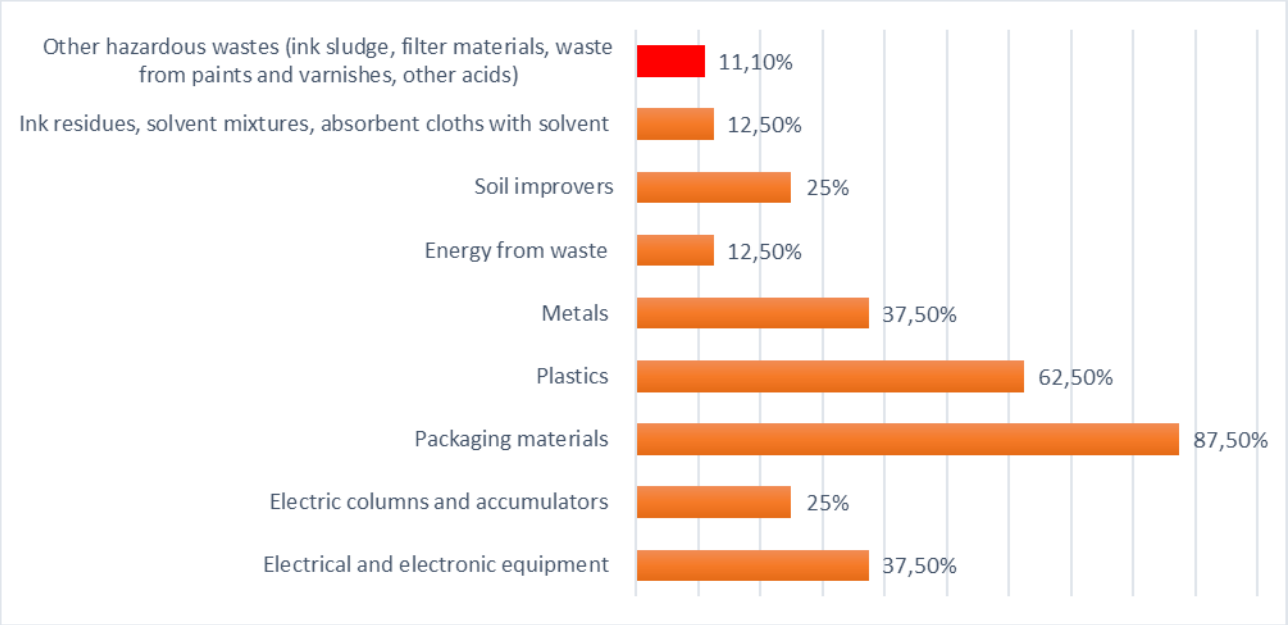


3.2.2.2 Current situation regarding waste management

What type of waste does your business generate?

It appears that almost all SMEs produce waste from packaging material (87.5%), followed by other plastic waste (62,5%), metals and EEEE (37,5% respectively). One (1) SME also reported the production of several hazardous waste (in small quantities).

Therefore, it appears that the main market opportunity in recycling and/or reusing waste material is derived from packaging and other, similar material.



Do you implement a separate waste collection action in your business? For which category of waste?

It was made clear that all participants have designed and implement some kind of waste collection action, deriving from a systematic and recorder procedure such as a "waste management plan", "ISO 9001 and/or 14001" or other, similar procedure.

It appears that almost all participants apply a packaging as well as plastic management action. Other actions include EEEE and metals (6 out of 9 apply a relevant plan) and batteries- accumulators management action (5 out of 9 apply a relevant plan).

An **opportunity** appears in the field of organic waste as well as waste from wood, since little or no action is being taken at the moment.

Waste management action	Application (%)
Batteries and accumulators	56%
Electrical and electronic equipment	67%
Packaging waste	**89%**
Plastics	**89%**
Glass	22%
Metals	67%
Wood	33%
Household goods	11%
Food-organic waste	33%

From participants applying a management action, a further analysis followed, in which **37,5%** (1 out of 3) explained that pre-processing activities are taken in their facilities implying that the rest of the action is implemented outside the facility from a 3rd party.

62,5% replied that they utilize some of the waste / by-product streams directly in the facility or in the production process. Materials that are not used, are disposed of outside the company.

In this direction, the following methods were presented in the comments section:

Organic, non-hazardous material: Composting is performed in the facility if possible. Moreover, organic waste is also admitted from other SMEs and farmers. In case this is not appropriate for direct use, it is selected before use and the remaining is disposed outside the facilty. A "***market opportunity***" was recognized here in the field of preselection of organic material from farmers and producers. More specifically, compost units are in need of pure, usable raw material. Mixed material, inappropriate for direct use have high cost and requires human and technological resources to be used. As a result, sometimes, useful raw material is discarded, since it is difficult or costly to separate and use.

In another example, waste from food is selected, repackaged and delivered for cooking to restaurants and kitchens that can use it for cooking food. Another "***market opportunity***" as well as an "***ethical opportunity***"" was recognized here regarding organic and food waste that can is thrown away.

Finally, waste from food preparation can be used in other companies as raw material for **biofuels** and **bio-oil**.

For waste / by-product streams available to other entities for recovery, outside of your business, do you know what is produced?

Knowledge of what is produced when waste is directed outside the SME in order to be further managed	Application (%)
Don't know	11%
Raw material for recovery of high value chemical additives	11%
Raw material for reuse in the production process	33%
Raw material for the other company's production process	33%
Packaging material	33%
Solid fuel (e.g. firewood, pellets, etc.)	11%
Raw material (either directly or as an additive) for animal feed production	11%

Knowledge of what is produced when waste is directed outside the SME in order to be further managed	Application (%)
Biogas	33%
Soil conditioner – compost	33%
Combustion for electricity production	11%

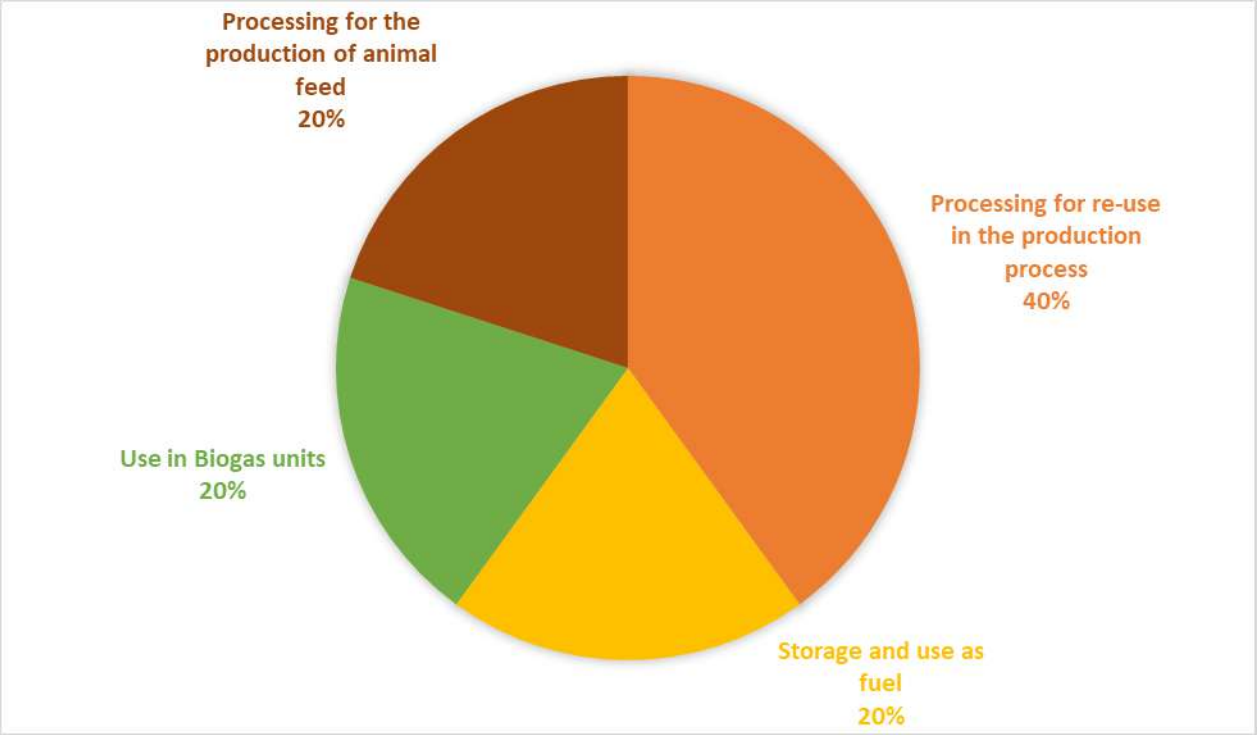
It appears that a small percentage of the participants is not aware of the "end-of-the-cycle" management of the waste produced. Most of the waste delivered to a third party for management is used as:

- Raw material for reuse in the production process (chemicals, materials, etc.).
- Raw material for the other company's production process as well as energy (chemicals, materials, etc.). One SME participant stated that Hazardous waste, as well as non-recyclable waste, is processed by a licensed company in order to make it suitable for burning for energy production, for example in cement factories.
- Biogas (organic, food waste, etc.).
- Soil conditioner – compost (organic, food waste, etc.).

Apart from the above, what other processes do you think can be done on the residues / by-products of your business by third parties for their utilization?

This was an interesting question, as SMEs were asked to identify further opportunities (i.e. other than the ones applied) in the framework of the circular economy and the possible added value of their waste. Most of them identified "Processing for re-use in the production process (40%)" as the most possible answer. Other answers included:

- Storage and use as fuel (20%)
- Use in Biogas units (20%)
- Processing for the production of animal feed (20%)

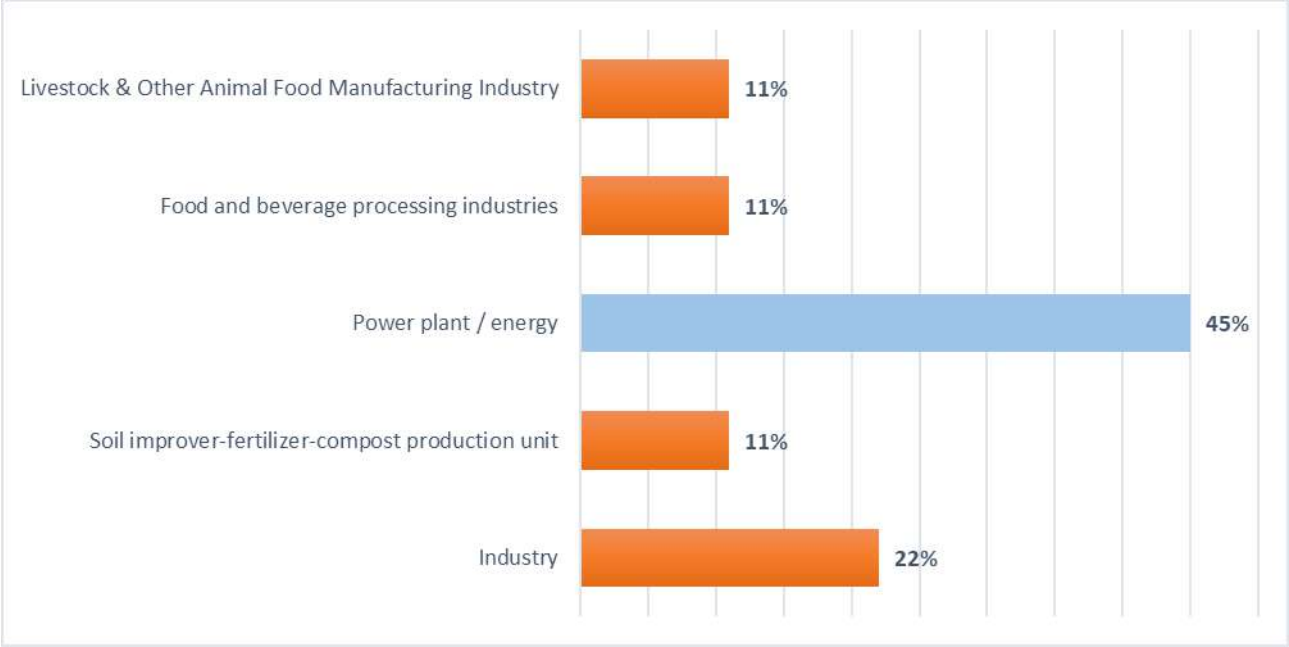


You would be interested in collaborating with other organizations in the area in order to utilize the residues / by-products

In the same direction, **42,9%** replied that they are interested in developing a collaboration with a 3rd party to further explore and utilize their waste, while **57,1%** appeared skeptical but not negative. Therefore, a clear "market opportunity appears here".

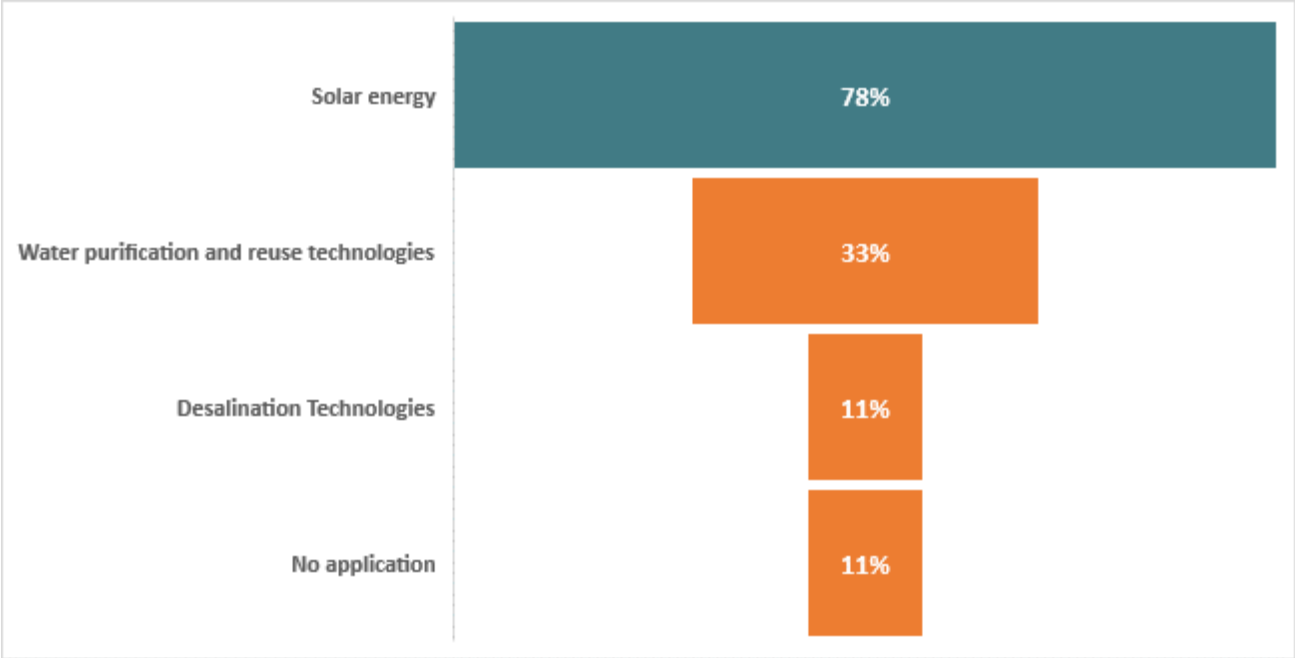
Identify the immediate type of business that would need your by-product-waste as a raw material even if some form of treatment was required before it was disposed of?

It becomes clear that the major type of business that would need by-product-waste as a raw material is the energy sector, followed by the industry, where the by-products can be used as production raw-material.



3.2.2.3 Other actions to promote circularity

Is any renewable energy and/or water saving technology applied in your company's production process, and if so, what is it?



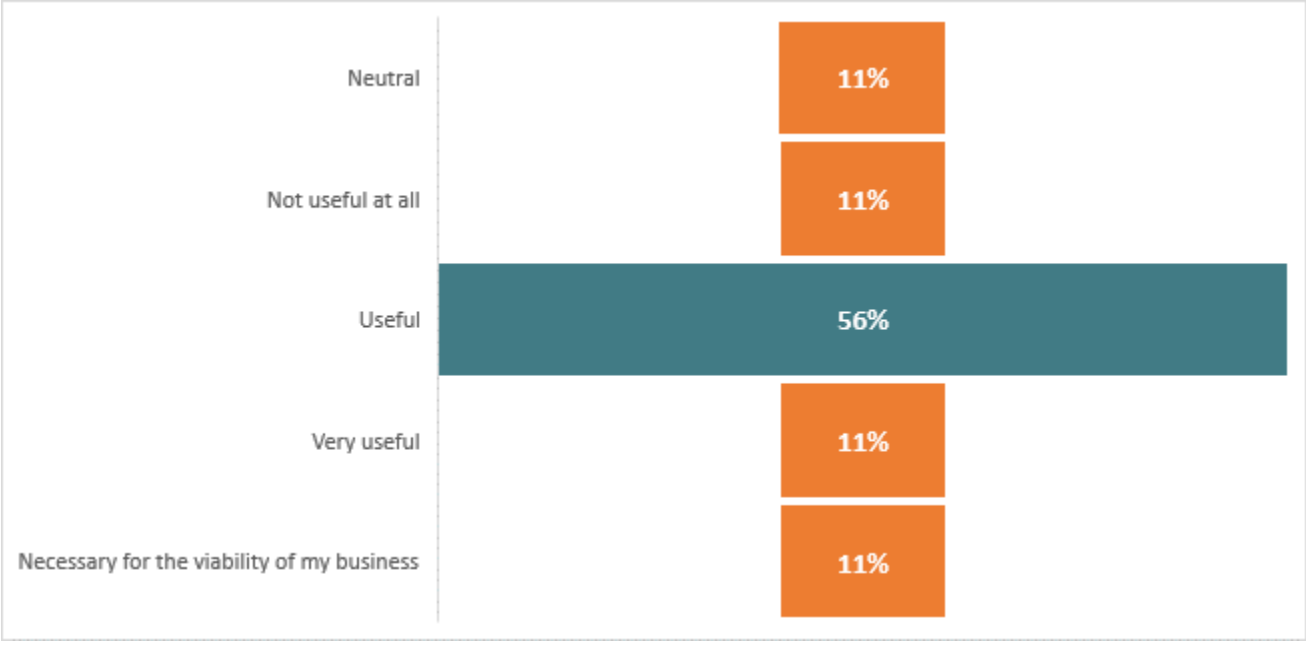
Almost all participants appear to be using ore ready-to-use some sort of renewable energy and/or water saving technology in their company. It is widely accepted that SMEs, which are friendly to the environment and use renewable sources of energy, will be more willing to apply a waste management scheme and support circular economy.

Further down to the same type of question, **none (0%)** of the participants appeared to be applying a BMS system for monitoring energy consumption and applying further energy reduction measures. This appears to be a significant gap in the analysis.

3.2.2.4 Mapping the needs of circularity for SMEs

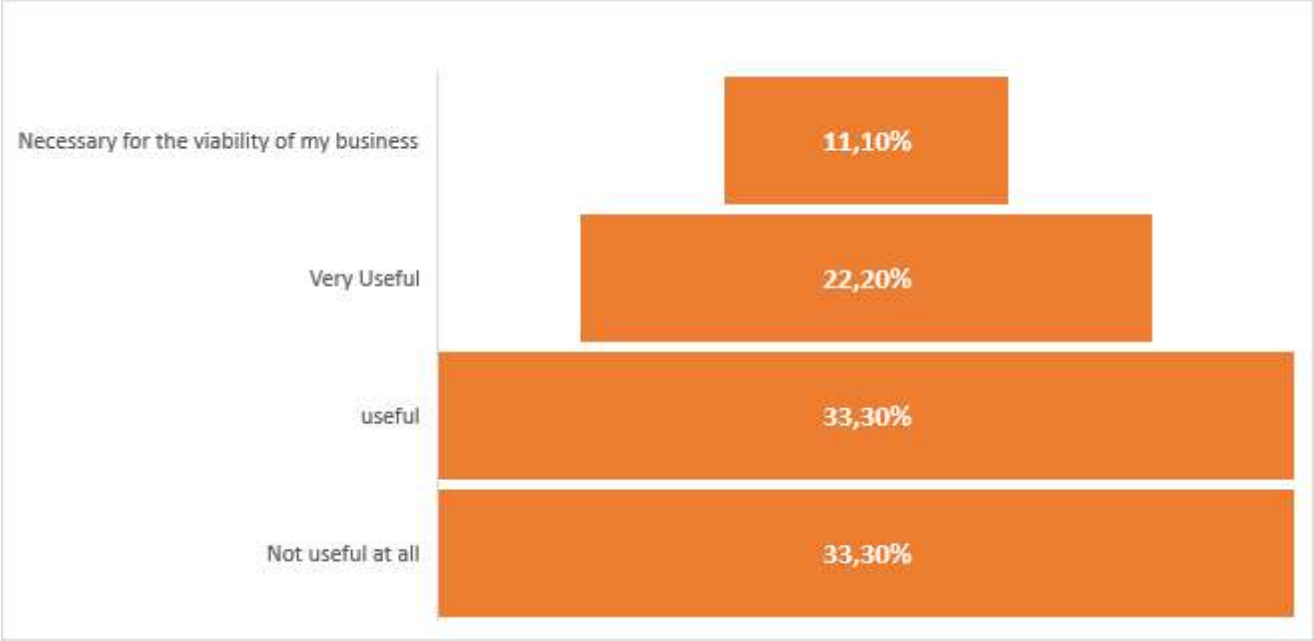
Increasing the competitiveness of environmentally friendly raw materials (e.g., saving raw materials for my production process) that I source for my business

Most participants (56%) found "**environmentally friendly raw materials**" very useful. From the comments provided, it appears that highly recyclable raw material is needed. Therefore, research on such type of material is needed.



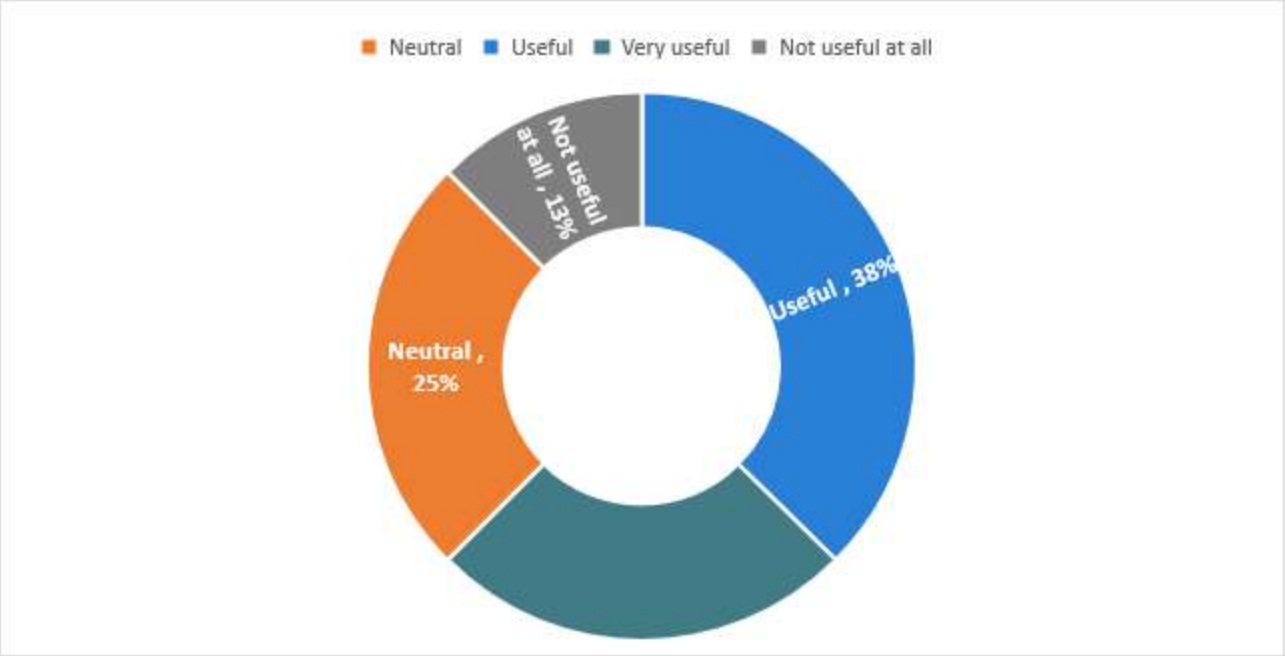
Equipment for the utilization of residues / by-products in order to reduce the operating costs of my business

Another important factor to increase the competitiveness of the business and at the sane time support and increase circularity rates, is to introduce specific technologies and equipment in order to be able to re-use residues / by-products in any of the previous applications mentioned. Participants stated that this is useful (33%), while others find it very useful (22%) and a smaller percentage (11%) recognize this as a "necessity". Approximately 3 out of 9 replied that this is not important for them.



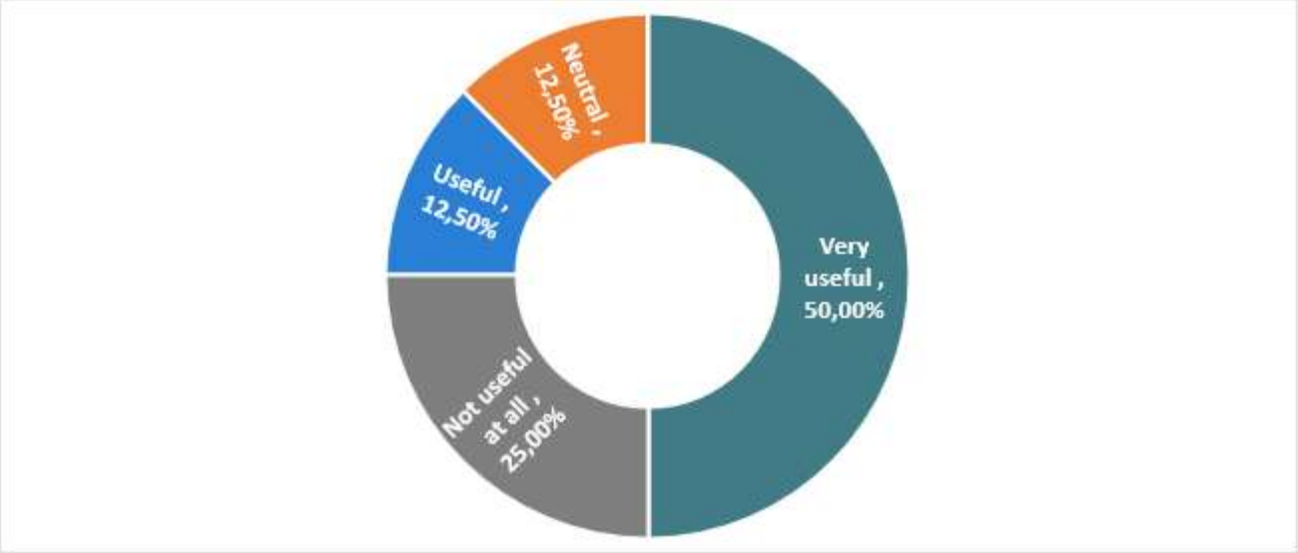
Equipment for the utilization of residues / by-products in order to produce a new product from my company

In the same framework, participants were asked to answer if new technology-equipment will be useful for producing new products "in-house". In this direction the majority (38%) found this "useful" and "very useful" (25%). This is a clear "**market opportunity**". Considering the fact that lots SMEs do not invest a lot of time, resources and money in R&D to develop or discover such type of equipment.



Equipment to save energy and/or water

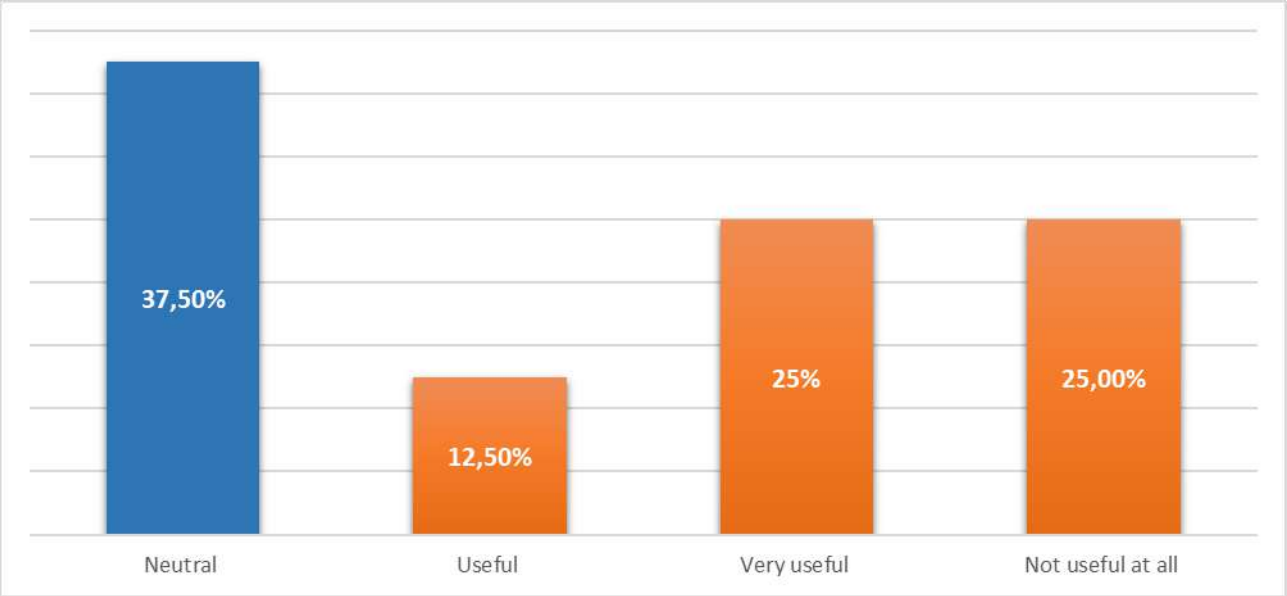
The same applies for resources such as water and energy. In the question regarding saving of water and/or energy in their production process they responded that such processes and/or equipment will be very useful (**50%)**



Collaboration with other businesses to utilize residues / by-products in order to form a value chain for a new product

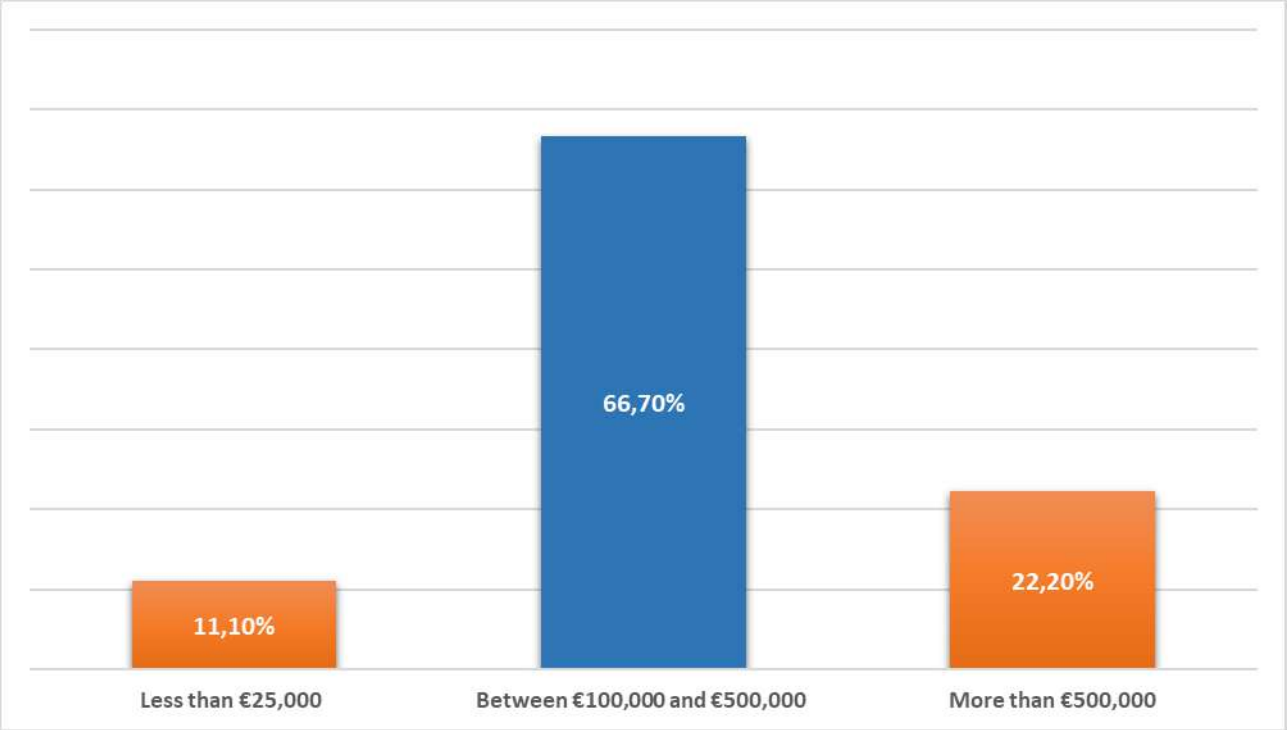
It also appears that **synergies** (collaboration) are very important for the use of residues / by-products in order to form a value chain for a new product, with

participants stating that it is necessary for the viability of the business and very useful (**50% in total**). A significant percentage (**37,5%**) also identified as being "neutral" towards this and asking for more information, but definitely not negative.



Estimate the amount of an investment (in the context of the circular economy) that you would be interested in making for your business in a 3-5 year time horizon

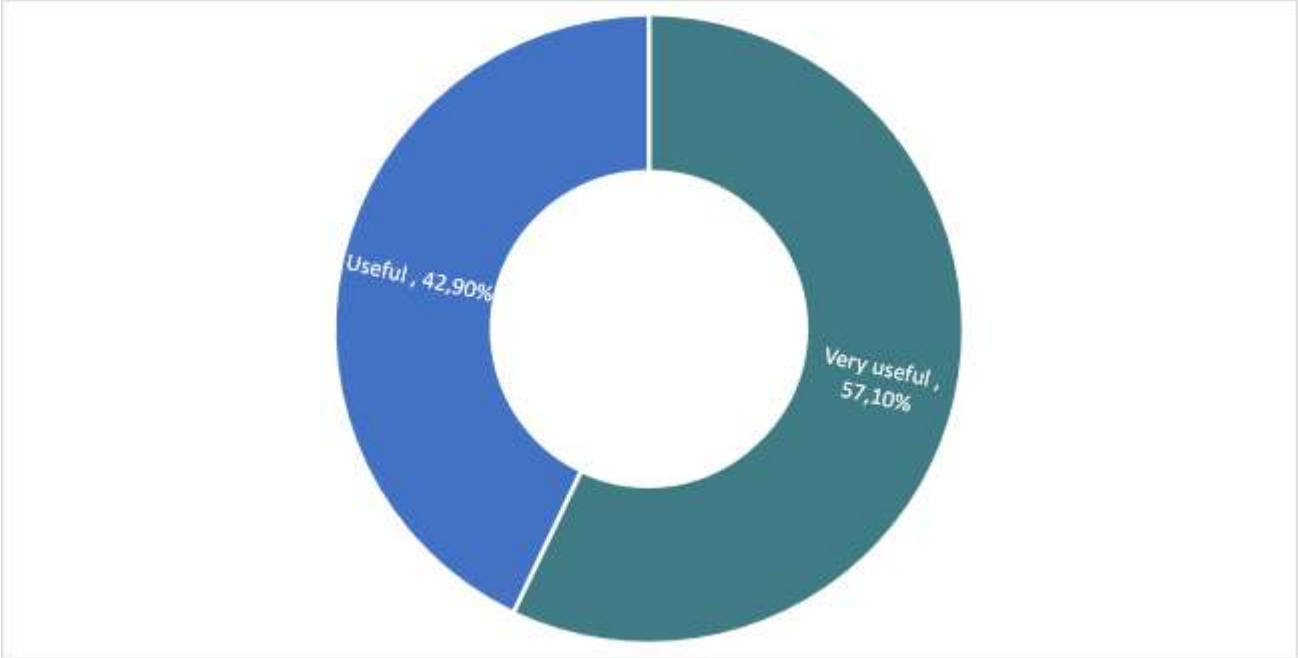
In terms of fiscal investment, participants were asked to identify their will to invest in "business circularity" in a horizon of 3-5 year. Approximately **65%** stated that they are willing to invest "between €100,000 and €500,000" in the next years, while an impressive **22,5%** stated that they are willing to invest more than €500,000 €.



3.2.2.5 Motives to support circular economy

Equipment (e.g., exploiting innovative and commercially 'mature' technological solutions)

As stated before, this question and the answers provided, ensure that the participant SMEs are willing to learn more an invest innovative and commercially "mature" technological solutions, in order to further invest in circularity and the added value the concept provides.

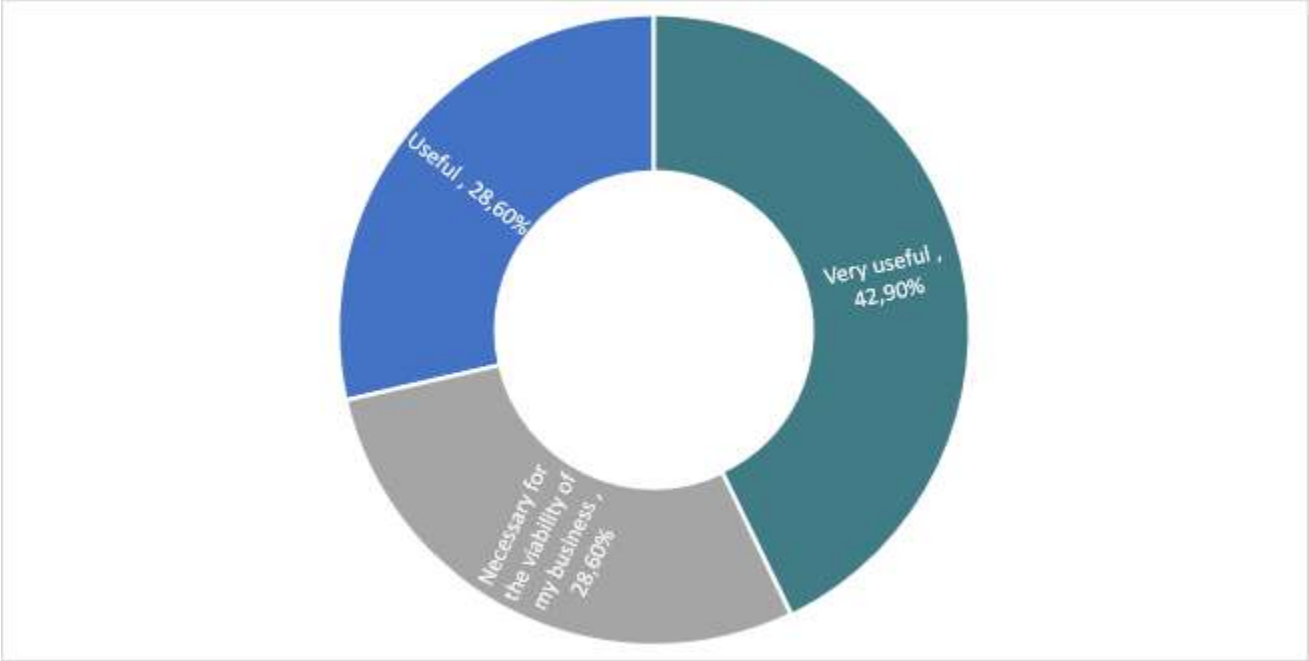


Financial incentives (ESPA, DEVELOPMENT LAW, RESEARCH-CREATE-INNOVATE, GREEN FUND, etc.)

In this direction, National and European fiscal incentives in the form of subsidies are considered very useful in most of the cases (**50%**), while some SMEs find them "necessary for the viability of the business" (**37,5%**). The remaining **12,5%** finds useful but they consider that external funding should not become "an end in itself", rather circular economy should be the target and subsidies the mean to its successful implementation.

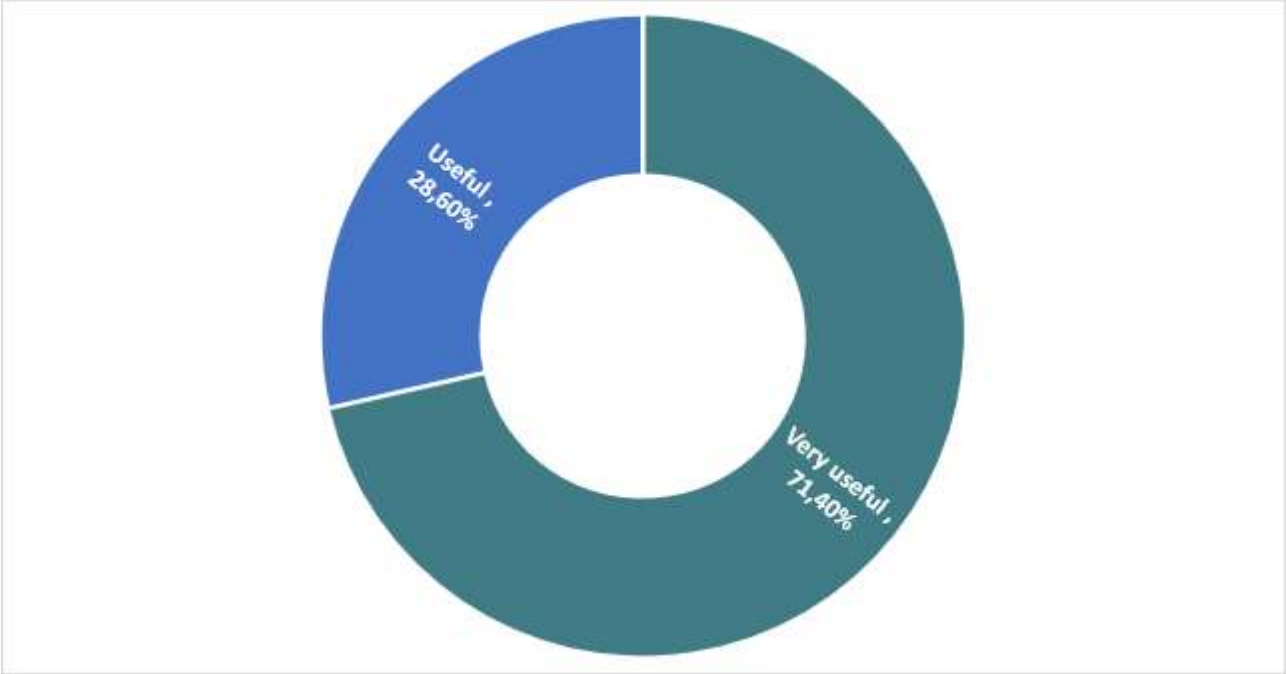
Know-how (e.g., employment of highly qualified personnel) and/or collaboration with know-how transfer bodies (e.g. research centers and/or university institutions)

All participant SMEs agreed that funding alone is not capable of setting circularity in the heart of business. Other factors such as employment of highly qualified personnel, research and collaboration with research institutions etc. are also critical.



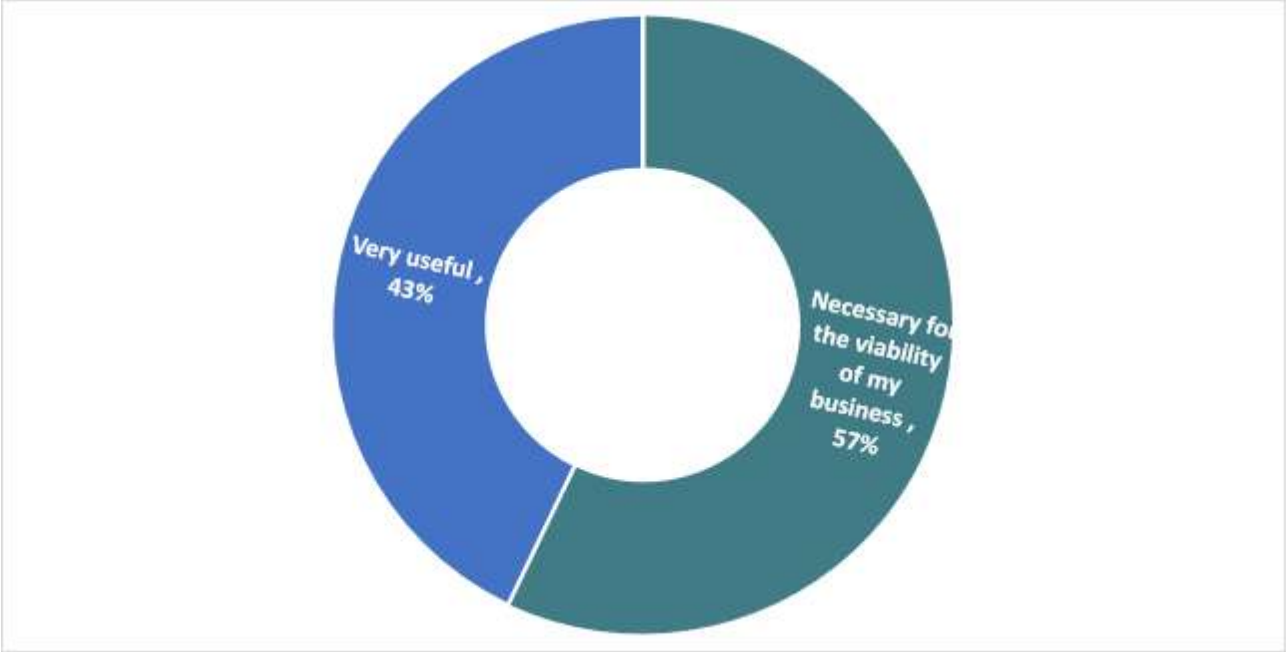
Synergy with valorization bodies (e.g., industrial symbiosis – cooperative management in the framework of cooperation agreements)

Moreover, the majority (**71.4%**) agrees that synergies with other valorization bodies (industries, energy producers, farmers, etc.) can be useful. The concept of industrial symbiosis is very important here, since one SMEs' wastes can be another SMEs' raw material or source of energy.



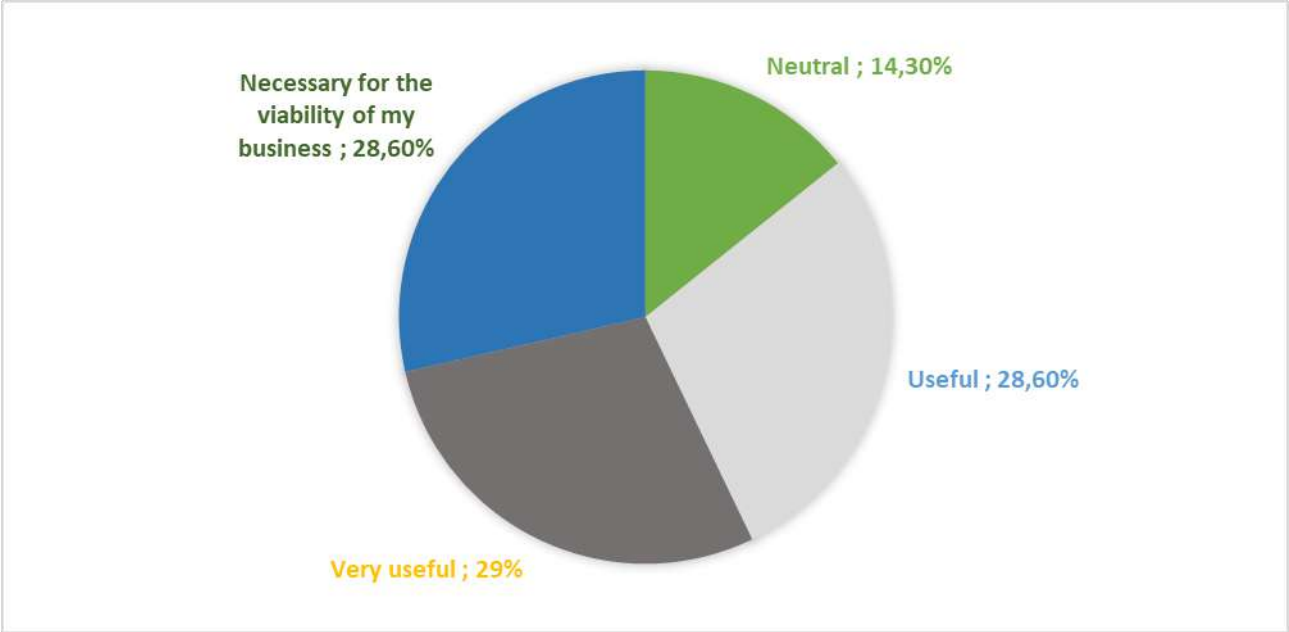
Information on the possible ways of utilizing residues / by-products

Therefore, information can be the key to increase circularity, since the majority of the participants (**57.1%**) agree that timely and correct information is necessary for the viability of the business.



Formation of a collection and transport network to exploit

Concluding, the majority of the participants strongly believe in the formation of networks, such as the "ENGINE-HUBs" network in the direction of circularity.



3.2.3 GIS mapping of circular economy industries

The main circular economy industries of the area located at the Regional Units of:

- ✓ Thessaloniki
- ✓ Evrou
- ✓ Chalkidikis
- ✓ Serron
- ✓ Imathias

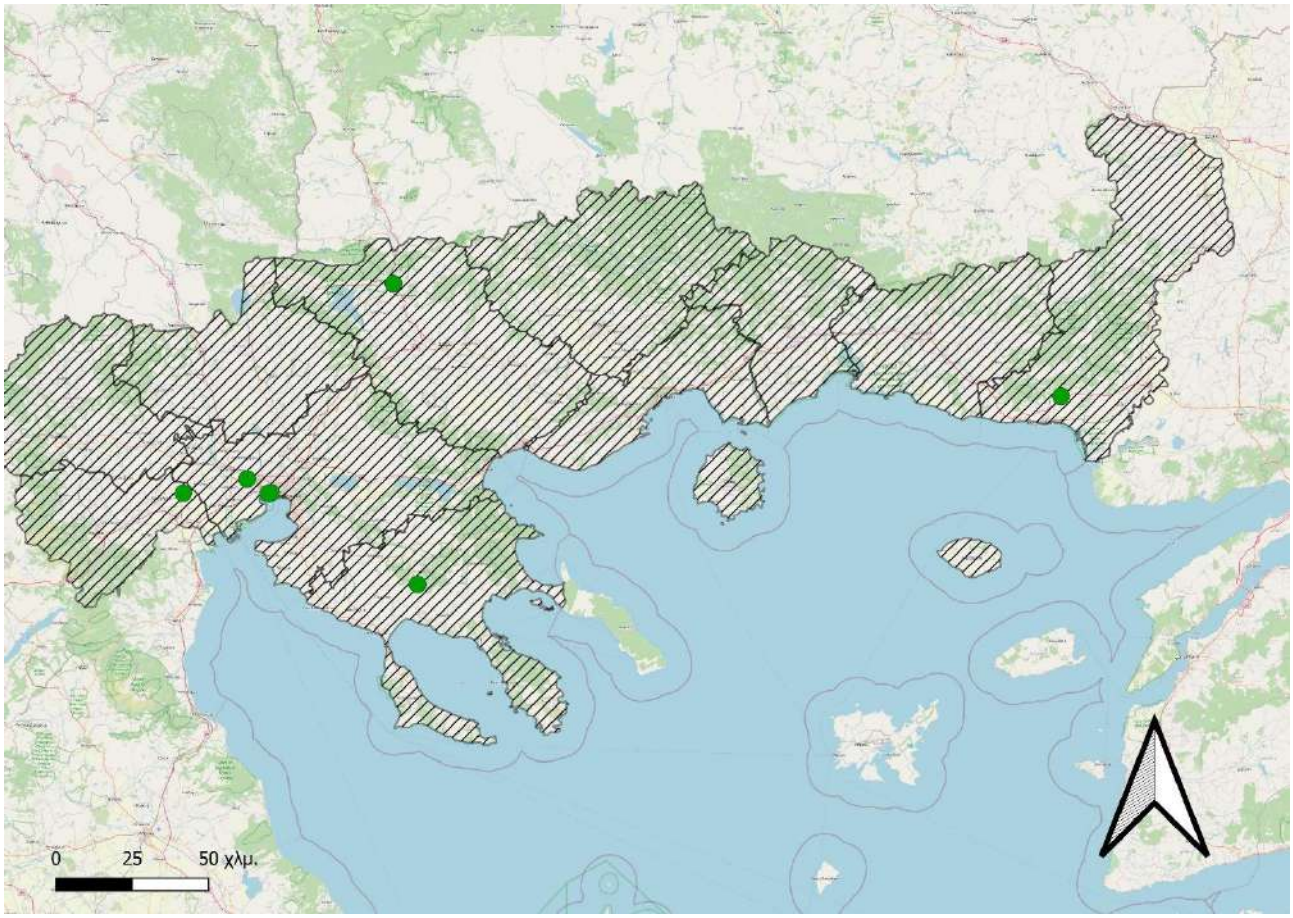


Figure 3.3 - *Main circular economy industries*

4 CIRCULAR ECONOMY PRIORITIES AND RECOMMENDATIONS

In this section, the report builds on the previous chapters and delivers a set of priorities and recommendations for each sector presented in the previous chapters. These priorities are then translated into "Market Opportunities" categorized under the main principles of CE: "*Recycle - remanufacture - Reuse - Maintain*".

4.1 De-Siloing and Strengthening Environmental Governance

SMEs and Industrial Environments can be sees as laboratories for innovation, where experiments and pilot projects can take place. The circular economy can provide technically innovative solutions for facing and overcoming waste management risks (i.e., technical innovations for waste reuse, recycling and reduced consumption of raw material, aiming to keep the value of production at its highest for as long as possible, generate new inputs and material, while optimising production costs (e.g. at industry level) and closing loops). Nonetheless, the potential of the circular economy can be unlocked only if the necessary economic and governance conditions will be in place.

Although strategic documents for CE are available to SMEs, Industries and decision-makers, they only appear to address the set goal partially, at the level of mention, so they are able to perform their function with low efficiency.

More detailed (national and local) strategies for more efficient use of all type of waste and circular waste management, outlining specific objectives in the short and medium term, were therefore recognized as overall essential. These goals are the milestones that ensure that the goal is achieved through legislation and standards, aids, and awareness raising work.

Current approaches to SMEs waste management remain sector-specific, lacking the necessary scope to adequately address cross-cutting, symbiotic challenges. Therefore, best practices and good industrial examples are often fragmented and not well coordinated within National and Local planning. As a consequence, variations in the overall performance between SMEs and Industries, even when they belong to the same sector result in under-performance.

For many productive sectors decision-making on waste management issues based on the 4Rs approach takes place in silos, while circular economy requires a more multi-dimensional and integrated way of activity, administration and regulation.

Trans-sectoral cooperation as well as continuously driven innovation and coordination of circular economy efforts in all sectors are crucial.

Furthermore, as no sector appears to be the leader in CE initiatives, external stakeholders should be identified, addressed and included early on in the transition process (e.g. businesses, knowledge institutes, citizens) - in order to craft the process to come to circularity within a market context. The interests of the SMEs, funding schemes, politicians, investors, interest groups and citizens should be involved early and comprehensively, preferably in the solution design stage. Moreover, the Government should adapt the EU legal framework and act in a decisive regulatory role, in order to foster new market paradigms related to CE.

4.2 Key recommendations for Boosting Circular Economy in the area of study

4.2.1 Horizontal recommendations

More accurate waste data and traceability: There is an urgent need to ensure that closer monitoring combined with more effective enforcement and more accurate data is provided, on a cross-sectoral level. Therefore, improving the Quality of Data and Understanding for Commercial and Industrial Management of End-of-life Materials is necessary. Whilst it would be desirable to have quality data on the management of industrial and commercial waste, past experience suggests that survey approaches which are diluted across a wide range of sectors are unlikely to improve matters greatly. It is likely to be more effective to identify key sectors and to work with those to understand better what wastes they generate and how they deal with them. Key sectors in this regard are likely to be those service sub-sectors, such as financial services, which would seem to be potential sources of material for remanufacturing, repair and reuse. More detailed bottom-up survey work within these key sectors, aimed at understanding the issues confronting the businesses concerned, is likely to provide far more useful data for the purposes of informing how those sectors are rendered "**more circular**". Such exercises can become part of the strategy to 'circularise' sectors, rather than simply trying to generate a low-resolution depiction of what happens across all waste generators. The approach suggested would deliver information on (at least) quantities generated by businesses, how they are managed and by whom, and what is the composition of the materials leaking to landfill and incineration.

Landfill tax and enforcement: As long as there are no strict penalties for those who do not meet recycling targets, the avoided cost of treatment/disposal of residual waste is likely to provide the main incentive for recycling. For now, this "*avoided cost*" remains too low to drive recycling. There is clearly an urgent need

for stricter enforcement measures to prevent informal/illegal waste disposal, including landfilling, as also indicated in the new NWMP 2020-2030.

Broader economic incentives and disincentives: Disincentives need to be sorted according to the waste hierarchy. In other words, landfill must be the most expensive option as it is the least desirable way of waste management and incentives or disincentives must be considered in order to improve the quantity and quality of recycled materials.

Scale up Pay as you Throw Initiatives: A number of pilots programs have already been carried out to test pay as you throw (PAYT) approaches to increase recycling at the local level in Greece. In addition, the European Commission's 2018 Early Warning Report for Greece suggests PAYT as a key measure for improving Greece's performance against future municipal waste recycling targets[54]. In this direction the following can be considered:

- Weight-based schemes have the greatest impact on reducing total waste quantities and increasing recycling. On the other hand, a fee levied on the basis of prepaid bags/containers may be preferable, as there are significant barriers for local authorities upgrading their waste fleet to include weighing scales, and sack-based schemes can achieve a high level of impact with lower upfront costs.

- The charge per bag/container for residual waste can be set either on a National Lever, or more preferably according to the needs of each municipality. (examining variations in separate collection services and frequency, as well as the population density and income levels in different localities). Bags/containers should only be purchased directly from the municipality and should be appropriately identified/labelled.

- The charge should be levied so as to cover the full costs of the service provision.

- The service costs should include consideration of the need for enforcement to ensure the success of PAYT programmes.

Increase separate collection and sorting of recyclables: It is suggested that the EPR (Extended Producer Responsibility) system for packaging, for example, can be significantly improved if the existing requirement for all packaging

[54] Eunomia. (2018): Study to Identify Member States at Risk of Non-Compliance with the 2020 Target of the Waste Framework Directive: http://ec.europa.eu/environment/waste/framework/pdf/Early%20Warning%20System_Final_Report.pdf
The early warning report for Greece: http://ec.europa.eu/environment/waste/pdf/early_warning_report_EL.pdf

producers, to register in an Alternative Management Systems and pay annual contributions (including importers) better implemented, including all forms of packaging. Special measures must be taken to reduce the tax evasion phenomena currently observed. In addition, significant improvements must be made to the current collection system, increasing the levies charged to producers (currently some of the lowest in Europe) to cover the full cost of end-of-life management, including litter (under EU policy, 'litter'). These should be further structured so that producers with fewer forms of recyclable packaging are charged at a higher rate to properly reflect the polluter pays principle and to encourage changes in packaging design that include recycling, recycled content and reuse.

Waste decharacterization criteria and quality criteria: The development of waste decharacterization criteria and/or quality standards for certain applications of waste materials in new products (e.g., hazardous ingredients).

Voluntary agreements to promote circularity: The possibility of introducing voluntary agreements by sector or industry to improve resource efficiency and circular economy outcomes in priority sectors should be considered, but only as an interim measure while EPR measures are being formulated. Industry priorities may include the Construction and Demolition, Packaging and Plastics industries.

Support for circular economy businesses: Support for businesses in priority industrial sectors must be the central pillar of Greece's Circular Economy Strategy, in order to ensure that the industry can take advantage of the relevant opportunities. EU programs that offer access to financial tools to support businesses should be exploited. In addition, the development of corporate is important relationships focused on sharing and developing expertise and knowledge. As well as collaboration and coordination between product supply chains.

Create new and empower existing reuse and repair networks: To build on existing reuse and repair networks so as to develop a major reuse and repair sector with the aspiration to import materials for reuse / repair and remanufacture on a country-based level. The reuse and repair sector, which mainly refers to the commercial sector does not handle a significant quantity of materials in Greece at present. In a move to a more circular economy, the sector will have an enhanced role to play, and could become involved in remanufacturing activities. The 'density' of products available in London makes London a logical place to locate reuse and repair organizations.

Industrial symbiosis program: There is an urgent need for a program that actively supports cooperation in the exchange of resources, especially waste and materials, but also potentially in water and energy waste.

Taxes: Consider incentives for repair and re-use businesses to stimulate business and disincentives for using virgin (primary and clean) materials.

Mandatory Green Public Procurement: For all key product groups related to the public sector, mandatory Life Cycle Costing (LCC) and a progressive shift towards the mandatory use of core criteria Green Public Procurement (as in Italy[55]).

Funding and investment in R&D: To accelerate knowledge and implementation of solutions related to the transition to circular resource flows in high-impact sectors and supply chains.

Business Support for Circular Economy Start-ups: The objective would be to support entrepreneurs to move innovative ideas from conceptualization to the market place. Start-up enterprises frequently lack access to finance, relevant commercial advice, information about securing intellectual property, and other essential components to enable them to scale-up their activity, and become successful businesses in their own right. In the absence of such support, start-ups may never flourish and excellent ideas may be lost, or may never be developed. Given that today, many business incubators and accelerators have focused on the digital sector. These concepts have been sufficiently successful that several corporately backed accelerators now exist. The aim of this measure is to ensure that start-up companies with offerings of relevance to the circular economy are able to benefit from advice that incubators offer, and in due course, to seek support (potentially from private companies) for accelerators which focus on developing companies in the circular economy.

Dissemination of the Circular Economy Concept to SMEs and Industries: The objective would be to enhance awareness of the concepts underpinning the circular economy through signposting. Although a number of businesses have grasped the concept of the circular economy (or are in the process of doing so), probably the majority have had limited exposure to the underlying ideas. To heighten awareness, and to normalise discussions around circularity, and to enhance the likelihood and extent of action, some dissemination is proposed over and above the more targeted business support indicated above. There is a growing number of websites hosting tools and information about moving towards more circular business models. It should not be the intention to replicate these, rather, to signpost businesses to the most useful sources of information.

[55] Ministry of the Environment 2020 Minimum Environmental Criteria retrieved November 27 2020: https://www.minambiente.it/pagina/i-criteri-ambientali-minimi

4.2.2 Sectoral recommendations

All sectoral recommendation will be presented in a tabular form.

4.2.2.1 Packaging waste

Recommendation	Brief description	Implementation period		Stakeholder	Key stakeholder responsibilities	Priority
		Short-term	Long-term			
New design and development principles	Greek bottling companies have taken initiatives for the best design and development of products design and development of the product, focusing on the following: use of rPET in soft drinks and water containers, zero landfill plants, reduction of packaging material (lower weight). This needs to be transferred to other food SMEs that manage packaging	**X**		SMEs YPEN ERP schemes Certification bodies Recycling companies Universities and R&D centers	• Develop new regulation on food packaging • Decide the appropriate materials • Create legislative framework	**HIGH**
Single Use Products regulation	Best practice in the implementation of the Directive regarding the enforcement of bans (transparent, phased approach with good enforcement), charges/ levies to reduce consumption of single use alternatives (and incentivize multi-use that can be managed in local waste systems), and supply chain engagement to minimize adverse impacts and monitoring/ evaluation of activities		**X**	SMEs - Industries YPEN Recycling companies EPR schemes	• Develop the framework • Examine penalties • initiate dialogue with producers to decide the time-framework of implementation • Provide incentives for progress	**HIGH**
Scale up Pay as you Throw (PAYT)	Recommendations regarding the	**X**		SMEs -	• Develop the	**HIGH**

Recommendation	Brief description	Implementation period		Stakeholder	Key stakeholder responsibilities	Priority
Initiatives	design and implementation of PAYT in Greece to improve recycling performance.			Industries YPEN Recycling companies EPR schemes EOAN	framework • Examine penalties • initiate dialogue with producers to decide the time-framework of implementation • Provide incentives for progress	
Reduce Single Use Products Consumption through Green Public Procurement	Implementation of legislation to underpin development of standards/ guidelines incorporating CE principles– reusability, recyclability, recycled content, consideration of applicable sectors (direct/ indirect procurement), available end of life management options and full lifecycle costs of different alternatives		**X**	YPEN Regional and Local Authorities	•	**MEDIUM**
Improve Existing EPR Scheme for Packaging	Implementation of DRS is linked to its likely impact – a well-designed scheme can have significant benefits in the form of increased recycling rates, reduced littering of deposit bearing containers, a reliable supply of high-quality recycled material, reduced greenhouse gas emissions and air pollutants; and increased employment.		**X**	SMEs - Industries YPEN Recycling companies EPR schemes DRS schemes EOAN	• Develop the framework • Examine penalties • initiate dialogue with producers to decide the time-framework of implementation • Provide incentives for progress	**MEDIUM**
Defining the costs to be covered by the EPR scheme	Decide whether the costs shall cover only the financial	**X**		SMEs - Industries	• Develop the framework	**HIGH**

Recommendation	Brief description	Implementation period		Stakeholder	Key stakeholder responsibilities	Priority
	contributions needed to facilitate the level of collection, transportation and recycling set out by the targets. Decide whether producers shall also be held responsible for the costs of the residual fraction, plus the cost of dealing with any illegally dumped products. Consultation with relevant stakeholders to identify and confirm cost items that will be covered by the EPR scheme.			YPEN Recycling companies EPR schemes EOAN	• initiate dialogue with producers to decide the time-framework of implementation • Provide incentives for progress	
Improvement of monitoring systems including digital tracking of waste	Channeling additional funding from PAYT (pay-as-you-throw), EPR, landfill tax, etc. to improve enforcement and increase penalties associated with illegal dumping, fly-tipping, and other forms of waste mismanagement.			SMEs - Industries YPEN Recycling companies Landfill operators FODSA EOAN	• Decide funding schemes • Develop appropriate mechanisms • Organize pilot actions	**MEDIUM**
Packaging Labelling Standard to Reflect Local Waste Management Conditions	There is a need for plastic packaging labelling to reflect local waste management conditions. In this direction a dynamic system that can respond to changes in waste management infrastructure, as well as the types of packaging on the market needs to be introduced.		**X**	SMEs - Industries YPEN Recycling companies EOAN Certification bodies	• Design the standard • Raise awareness • Convey information to consumers. • Create incentives	**LOW**

Recommendation	Brief description	Implementation period		Stakeholder	Key stakeholder responsibilities	Priority
Implement Microplastic Prevention/Reduction Measures	There is a need for detailed studies and stakeholder engagement to understand the issue of microplastic pollution in Greece, including consideration of the stocks and flows of both intentionally added sources of microplastics. Short/ medium term policy actions could therefore include limiting microplastic pollution associated with microplastics intentionally added to products, such as a supply chain approach to pre-production plastic pellet handling regulations and a ban on microbeads in hygiene products.		**X**	YPEN Recycling companies EOAN SMEs - Industries University and R&D centers Start-ups	•	**LOW**

4.2.2.2 *Excavation, construction and demolition waste*

Recommendation	Brief description	Implementation period		Stakeholder	Key stakeholder responsibilities	Priority
		Short-term	Long-term			
Voluntary Partnership Agreement "For the utilization of secondary fuels by the cement industry, in the context of industrial symbiosis and the circular economy" between the Union of Cement Industries of Greece and YPEN	The framework of the voluntary agreement defines the responsibilities of the Greek government and the Greek cement industry and the specifications in order to increase the substitution of traditional fossil fuels and re-use of ECDW		**X**	YPEN Union of Cement Industries ECDW operators	• Develop the framework: Agree on the overall scope and objectives. • Define the fiscal arrangements • Report on the performance • Identifying which producers including importers must contribute (avoiding free-riding). • Decide whether the costs shall cover only the financial contributions needed to facilitate the level of collection, transportation and recycling set out by the targets	**MEDIUM**
Implementation of the legal framework for the right ECDW management (ECDW management plans)	According to the new Greek Law 4685/2020 (article 89), the licensing process of a new building construction or renovation activity, the obligees must provide an ECDW	**X**		YPEN ECDW operators Building construction authorities	• Monitor closer the construction and ensure implementation. • Impose fiscal and other penalties	**HIGH**

Recommendation	Brief description	Implementation period		Stakeholder	Key stakeholder responsibilities	Priority
	management plan and a contract with an approved alternative management system (AES) for ECDW management in order to obtain the necessary building permit.			(Urban Planning Authorities) Technical Chamber of Greece		
Environmental certification standards according to BREEAM and LEED (and others)	There is a growing interest in sustainable construction in the country. There are many construction projects that are accredited for "green building" (BREEAM & LEED) that include proper management of ECDW.		**X**	Certification bodies ECDW operators	• Provide incentives for certification and implementation of CE principles.	**MEDIUM**
Alternative management systems for construction products with secondary value	Formation of alternative management systems for construction products (e.g. PVC), to increase circularity at the end of their life cycle and encourage (through eco-modulation fees) innovative products and materials with lower environmental impact			YPEN ECDW operators SMEs and industries that need these material Universities and R&D centers	• Identify the source of these material • Explore and suggest techniques to separate and collect them • Develop the framework: Agree on the overall scope and objectives. • Define the fiscal arrangements • Report on the performance	**MEDIUM**
Strict regulations on disposal of ECDW	Prohibition of landfill disposal of construction waste that can be recycled	**X**		YPEN ECDW operators Regional Associations	• Decide on the penalties • Formulate teams of inspectors • Develop the	**LOW**

Recommendation	Brief description	Implementation period		Stakeholder	Key stakeholder responsibilities	Priority
				of SWM - FODSA Regional and Municipal Authorities Technical Chamber of Greece	framework: Agree on the overall scope and objectives.	
Implement Planning Policies to Require Consideration of Deconstruction and the Reuse of Materials	To ensure developers consider (for specific classes of buildings) deconstruction from the outset, and that they increase the extent to which they reuse materials. In principle, it would be desirable if all buildings were designed with deconstruction in mind, where it was appropriate to do so. Modular design and construction might facilitate this. In terms of use of materials, materials reuse (through selective demolition) would be desirable where appropriate, whilst there may also be possibilities for leasing materials for use in construction. The intention would be to ensure that developers demonstrate that they have given adequate consideration to this when making their planning applications. This would be achieved through enacting planning policies to		**X**	YPEN Building construction authorities (Urban Planning Authorities) Regional and Municipal Authorities Technical Chamber of Greece	• Generate the general principles of the policy	

Recommendation	Brief description	Implementation period		Stakeholder	Key stakeholder responsibilities	Priority
	require that this is done for specific types of building.					

4.2.2.3 Waste Electrical and Electronic Equipment

Recommendation	Brief description	Implementation period		Stakeholder	Key stakeholder responsibilities	Priority
		Short-term	Long-term			
Strategic Business Review of Reuse and Repair sector in WEEE	Companies who make specific pieces of electrical equipment are comfortable allowing others to engage in asset recovery, there are others who prefer to retain that material within their own systems (with brand-specific centers for repair and reuse). In principle, it might be desirable for the logistics of any take back scheme to operate at scale	**X**		YPEN Reuse networks Electronic retailers and companies Start-ups SMEs and private companies Certification bodies	• The review should be undertaken with a view to supporting the transformation of the sector into a major player in the delivery of the vision for a circular economy in Greece, capitalizing on the amount of material available in the capital to develop a thriving industry that attracts suitably collected products from other locations • Provide national guidelines on reuse • Provide incentives	**HIGH**

Recommendation	Brief description	Implementation period		Stakeholder	Key stakeholder responsibilities	Priority
					for closing-the-loop in WEEE management • Create a Quality label for second-hand devices	
Create networks for collecting WEEE	At the moment there are only a few spots for WEEE recycling. As a result, producers and consumers deliver end-waste to municipal bins. Therefore, circularity is not guaranteed.	**X**		YPEN Reuse networks Electronic retailers and companies Start-ups SMEs and private companies Local authorities	• Provide incentives for closing-the-loop in WEEE management • Work closely with local authorities to decide the best spots • Strengthen in store take-back in line with WEEE Directive • Design and place attractive collection boxes at checkouts • Public Collection Points • Pop-Up Collection Drives • Design financial rewards for high return volumes • Partnerships with schools, colleges etc.	**HIGH**
Create initiatives for specific streams of WEEE waste	Specific streams of WEEE waste such as cables need to be managed in more organized	**X**		YPEN Reuse networks	• Create a solid framework for reuse of cables and other	**HIGH**

Recommendation	Brief description	Implementation period		Stakeholder	Key stakeholder responsibilities	Priority
	ways. Today, informal networks of citizens (e.g. "roma" groups) collect cables and other WEEE as well as metals and dispose them in a questionable way			Electronic retailers and companies Start-ups Local authorities	WEEE. • Provide incentives to citizens and SMEs to participate in the CE management schemes •	
Provide more information on hazardous materials in WEEE	At the moment, better information on the hazardous materials existing in WEEE is needed in order to raise awareness		**X**	YPEN Start-ups Social start-ups Education and Schools University NGOs	• Raise awareness • Inform • Create catalogues of hazardous wastes coming from certain streams of WEEE	**HIGH**

4.2.2.4 End-of life vehicles

Recommendation	Brief description	Implementation period		Stakeholder	Key stakeholder responsibilities	Priority
		Short-term	Long-term			
Wholesale and retail trade: repair of motor vehicles	under a substantial shift to a circular economy, the retail trade may, in some areas, come to (re-)consider how it relates to its customers. Retailing might, in some product areas, become less about volume of sales, and increasingly, if the aim is to retain		**X**	YPEN Retailers Repairing SMEs	• Create guidelines on reuse and repair • Create incentives •	**MEDIUM**

Recommendation	Brief description	Implementation period		Stakeholder	Key stakeholder responsibilities	Priority
	value in products, about take back with a view to remanufacture and repair (either on site or remotely);					
Set clear and quantifiable targets	The aim is to increase the reuse, recovery and recycling rates of ELVs by making producers responsible through the setting of clear quantified targets and to correctly manage the annual million tons of waste generated by ELVs in the EU		**X**	YPEN Retailers Repairing SMEs	•	**HIGH**
Reuse of valuable material from ELVs	Investigate the opportunities to move towards a Circular Economy state in the automotive industry whereby the value embedded in ELVs' components and materials is recaptured through reuse, recycling and recovery. New technology development together with the rising cost and scarcity of certain materials, such as lithium and platinum in new vehicles, encourages the recycling of these materials. Importantly, collaborative networks and regional/national effort are needed to create profitable volume. Furthermore, other opportunities to be explored include: Technology, products, parts and materials evolution Material		**X**	YPEN Retailers Repairing SMEs University and R&D centers	• Explore landfill and other tax schemes and prevention of illegal exports. • Research is needed in developing technology and practices for both pre- and post-shredder treatment. • Raise public awareness	**MEDIUM**

Recommendation	Brief description	Implementation period		Stakeholder	Key stakeholder responsibilities	Priority
	(in)compatibility, Parts (in)compatibility, Inefficiency in reusing of parts from older vehicles in new ones, designong for upgradability and modular part and finally reuse of ceratin material in different applications / industry					
Empower change in consumers' behavior	Change in ownership structure, such as renting, leasing or car sharing, need to be accepted by consumers in order to successfully implement new business models for ensuring increased CE performance. Such business models offer the advantage of increased capacity for monitoring resource use, controlling parts and materials for the vehicles on the road, and organizing end-of-life treatment and resource reclamation.		**X**	YPEN Retailers Rental companies Citizens NGOs	• Investigate new business models • Raise awareness and change consumption patterns • Introduce "shared responsibility" tools for all stakeholders	**HIGH**

4.2.2.5 Waste lubricating oil

Recommendation	Brief description	Implementation period		Stakeholder	Key stakeholder responsibilities	Priority
		Short-term	Long-term			

Recommendation	Brief description	Implementation period		Stakeholder	Key stakeholder responsibilities	Priority
Expand the ERP system to more types of waste from lubricating oils	Ensure complete coverage of the ERP system for all industrial and commercial sectors		**X**	YPEN ERP systems Industry	• Detect gaps in sectors not covered form the ERP system • Provide incentives for proper management	**HIGH**
Promotion of innovation and high-tech processes	Implementation of innovative projects on the development of ecologically innovative processes for the reuse of materials from petroleum waste and petroleum residues		**X**	YPEN University and R&D centers SMEs and Industries	• Invest in R&D on innovative management methods • Conduct pilot projects • Report on progress • Scale up successful results	**MEDIUM**
Invest in collection networks and infrastructure	Increase infrastructure to maximize the collection of waste oil (we assume 70% in Greece according to EPR data)		**X**	YPEN SMEs and Industries ERP systems	• Design new models of collecting • Expand refineries and management infrastructure to achieve better geographical coverage • Provide incentives for proper management • Impose penalties to illegal networks and collection schemes	**MEDIUM**

4.2.2.6 Agro-food waste

Recommendation	Brief description	Implementation period		Stakeholder	Key stakeholder responsibilities	Priority
		Short-term	Long-term			
Define priority areas for action	Finance the collection and reporting of a more detailed - Food loss and waste dataset for key agri-food sectors in Greece. Use this research to refine priority areas for action and to identify circular economy opportunities in the country (i.e., where raw materials have valorization potential and there are opportunities for geographic industrial symbiosis 'clusters')		**X**	Ministry of AgricultureRural Development and Food YPEN Farms-Producers Universities and R&D centers Industries Waste management facilities (Biogas, fertilize producers etc) Hellenic Association of Biogas producers[56]	• Review current by-product and waste streams to identify value-adding opportunities that could create new products and circular economy opportunities • Create a solid framework and regulations • Undertake a detailed review of regulatory barriers to using food industry by-products within industrial symbiosis ecosystems • Investigate the economic incentives to increase the business case for supply chain actors to invest in agrifood waste prevention	**HIGH**

[56] https://habio.gr/

Recommendation	Brief description	Implementation period		Stakeholder	Key stakeholder responsibilities	Priority
					processes and technologies	
Development of local/regional alliances for agro-food waste management	The aim of the action is to implement agrifood waste management solutions through local and/or regional alliances, developing appropriate methodology to support decision-making. This action is based on the "system-thinking" approach, an important aspect of the circular economy business model.		**X**	Ministry of AgricultureRural Development and Food YPEN Farms-producers Local and regional authorities NGOs	• Develop funding tools for alliances • Set up clear framework and guidelines • Map agrifood waste resources • Provide incentives for producers to participate in alliances	**MEDIUM**
Develop small and medium, decentralized units for biowaste composting	Decentralized and community composting refers to the composting of domestic organic waste from small farms, food producers and and households or in a small community composting facility respectively. It avoids the economic costs and environmental burdens associated with organic waste collection. A major advantage of composting especially in regions with low organic waste recycling rates, is that it can generate "buy-in" from citizens who are otherwise less likely to separate organic waste, thus significantly decreasing residual waste volumes and increasing overall		**X**	Ministry of AgricultureRural Development and Food Farms-producers Local and regional authorities NGOs Start-ups	• Create community compost schemes • Design the framework and policy • Find markets for the produced product • Organize and coordinate pilot actions in selected communities • Report in progress of pilot actions	

Recommendation	Brief description	Implementation period		Stakeholder	Key stakeholder responsibilities	Priority
	recycling rates.					
Implement EPR Scheme for Agricultural Plastics	Introduction of EPR scheme for agricultural films and pesticide packaging that will be closely monitoring /verification by EOAN (via Electronic Registry). The EPR scheme needs to be insured that it is designed to provide expanded (if not 100% geographical coverage - include waste producers in remote locations/ islands that currently have no access to separate collection points). All producers should be included, and smaller retailers could additionally be engaged to provide collection points/ take-back schemes.	**X**		Ministry of AgricultureRural Development and Food YPEN ERP Systems EOAN	• Design ERP system • Exchange of good practices with EU MS that have successfully implemented similar EPR scheme • Provide incentives • Inform about hazardous waste and their environmental impact	**HIGH**
Engage public and private actors in circular biowaste management	Set and replicate wide-reaching social programs aimed at raising awareness across all food supply chain actors of the need to better align food supply to actual demand, reduce food surpluses and food waste, and realise the environmental and economic implications of waste generation and treatment;		**X**	Ministry of AgricultureRural Development and Food YPEN NGOs Social actors SMEs - Industries Composting facilities Anaerobic Digestion facilities	• Raise awarenees • Create new Publi-Private tools for agro-food waste management • Adopt effective fiscal measures for taxing waste generation for all food supply chain actors • Create incentives for participation	**MEDIUM**

Recommendation	Brief description	Implementation period		Stakeholder	Key stakeholder responsibilities	Priority
Investigate further applications for production of biogas and biomethane	Biogas and biomethane production units need to be further researched in order to include more agro-food waste in their production cycle as a raw-material. The remaining future gas demand can be met by other renewable and low-carbon solutions such as green hydrogen. The development of synergies between green gases will be key to meeting future gas market demands		**X**	Ministry of AgricultureRural Development and Food YPEN Investing groups Public-private initiatives Hellenic Association of Biogas producers	• Explore PPI tools for the development of such units • Map available feed-stocks and design investments in proximity to the areas where bigger quantities of agro-food waste is produced	**HIGH**
Recycling biowaste into biogas and fertilizer	A key point in productivity and efficiency of anaerobic digestion units is the produced fertilized after biowaste has been digested. There is a need for better quality of the produced fertilizer, so that the market price equals expenses and the process becomes sustainable and viable		**X**	Ministry of AgricultureRural Development and Food YPEN Anaerobic Hellenic Association of Biogas producers	• Explore PPI tools for the development of such units • Map available agricultural plots in need of high-quality organic fertilizer and design synergies between compost facilities and farmers	**HIGH**
Explore new tools for collecting agri-foods waste	Collecting the agro-food waste is not an easy task, since producers are not in proximity and can be scattered.		**X**	Ministry of AgricultureRural Development and Food YPEN Investing groups Farms-producers University and	• Map producing areas • Integrate IT technologies in collection activities to increase efficiency	**LOW**

Recommendation	Brief description	Implementation period		Stakeholder	Key stakeholder responsibilities	Priority
				R&D centers Hellenic Association of Biogas producers		

4.3 Identification of Market Opportunities

A circular economy would decouple economic growth from resource use. Across the three study sectors, carbon emissions would drop as much as 48% by 2030 (31 percent on the current development path) and 83% by 2050 (61% on the current development path), compared with 2012 levels[57].

Electric, shared, and autonomous vehicles, food-waste reduction, regenerative and healthy food chains, passive houses, urban planning, and renewable energy would be the principal sources of emission reduction across the three sectors. Today, materials and components constitute 40 to 60% of the total cost base of manufacturing firms in Europe and often create a competitive cost disadvantage. Europe imports 60 % of its fossil fuels and metal resources, and the EU has listed 20 materials as critical with respect to security of supply. In the circular scenario, primary-material consumption measured by car and construction materials, synthetic fertilizer, pesticides, agricultural water and land use, fuels and nonrenewable electricity, and land for real estate could drop as much as 32% by 2030 and 53% by 2050.

A transition to the circular economy would involve considerable transition costs but if well managed could create an opportunity for economic and industrial renewal. The transition would involve considerable costs, such as R&D and asset investments, stranded investments, subsidy payments to promote market penetration of new products, and public expenditure for digital infrastructure. While it is hard to find an appropriate cost comparable for such an economy-wide project, best practices and successful applications could shed light on parts of the needed transition.

4.3.1 Opportunities: Recycle

In the cross-border region there is a strong tendency for recycling. The main streams of discarded materials or waste are:

4.3.1.1 Packaging materials

Objective: To reduce the amount of local collected waste which is incapable of being recycled using current systems.

57 https://www.mckinsey.com/~/media/McKinsey/Business%20Functions/Sustainability/Our%20Insights/Europes%20circular%20economy%20opportunity/Europes%20circulareconomy%20opportunity.ashx

Opportunity: The intention is to understand what materials, products and packaging are most common in residual SME waste. This would involve undertaking a representative analysis of residual waste with a view to identifying the most prevalent non-recyclable items in SMEs in the area under focus. As a rsults of the analysis, authorities along with SMEs, industries and other initiatives would seek to engage with the relevant producers / manufacturers with a view to explaining the rationale for the approach, and supporting product re-design to ensure the materials were recyclable in future. The analysis is a very good step in order to explore future synergies, develop proper policy tools and guide subsidies and funds in the proper direction

4.3.1.2 Various Plastics

Objective: Reduce plastic by increasing recycling activities in order to cover increasing demand.

Opportunity: Factors such as rising demand for plastics in various end-user industries and favorable government initiatives towards the reduction of plastic waste has strengthened the growth of this market. With the increasing awareness about global warming, plastic manufacturers are largely focusing on developing new recycling concepts to reduce greenhouse gas emissions and maintain environmental sustainability.

Conversely, the increasing use of virgin plastics and the lack of a proper plastic collection system has hampered the growth of this market. The lack of an established waste collection and sorting system for solid waste is posing a challenge for this market. Increasing demand for recycled PET and HDPE is creating an opportunity for the Plastic Recycling market due to its low costs.

Drivers	Growing Focus on Environmental Sustainability	**Opportunities**	Increased Awareness about the Need for Recycling Technologies
	Rise in Initiatives for Plastic Waste Management		Demand for Recycled PET and HDPE
	The rise in the Demand for Plastics in Diverse Industry Practices		Application of Recycled Plastics Across Consumer Goods
	Favorable Government Support for Recycling Plastic		Increased Research Activities to Find an Effective Method of Recycling Plastic Waste
Restraints	Recycling Mixed Plastic Waste		Availability of Improved Technologies for Plastic Waste Management
	Stringent Competition from Virgin Plastics	**Challenges**	Lack of an Established Waste Collection and Sorting System
	Difficulty in the Collection of Raw Materials		Rising Need for Better Recycling Technologies

Market opportunities, in the field of plastic recycling may include:

- ✓ Door-to-door collection of as many materials as possible, supplemented with drop-off points of bulky/hazardous materials from every household & business

- ✓ Invest in quality collection points. At the moment, collection points (apart from the municipal blue bin) are not easily accessible for SMEs and industries. Therefore, they need to collect them and store them internally for as long as needed until delivered to a facility for further use.

- ✓ Foster collaboration between SMEs and research institutions in order to:

    - Improve design and support innovation to make plastics and plastic products easier to recycle.

    - Expand and improve the separate collection of plastic waste, to ensure quality inputs to the recycling industry.

    - More and better plastic recycling is also held back by insufficient volumes and quality of separate collection and sorting. The latter is also essential to avoid introducing contaminants in the recycling streams and retain high safety standards for recycled materials.

    - Create viable markets for recycled and renewable plastics. 3d printing can be of use in order to create new and innovative products from recycled plastic.

- ✓ Design for recyclability: Today, producers of plastic articles and packaging have little or no incentive to take into account the needs of recycling or reuse when they design their products. Plastics are made from a range of polymers and are highly customised, with specific additives to meet each manufacturer's functional and/or aesthetic requirements. This diversity can complicate the recycling process, make it more costly, and affect the quality and value of recycled plastic. Specific design choices, some of which are driven by marketing considerations (e.g., the use of very dark colours) can also negatively affect the value of recycled material.

  Moreover, some of the major packaging producers in Greece focused mainly on the design of plastic packaging in order to facilitate sorting and recycling. In this context they focus on monomer-polymer designs, for example 100% PP bags or 100% PET trays.

- ✓ Low weight plastics: The largest materials & packaging industries continue to reduce the weight of packaging of all kinds wherever possible, both to reduce costs and impact on carbon emissions. Legislation also suggests significant reduction in the weight of food packaging. Therefore, innovative design for low weight plastic is imperative.

- ✓ Avoiding hazardous substances (also design/specification): Avoiding hazardous substances and problematic materials remains at the top of the priority list when it comes to packaging, and especially in relation to packaging materials containing food. For example, oxobiodegradable plastics are now banned in the EU from 2021 due to the amount of microplastics that are released into the environment at the end of the product's life.

- ✓ Innovation and Materials Technology: Various examples at the national level testify to a shift towards innovation and technology, such as PureCycle Technologies, NaturALL Bottle Alliance and other practices.

4.3.1.3 Electrical equipment

Objective: E-waste and recycling through a producer responsibility organization.

Opportunity: Producers of electronic equipment are held responsible for the collection and treatment of their own products in accordance with the European WEEE directive. In Greece, these measures have not yet come into full effect. Therefore, there is a low collected waste per capita rate. From the consumer perspective, there already was a certain regard for sustainability, easing the collection of e-waste. For a fruitful implementation of the directive, manufacturers, municipalities and the Regions need to work together in order to create efficient and competitively neutral collection and logistics solutions.

New market models must be based on eco-innovative services such as:

- eco-leasing,
- product customization,
- better WEEE management, and
- ICT tools to assist with other circular services.



4.3.1.4 Metals

Objective: For the metal as well as the plastic waste there is a market need for high quality recycled aggregates, used in the construction sector.

Opportunity: The Steel industry, being completely independent of iron ore, uses exclusively scrap as its primary resource for the production of steel, thus reclaiming this valuable resource which would otherwise end up in landfills. All Greek steel makers apply the model of resource recovery, currently also widely applied by the steel makers in the EU.

WEEE (as mentioned din the previous chapter) contains a number of hazardous and toxins e-waste also contains over 60 valuable elements. Manufacturers in the sector are a major consumer of precious and special metals such as nickel and nickel alloys, cobalt alloys, titanium and titanium alloys. Company services that need to be developed, complementary to those mentioned before may includeinclude:

- ✓ Recycling of e-waste from the corporate and public sector;
- ✓ Increasingly intensive e-waste service by home users;
- ✓ Creating curricula to strengthen technological competence and environmental culture for schools and start-ups;
- ✓ Foster consultations for businesses to improve the sustainability of their business and strengthen environmental responsibility;
- ✓ Training and consultations on the rules and good practices in e-waste

- ✓ Offer a brokerage service to companies in the recycling market whilst taking care of the logistics management.

Especially for aluminum recycling, the following must be taken into account:

- Aluminum residues, including those produced through the alumina production process can be used in other industries (e.g., cement industry) as raw material.
- Secondary scrap aluminum is widely remelted in aluminum smelters.
- Aluminum scrap is widely remelted in aluminum foundries. The use of the Waste Management Plan for certain construction projects aims to maximize the recovery of aluminum scrap and demolition aluminum to allow direct recycling by the supplier or through contractors active in waste management.
- Aluminum alloy and derivative products are, of course, widely processed and traded due to the value of the materials.

4.3.1.5 Food

Objective: To provide businesses engaged in food preparation as well as catering activities with measures of their current food wastage and advice on reducing the amounts of food wasted.

Opportunity: There is evidence that simply measuring food waste can provide a strong incentive towards its minimization, through raising awareness. This incentive is bolstered and supported when coupled with organization specific, targeted advice on waste minimization. SMEs can be provided with clear objectives and actionable steps towards food waste reduction through comprehensive audits of areas such as inventory spoilage, preparation waste, and customer plate waste. Schemes like the one suggested here have been implemented as pilot projects in several countries in the EU[58].

58 https://www.london.gov.uk/programmes-and-strategies/environment-and-climate-change/waste-and-recycling/helping-businesses-reduce-food-waste

Moreover, similar food redistribution schemes can also support social actions, where available food can be delivered to low-income households through food redistribution.

Other, market opportunities are suggested here:

Resource-efficient agricultural practices. IT and automation are positively disrupting farming practices by enabling precision agriculture – a whole-farm management approach that leverages IT, big data, remote sensing, and satellite positioning data. These technologies optimise returns on inputs while reducing environmental impact. *Precision agriculture* is already profitable in many cases, and the technologies have great potential to improve resource efficiency. Farmers report 20–30% improvement in irrigation efficiency, 10–205 reduction in fertiliser and pesticide use, and as much as 75% reduction in machinery and input costs by combining precision agriculture with notillage farming.

Today, 70–80% of new farm equipment sold includes some precision agriculture component.New technological solutions promise to further increase resource efficiency. For example, vapour-transfer irrigation systems enable saltwater irrigation by using low-cost plastic tubes so water vapour, but not water or solutes, can pass.

Closed loops of nutrients and other materials. The potential to extract valuable bio-chemicals or recover energy and nutrients from various waste streams is significant. For example, phosphorus recovered from sewage sludge, meat and bone meal, and biodegradable solid waste in the EU-27 amounts to almost 30% of today's use of synthetic phosphorus fertiliser. This is important, since more than 95% of the consumed phosphorus in Europe is imported as fertiliser, livestock feed, food, and other organic products.

Of course, not producing waste is an even better solution. Several companies have developed closed-loop systems that use by-products or the waste from one process as input for other processes. Bunge, one of the world's largest agribusiness and food companies, found synergies between their soybean and sugarcane bio-processing value chains. The Plant in Chicago uses carefully selected tilapia, vegetables, beer, and kombucha tea production to balance waste and feed stock needs. Combined with a commercial kitchen and an anaerobic digestion chamber to convert remaining waste into power and steam, this is a fully closedloop, zero-waste system. Scaling such a closed-loop system requires identifying synergies between existing input and

output flows. This, in turn, requires more transparent resource flows and crosscompany and cross-sector collaboration.

4.3.1.6 Waste from fabrics

Objective: Business models enabling the circular economy can target textile industry in several sub-areas:

- Production processes
- Product life cycle management
- Trade
- Consumer behavior
- Waste management system for textile

Opportunity: New business models that recently have gained attentions regarding efforts to transition towards a circular economy in Bulgaria are mainly in the field of product-life extension model, renewability and sharing platforms. The models are focusing in how to reuse textiles by repair, maintenance, reuse as a product (e.g., second-hand trading), and as a material (e.g. as handicraft), selling and sharing through online platforms.

4.3.2 Opportunities: Remanufacture and Reuse

The opportunities for re-use with the data so far are not many regarding the businesses of the region analyzed. The basic materials that can be reused are:

4.3.2.1 Electrical equipment

In the EU, the Waste electrical and electronic equipment (WEEE) collected in year 2018 was estimated at 8.9 kg per inhabitant, while the average EEE put on the market over the period 2015-2017 was estimated at 19.1 kg per inhabitant. This type of waste contains a complex mixture of materials, some of which are hazardous. In addition, modern electronics contain rare and expensive resources, which can be recycled and re-used if the waste is effectively managed. Batteries, are a main component in the WEEE, and every year more than 1 billion tons of consumer batteries enter the European Union. Not all these batteries are properly collected and recycled at the end of their life, which increases the risk of releasing hazardous substances and constitutes a waste of resources. **WEEE Directive (2012/19/EU)**

stablishes that the collection target is set at 45 % for 2016 (reported in 2018) and will rise to 65 % in the coming years.

WEEE management is both a threat for the environment and an opportunity for creation of jobs and growth. Circular economy applied on new business models can prevent the impact of waste on the environment while creating additional economic value both on cities and rural areas.

The generation of electronic waste in **Greece** is estimated at around 14 kg/per capita annually, significantly higher than the EU average (3.5kg/capita). The WEEE Directive (2012/19/EU) sets specifications for the treatment of Waste Electrical and Electronic Equipment (WEEE) and specific recycling targets for EU Member States. The collection rate for WEEE in Greece is limited due to relatively poor citizen participation. This is due to low levels of environmental education, a lack of implementation of recycling schemes for WEEE by local government bodies, and limited trust towards recycling systems. In addition, the existence of peddlers illegally collecting and trading WEEE and used electrical parts at extremely low prices hinders the effectiveness of current recycling schemes. Meanwhile, companies cooperating with the Appliances Recycling S.A. system do not always implement the foreseen environmental techniques when managing end-of-life equipment. As a result, collected WEEE can be of low quality with parts of significant market value (when recycled) missing; while hazardous substances such as mercury, cadmium, lead, asbestos and PCBs are extracted without specific precautions, endangering the natural environment.

Electrical and electronic equipment and waste arising from these appliances, including waste portable batteries and accumulators, have environmental impacts throughout their life cycle. This is due to the fact that in recent years, WEEE has increased in technological complexity, with new product innovations and ever-shortening product life expectancy. The amount of collected obsolete household appliances, computers, mobile phones and other electronic products increases every year. To reduce the environmental impact of WEEE and waste portable batteries and accumulators a high level of separate collection is essential and at the moment it is absent or not clear to producers and consumers.

Therefore, market opportunities appear in the following:

- ✓ Set up and expand the collection network and increase the capacity for efficient and sustainable management of WEEE, with the aim of:

- Improving the available quantity of WEEE
- Increasing the quality of processes at existing collective recycling schemes run by existing schemes
- Minimise the environmental footprint of WEEE
- Identify potential synergies with SMEs and other end users
- Increase environmental awareness regarding the risks of maltreating WEEE

4.3.2.2 Packaging material

Examples of opportunities for producers and other SMEs as users:

- Developing and using smart packaging materials that prevent food wastage; this can lead to the increased use of packaging materials.
- Putting the environmental impact of products, particularly food, first: the packaging is mainly designed to protect the product.
- Packaging products closer to the consumer and in smaller quantities.
- Integrating the collection of packaging materials in the reverse logistics of delivery to SMEs, industries and households.
- Using standardized and labeled secondary packaging materials.
- Setting up paid collection systems for chains that are not closed in a financial sense.
- Using recycled materials for non-food packaging materials.
- Closing one's own chain: traceability of plastic to guarantee good use.
- Limiting transport movements and making transport more efficient, for example by using multi-modal transport by rail and water.
- Offering transparency regarding the origin and environmental impact of products and packaging materials at the user's - consumer's request.

4.3.2.3 Fabrics and textile

Reuse is the most environmentally friendly extension of the life of the textile, as it requires the least additional resources and energy. The collected clothes are sorted and disinfected and according to their condition are sold in the second-hand markets. Most of the usable clothes collected in Greece and Bulgaria are sold in countries with a lower standard of living. The main goal is for each garment to find an owner who needs it and would wear it, extending its life cycle.

Such business models, can be ready for to help victims of global disasters, accidents and crises, which, if necessary, can immediately provide clothes for thousands of people in need. About 10% of the collected quantities are suitable for cutting and from them are made cotton towels used for cleaning in various industries. About 50% are clothes that are reusable and exported to countries in Africa, Central America, the Middle East. Some of the quantities are redirected to recycling facilities in the country and abroad for the production of insulating wool, filling for upholstery, and knitted for yarn, etc.

Moreover, there is a significant trend lately for "ecological fabrics". Therefore, SMEs that produce fabrics or raw materials can work together to reduce the sector's environmental impact, by introducing garments in their value chain made of an innovative polyester fibres (or other material) that can be fully reused. Projects such as this one, can be fully funded under EU funds and achieve several synergies such as:

- Closed loops for production materials
- Need for less water and land for cotton
- Innovative products

Finally, one inspiring market opportunity coming from a field that is not yet known in Greece is the Diapers-as-a-service. The consumption of disposable diapers has sky-rocketed with the vast majority not being recyclable. We see disrupting innovations starting in European countries: Washcot[59] for example is a full-service platform where one subscribes for reusable diapers on a monthly basis. Weekly clean cloth diapers are delivered, and dirty ones are picked up. The supermarket is skipped, and

[59] https://zerowasteshowcase.enviu.org/solution/washcot/

producers and consumers interact directly, while eliminating as much as 20kg of single-use diapers waste per month per baby.

Literature

European Commission. (2012). Innovating for Sustainable Growth: A Bioeconomy for Europe: https://op.europa.eu/en/publication-detail/-/publication/1f0d8515-8dc0-4435-ba53-9570e47dbd51#:~:text=A%20bioeconomy%20for%20Europe.%20On%2013

European Commission, 2015. COM (2015) 614: *Communication from the Comission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: Closing the loop - An EU action plan for the Circular Economy. Brussels, Belgium. European Commission*.

European Commission, 2019. COM (2019) 640: *Communication from the Commission to the European Parliament, the European Council, the European Economic and Social Committee and the Committe of the Regions: The European Green Deal. Brussels, Belgium*.

European Commission., 2020a. Circular economy action plan: For a cleaner and more competitive Europe: https://ec.europa.eu/environment/circulareconomy/pdf/new_circular_economy_action_plan.pdf

European Commission, 2020. COM (2020) 381. *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. A Farm to Fork Strategy for a fair, healthy and environmentally-friendly food system. Brussels, Belgium*.

Kirchherr, J., Reike, D., & Hekkert, M. (2017). Conceptualizing the circular economy: An analysis of 114 definitions. Resources, conservation and recycling, 127, 221–232.

Geissdoerfer, M., Savaget, P., Bocken, N. M. P., & Hultink, H. J. (2017). The Circular Economy: A new sustainability paradigm? Journal of Cleaner Production, 143, urn:issn:0959-6526.

Nobre, G and Tavares, E, 2021. The quest for a circular economy final definition: A scientific perspective. *Journal of Cleaner Production,* 314:127973

ANNEX I: MARKET ANALYSIS QUESTIONNAIRE

QUESTIONNAIRE - GENERAL INTRODUCTION

Definition

Circular economy is a new model of production and consumption, which focuses on the reuse, repair, renew and recycling of existing materials and products in order to extend their life cycle. By rejecting the linear model of production based on "supply - manufacture - disposal", it focuses on reducing the waste of resources used in the production process, emphasizing in the utilization of renewable resources, plant and animal by-products and biodegradable materials, but also the production of energy from the waste of production processes, the maintenance of a product in good working condition for a longer period of time, the use of products to provide services to multiple users (sharing economy) and, finally, the use of the service offered by a product and not its possession per se.

Based on the economy of knowledge and expertise, circular economy exploits and respects natural resources, creates new jobs, provides to small and medium entrepreneurship and contributes to the development of a social economy.

Objective of the questionnaire

This questionnaire was prepared in the context of supporting new businesses and startups in the framework of the implementation of Circular Economy actions. The questionnaire and the Market Analysis are developed in the context of the project entitled **Creating "Circular Business by young ENGINEers at the cross-border area of Greece-Bulgaria"** and acronym **ENGINE-HUBs**, which is financed by the **INTERREG VA Cooperation Program "Greece-Bulgaria 2014-2020"** in the context of supporting actions to strengthen entrepreneurship in the circular economy sector.

The main objectives include:

1. The mapping of existing and the promotion of future actions based on the needs and requirements of the business environment of the cross-border area in the field of circular economy.

2. The mapping of opportunities for new businesses and start-ups in the circular economy sector.

3. The mapping of the trends for the potential future formation of tools (technical and financial) for strengthening industries and businesses of the area.

Thank you in advance for your time.

PART A': GENERAL COMPANY DETAILS (OPTIONAL)

Pledge of Confidentiality of Information

The data will be used only for the purposes of the research carried out by the SBE working group for the project «*Creating Circular Business by young ENGINEers at the cross-border area of Greece-Bulgaria*" with the acronym: *ENGINE-HUBs* funded by INTERREG VA Cooperation Program "Greece-Bulgaria 2014-2020" in the context of supporting actions to strengthen entrepreneurship in the circular economy sector

Name of organization

Regional unit			
Thessaloniki	Serres	Kavala	Drama

Municipality

Person responsible for communication

Telephone	e-mail

Web page

How many employees does your business employ (in the current year)?	
1	
2-10	
10-20	
20-50	
50+	

Declaration of Participation	
	I have been informed about the purposes of completing this questionnaire and I participate voluntarily
	I consent to the processing of data by the SBE and the project team of the ENGINE-HUBs program in the context of supporting actions to strengthen entrepreneurship in the circular economy sector
	I want to be further informed by the SBE about the results and conclusions of the relevant research

PART B: CURRENT STATUS OF CIRCULAR ECONOMY

Which of the following categories/sectors does your business belong?	
Solid Waste Management Body (FoDSA, FoDSA network)	
Alternative Waste Management System	
Agricultural sector (primary production)	

Which of the following categories/sectors does your business belong?	
Industrial sector	
Energy sector	
Construction sector	
Mining sector	
Tourism sector	
Recycling - Reuse sector	
Food sector	
Commercial sector	
Other - Please specify :	

What streams of discarded materials and/or waste does your business generate? (*Possibility to choose multiple answers*)	
Construction material	
Electric and electronic material	
Batteries	
End of Life Vehicles	
Packaging material	
Plastic	
Tires	
Metals	
Food	
Textile products	
Energy from waste	
Soil improvers - fertilizers	
Biomass - Agro-products	
Other - Please specify :	

Do you implement a separate waste collection action in your business? For which category of waste? (*Possibility to choose multiple answers*)	
	No, no separate action is implemented
	Yes, for construction waste

Do you implement a separate waste collection action in your business? For which category of waste? (*Possibility to choose multiple answers*)	
	Yes, for electric and electronic material
	Yes, for batteries
	Yes, for end of Life Vehicles
	Yes, for packaging waste
	Yes, for plastic
	Yes, for glass
	Yes, for metal
	Yes , for wood
	Yes, for textile products
	Yes, for home appliances
	Yes, for food waste
	Yes, for agro-waste
	Other - Please specify :

If you answered YES to the previous question, what exploitation actions are you following?	
	Only preparation for delivery of waste is done (eg separation, temporary storage, drying, shredding, etc.) and then the residues / by-products are disposed off-site
	We utilize only some of the waste / by-product streams. Those that are not used are disposed of outside the company
	We utilize all waste / by-products
Brief process description	
Please provide a brief analysis of the action within the business	

If you answered YES to the previous question, what is produced from the waste / by-product streams that are utilized, in-house? (*Possibility to choose multiple answers*)	
	Water for industrial use and/or irrigation
	Raw material for the recovery of high value chemical additives

If you answered YES to the previous question, what is produced from the waste / by-product streams that are utilized, in-house? (*Possibility to choose multiple answers*)	
	Raw material for reuse in the production process
	Packaging material
	Raw material for solid fuel production (e.g., firewood, pellets, etc.)
	Raw material (either directly or as an additive) for animal feed production
	Energy - fuel
	Fertilizer – compost
	Other - Please specify :
Brief process description	
Please provide a brief analysis of the action within the business	

For waste / by-product streams available to other entities for recovery, outside of your business, do you know what is produced? (*Possibility to choose multiple answers*)	
	I do not know
	Water for industrial use and/or irrigation
	Raw material for the recovery of high value chemical additives
	Raw material for reuse in the production process
	Packaging material
	Raw material for solid fuel production (e.g., firewood, pellets, etc.)
	Raw material (either directly or as an additive) for animal feed production
	Energy - fuel
	Fertilizer – compost
	Other - Please specify :
Brief process description	
Please provide a brief analysis of the action within the business	

Apart from the above, what other processes do you think can be done on the waste / by-products of your business by third parties for their utilization?	
	Storage and use as fuel
	Processing for re-use as solid fuel.
	Separation of water for industrial use and/or irrigation
	Recovery of high value chemical additives
	Repair and reuse
	Processing for re-use in the production process
	Processing for re-use as packaging material
	Processing for the production of animal feed
	Use in Biogas units
	Processing for the production of Soil Improver – compost
	Other - Please specify :
Σύντομη περιγραφή	
Please provide a brief analysis of the action	

You would be interested in collaborating with other organizations in the area in order to utilize the waste / by-products	
	YES
	NO
	MAYBE

Identify the immediate type of business that would be interested toy use your by-product-waste as a raw material even if some form of treatment was required before it was disposed of? (*Possibility to choose multiple answers*)	
	Citizens
	Industry, please describe:
	Soil improvement-fertilizer-compost production unit
	Energy company, please describe:
	Food and beverage industries

Identify the immediate type of business that would be interested toy use your by-product-waste as a raw material even if some form of treatment was required before it was disposed of? (***Possibility to choose multiple answers***)	
	Other - Please specify :
Brief process description	
Please provide a brief analysis of the action within the business	

OTHER MEASURES TO PROMOTE "CIRCULARITY"

Is any renewable energy and/or water saving technology applied in your company's production process, and if so, what is it? (***Possibility to choose multiple answers***)	
	No
	Yes, Dry and/or fresh biomass energy utilization technologies (e.g., pellet boilers and/or through biogas production)
	Yes, Solar energy utilization technologies (e.g. solar water heaters and/or photovoltaic systems)
	Yes, Geothermal technologies
	Yes, Desalination technologies
	Yes, Water purification and reuse technologies (e.g. wastewater treatment facility and reuse for irrigation)
	Other - Please specify :
Brief process description	
Please provide a brief analysis of the action within the business	

PART C: MAPPING NEEDS OF BUSINESSES WITHIN THE FRAMEWORK OF IMPLEMENTATION OF CIRCULAR ECONOMY ACTIONS

Rate from 1 to 5, how do you think your business would benefit most from the circular economy?

Score Analysis:

1 : Neutral

2: Not helpful at all

3: Useful

4. Very useful

5. Necessary for the viability of my business

Please note that the utilization of residues/by-products means reuse, recycling and/or energy recovery actions.

Enhancing the competitiveness of environmentally friendly raw materials (e.g. saving raw materials for my production process) that I source for my business				
1	2	3	4	5
Brief description (if you wish)				
Please provide a brief analysis of the action within the business				

Equipment for the utilization of waste / by-products in order to reduce the operating costs of my business				
1	2	3	4	5
Brief description (if you wish)				
Please provide a brief analysis of the action within the business				

Equipment for the utilization of residues / by-products in order to produce a new product for my company				
1	2	3	4	5
Brief description (if you wish)				
Please provide a brief analysis of the action within the business				

Energy and/or water saving equipment				
1	2	3	4	5
Brief description (if you wish)				
Please provide a brief analysis of the action within the business				

Collaboration with other industries-businesses to utilize waste/ by-products in order to form a value chain for a new product				
1	2	3	4	5
Brief description (if you wish)				
Please provide a brief analysis of the action within the business				

None of the above / other (describe)

Estimate the amount of an investment (in the context of the circular economy) that you would be interested in making for your business in a 3-5 year time horizon	
	Less than 10.000€
	Less than 25.000€
	Between 25.000€ and 50.000€
	Between 50.000€ and 100.000€
	Between 100.000€ and 500.000€
	Moe than 500.000€

PART D: INCENTIVES FOR IMPROVING "CIRCULARITY"

Rate from 1 (least important) to 5 (most important), who do you consider the most important factor in making full use of the waste / by-products you produce in your business?

Score Analysis:

1 : Neutral

2: Less important

3: Important

4. Very important

5. Necessary for the viability of my business

Equipment (e.g. exploiting innovative and commercially 'mature' technological solutions)				
1	2	3	4	5
Brief process description				
Please provide a brief analysis of the action within the business				

Equipment (e.g. exploiting innovative and commercially 'mature' technological solutions)

Financial incentives (ESPA (Partnership Agreement (PA) 2014-2020), NATIONAL DEVELOPMENT LAW, other)				
1	2	3	4	5
Brief process description				
Please provide a brief analysis of the action within the business				

Know-how (e.g., employment of highly qualified personnel) and/or collaboration with expert bodies, institutions, authorities (e.g., research centers and/or university institutions)				
1	2	3	4	5
Brief process description				
Please provide a brief analysis of the action within the business				

Synergy with industries and/or businesses (e.g. industrial symbiosis – cooperative management in the framework of cooperation agreements)				
1	2	3	4	5
Brief process description				
Please provide a brief analysis of the action within the business				

Information on the possible ways of utilizing waste / by-products				
1	2	3	4	5
Brief process description				
Please provide a brief analysis of the action within the business				

Configuration of a collection and transport network to exploit				
1	2	3	4	5
Brief process description				
Please provide a brief analysis of the action within the business				

PART E: OBSERVATIONS and COMMENTS

If any, please report observations and comments regarding the activity of your business in the context of Circular Economy actions?

Thank you for your participation!

Interreg
Greece-Bulgaria
ENGINE-HUBs
European Regional Development Fund

EUROPEAN UNION

INTERREG V-A "GREECE – BULGARIA 2014-2020"

The project ENGINE – HUBS aims to identify and apply synergies and complementariness in the production line of the 2 regions and to turn an economic activity's waste into materials for others through the establishment of "circular enterprises".

ENGINE-HUBs will make it easier for both CB regions to start collaborating and developing jointly circular production lines.

The project's approach and joint assets (workforce) is to identify business opportunities in circular economy and to create a structure through which business ideas of young scientists will be transformed into businesses in the CBC area. The structure will deliver a new business approach to enhance youth entrepreneurship building on three pillars: knowledge, mentoring/coaching, and networking.

Project's comparative advantage is the connection of the scientific workforce with the market through its partnership.

It is worth noticing that the project focuses on the provision of assistance through 4 HUBs to the new entrepreneurs for the implementation of their business plans and not only the development of these plans so that the new enterprises can be operative before project's ending or 2 years after at the latest.

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

Partner Responsible for the Deliverable

TECHNICAL CHAMBER OF GREECE/SECTION OF CENTRAL MACEDONIA
Address: 49, Megalou Alexandrou, Thessaloniki, 54643, Greece
Tel: +30 2310883100 / -199
Fax: +30 2310 883110
E-mail: tee_thess@tee.gr
https://www.tkm.tee.gr/