BBioNets

Boosting the adoption of Bio-Based Technologies

High-level study of regional dynamics: Central Macedonia, Crete & Peloponnese, Greece

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Document information

Title	High-level study of regional dynamics: Central Macedonia, Crete & Peloponnese, Greece
Author	American Farm School
Brief summary	This document provides an overview of the regional dynamics in three Greek regions – Central Macedonia, Crete and Peloponnese - in terms of Operational Groups (OGs) activity, the maturity of Bio-Based Technologies (BBTs), and their potential.
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Central Macedonia

General description of the region

Geographic description of the region

Central Macedonia is one of the thirteen administrative regions of Greece, consisting of the central part of the geographical and historical region of Macedonia. With a population of almost 1.8 million, it is the second most populous region in Greece after Attica.

Figure 1: The region of Central Macedonia.

The region of Central Macedonia is situated in Northern Greece, bordering the regions of Western Macedonia (west), Thessaly (south), Eastern Macedonia and Thrace (east), and bounded to the north at the international borders of Greece by the Republic of North Macedonia and Bulgaria. The southern part is coastal and is bathed by the Thermaic, Toroneos, Singitic and Strymonic gulfs. The largest city and capital of the region is Thessaloniki. Serres is the second most populous city, followed by Katerini, Veria and Giannitsa. Central Macedonia is basically lowland and, with many rivers, is highly developed, both in the primary and the secondary sectors. The largest plain in Greece is situated in Central Macedonia. Thessaloniki, the metropolis of Macedonia, is Greece and second largest city.

The highest mountains of the region of Central Macedonia are Mount Olympus (2,918m), Voras Mountains (2,524m), Pierian Mountains (2,193m), Vermio Mountains (2,065m) and Mount Athos (2,033m). The largest rivers are the Haliacmon, the Axios, the Loudias and the Gallikos (Echedoros), which all flow into the Thermaic Gulf. Koroneia, Volvi, Doiran and Kerkini lakes are situated in Central Macedonia.

Agriculture and forestry sectors in the region

In Figure 2 the cultivated area and the production of different crops during the period 2010-2018 in the region of Central Macedonia are reported. In the region of Central Macedonia during 2018 a decrease of 32.3% of the harvested area cultivated with cereals was observed, resulting in a decrease in 36.7% of production. During 2018, the area cultivated with all the other crops was increased compared to the reference year 2010.

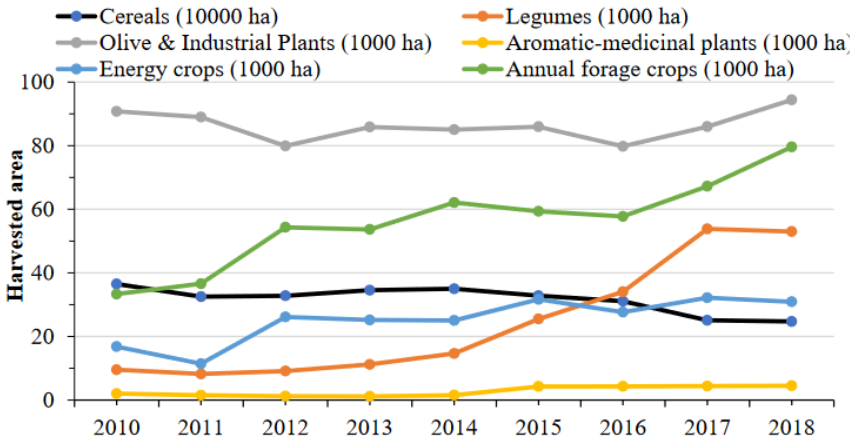

Figure 2: Plant production in Central Macedonia.

Based on the cultivated areas, in the region of Central Macedonia the main crops are cereals, olive and industrial plants, annual forage crops and legumes. Giving a closer look to the percentage distribution of the crops during the year 2018 it was observed that cereals repsesent the main crop produced in the region covering 48.5% of the area harvested but only of 38.2% of the production. Olive and industrial plants and forage crops, on the other hand, cover 18.5% and 15.6% of the area with a production of 12.8% and 41.6% respectively.

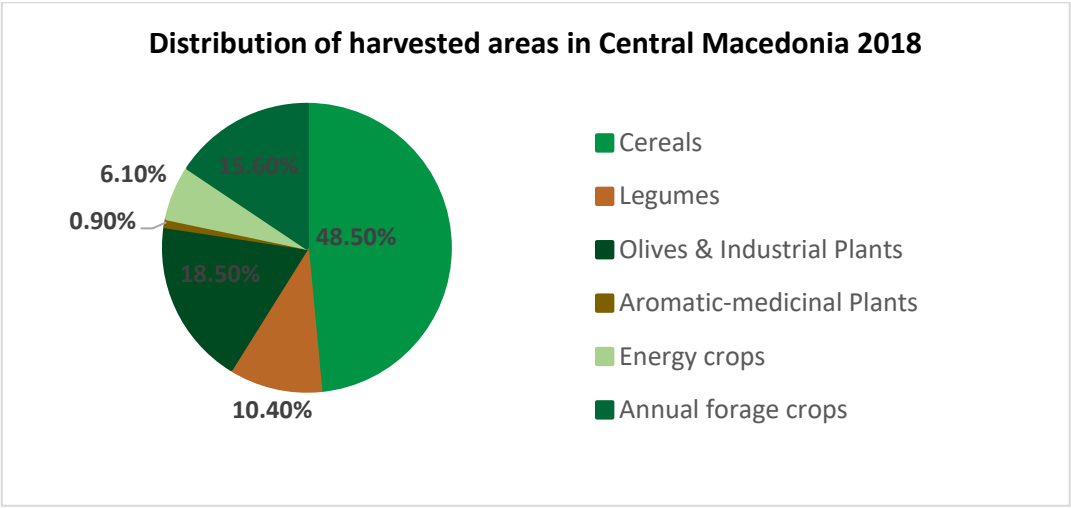

Figure 3: Harvested area 2018.

The percentage of the area harvested as well as the production of crops in the region of Central Macedonia in relation to Greece as a whole is presented in Figure 4. It is clear that up to 2012, more than 50% of the area harvested with Energy crops in Greece was in Central Macedonia covering more

than 81.8% and 62.0% of the total production of Greece. Aromatic-medicinal plants represent another product that Central Macedonia produces in high amounts. The area harvested in Central Macedonia with aromatic plants represents 39% of the total area cultivated in Greece with such plants whereas the production represents 59.9% of the total aromatic plants produced in Greece. Legumes represent another important crop, with production in Central Macedonia region representing 42% of the production of legumes in Greece during year 2018.

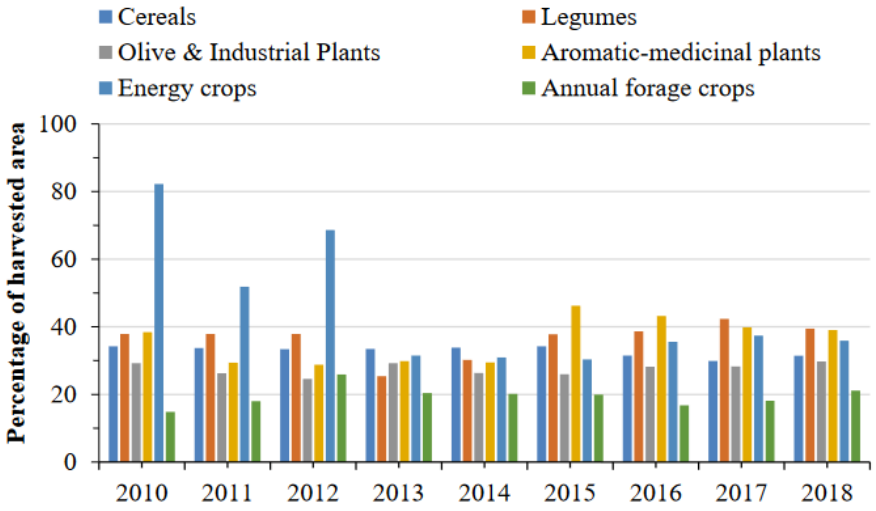

Figure 4: Types of different plant production 2010-2018.

During 2018, in the region of Central Macedonia, the main harvested area with fruits is made of stonefruit trees and olive trees covering 46.6% and 31.3% of the total area of the region cultivated with fruit trees (Figure 5). The respective production percentage is 70.8% and 1.1% of the total production of fruits in the area. During the period 2010 to 2018, a slight variation is observed in the area cultivated with fruit trees and the respective production. A decrease in the area harvested compared to the year 2010 was observed only for pomefruit trees, grape for raisins and olive trees.

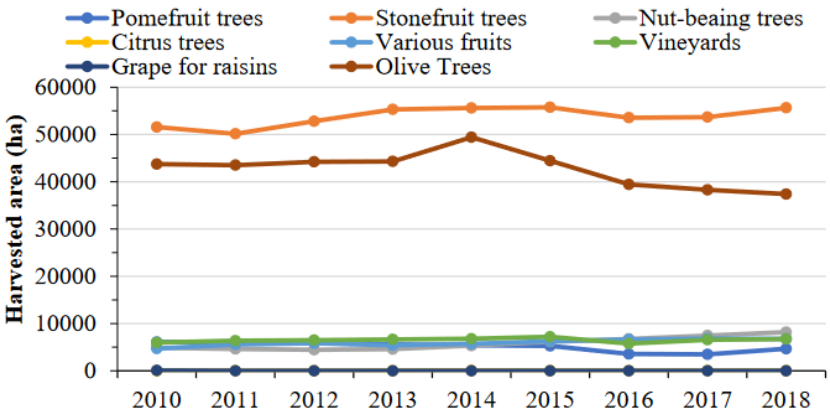

Figure 5: Different types of fruits & vegetables production 2010-2018.

For the category of animal production (animals and animal products) data were obtained from Agricultural Financial Accounts of Central Macedonia, Eastern Macedonia and Thrace and Greece and are shown in figure 6. According to ELSTAT (Hellenic Statistical Authority) during 2017 the animal production in the region of Central Macedonia represented 20.8% of the animal production of Greece. This value represents a high level of production at country level, and is similar to the respective value for the plant production (20.1%). Animal production represents 41.6% whereas animal products represent the remaining 58.4% of the total animal production of Central Macedonia. At country level, these values are 53.4% and 46.6% for the animals and animal products, respectively.

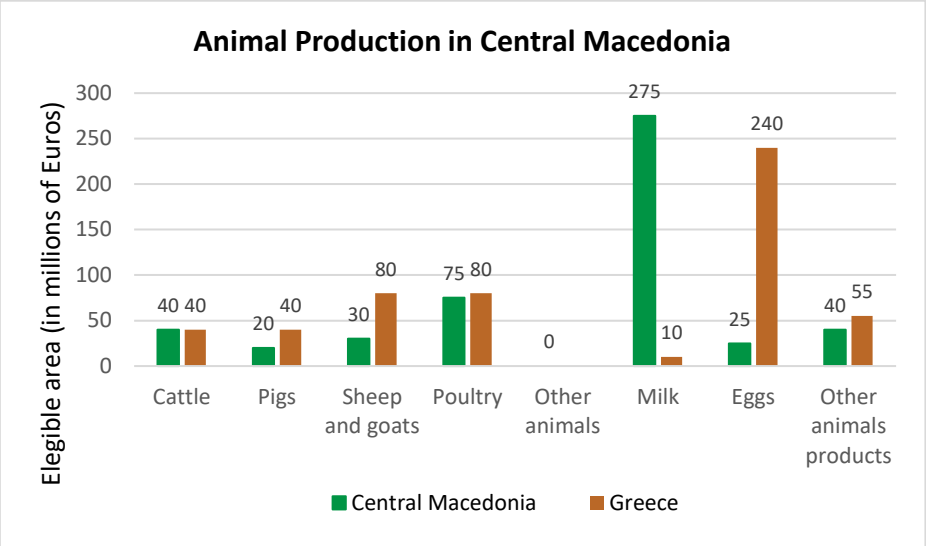

Figure 6: Animal production in Central Macedonia.

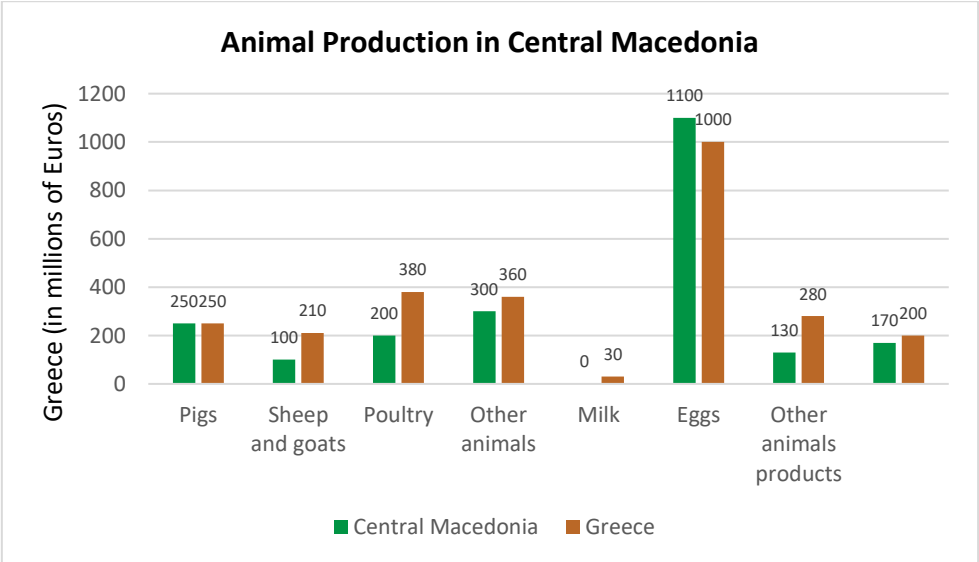

Figure 7: Animal production in Central Macedonia.

Economic indicators

According to the Regional Accounts published by ELSTAT with data for 2020, Central Macedonia, the most populous region in the country after Attica with 1.7 million inhabitants, does not even rank in the top five among all territories, with a per capita GDP of only €12 043 euros and a decrease of 9.7% from

2019. At the same time, with €19.7 billion of gross value added in 2020, it represents only 13.6% of the total territory, with Attica amassing a staggering 47.8%.

The financial situation of residents in Thessaloniki and neighboring cities in Central Macedonia is not any better. According to data from the Bank of Greece, the average deposits in the region's bank accounts amount to approximately €4 500, while in Attica they exceed 7,200 euros. Furthermore, Central Macedonia has a distressing rate of population at risk of poverty and social exclusion, reaching 23.8%. This is clearly explained by the high unemployment levels in the region, which exceed 15%, compared to around 8% in the capital.

In terms of business outward orientation, according to a study by the Association of Exporters for 2021, Central Macedonia experienced a 17.7% increase in export value to €6.2 billion, representing 15.6% of Greece's total exports, or 19% excluding petroleum products. The largest and most populous region of Attica understandably leads the ranking with over 20 billion euros in exports, recording a much larger increase of 23.4% within the year, accounting for 52.7% of the total.

Bioeconomy regulatory framework

In a recent comprehensive report by the European Commission, which aimed to map and analyze the development of bioeconomy strategies at the regional level within the EU-27 (titled "Bioeconomy Strategy Development in EU Regions"), the Region of Central Macedonia has distinguished itself by ranking first among the 13 Greek regions in terms of the number of Action Plans focusing on the promotion of bioeconomy. The report highlights that, although bioeconomy is embedded as a priority in several strategic documents -such as the Long-Term Strategy 2050, the National Strategy for the Circular Economy, the New Action Plan on Circular Economy, and the National Waste Management Plan 2020-2030- Greece still lacks a dedicated bioeconomy strategy at national level.

At regional level, many regions, including Attica, Epirus, and Thessaly, acknowledge the importance of circular economy and bioeconomy within their strategic frameworks. However, they currently do not have specific plans or strategies in place. Out of the 13 Greek regions, only two have published actionable plans dedicated to the promotion of circular economy and bioeconomy: the Region of Central Macedonia, with two Action Plans, and the Region of Crete, with one Action Plan. The Region of Central Macedonia has successfully developed and published two Action Plans for promoting circular economy and bioeconomy.

State of the art of biomass valorization

Biomass resource availability

In the Region of Central Macedonia, the main biomass producers are plant and forest residues (firewood, twigs, straw, sawdust, olive kernels, seeds), animal waste (manure, waste), plants grown on energy plantations for use in energy production, as well as municipal waste residues of the food industry, agricultural industry and the biodegradable fraction of municipal waste. More specifically, the crops that can produce biomass from their residues are mainly cereals and energy crops because they have an abundance of straws and stalks which can produce high levels of biomass. From the crop plans it is observed that the main cultivations of Central Macedonia are cereals (hard and soft wheat), cotton and maize and in some regional units such as Pella and Imathia the main cultivations are fruit trees.

Table 1: Biomass types in Central Macedonia.

Crops	Residues Type	Output of residues (tn/acres)	Humidity %	Biomass (tn/acre)
Alfalfa	Straw	0.3	0.15	0.26
Apples	Prunning	0.24	0.4	0.14
Apricots	Prunning	0.16	0.4	0.1
Barley	Straw	0.27	0.15	0.23
Cherries	Prunning	0.25	0.4	0.15
Cotton	Straw and shell (overground)	0.42	0.4	0.25
Cotton	Straw and shell (root)	0.13	0.56	0.06
Hard Wheat	Straw	0.16	0.15	0.14
Kiwi	Prunning	0.16	0.35	0.1
Maize	Stalks and cobs	1.05	0.55	0.47
Nectarines	Prunning	0.29	0.4	0.17
Olive Trees	Prunning	0.17	0.5	0.09
Peaches	Prunning	0.29	0.4	0.17
Rapeseed	Straw	0.4	0.53	0.19
Rice	Straw	0.38	0.25	0.29
Set Aside	Not applied	0	0	0

Olive trees have the highest percent of the cultivated area in the regional unit of Chalkidiki 41.50%, since Chalkidiki is well known in Greece for the olives and the virgin olive oil. The crops that follow are hard wheat with 21.82% and "set aside" areas with 16.04%. The cultivations with lower percent than 10% are barley with 5.74%, soft wheat with 4.92%, oats with 4.32%, vetch with 3.43% and sunflower with 2.23%. The total selected cultivated area ιν τηε Chalkidiki regional unit is 743.292 acres. The regional unit of Imathia has 650 007 acres total selected cultivated area. The main crops of the regional units are fruit trees and arable crops. Analytically, peaches hold 28.05% of the existent cultivated area followed by cotton with 25.16%. Under 10% of the cultivated area are maize with 9.23%, alfalfa with 8.54%, hard wheat with 7.45%, nectarines with 6.02%, apples with 4.02%, rice 2.50%, soft wheat 2.30% and barley 2.30%. The existent crop plan of the regional unit of Imathia had "set aside" area 4.27% and 42.16% of the cultivated area of the existent crop plan of the regional unit of Kilkis is covered by hard wheat. The soft wheat holds the 24.52% and 10.92% is set aside area. All the other crops which fill the existent crop plan of the regional unit of Kilkis presented percentage under 10%. Specifically, 7.51% is cotton, 4.86% is alfalfa, 3.91% is barley, 3.74% is maize and 2.38% sunflower.

Regarding the regional unit of Pella, peaches hold the highest percentage with 21.88%, followed by cotton (15.42%), maize (11.70%) and cherries (10.77%). Lower percentages are represented by hard wheat (8.17%), alfalfa (7.60%), the set aside area (6.88%), soft wheat (5.69%), barley (5.59%), nectarines (4.06%) and apricots (2.24%).

Pieria is well known for the cultivation of kiwis and tobacco but the main cultivations are cereals. Wheat holds the highest percentage in the regional unit of Pieria with 20.53%, followed by soft wheat (15.70%) and tobacco (10.20%).

Cotton with 9.30%, set aside with 8.70%, alfalfa with 7.00%, olive trees with 6.70%, kiwi with 6.50%, barley with 5.30%, maize with 3.70% and rice with 2.10% are the other main cultivations of Pieria.

The regional unit of Serres has mainly arable crops and cereals. The cultivated area of hard wheat participates in the existent crop plan with 25.11%, the cultivated area of maize with 18.08% and the cultivated area of cotton with 11.10%. Soft wheat, sunflower and alfalfa participate with 8.93%, 8.05% and 7.62% respectively. 6.18% of the cultivated area is set aside and barley holds the 5.86%. The cultivated area of olive trees, rice, tobacco and rapeseeds follow with percentages lower than 5%.

Management and logistics of biomass resources

In the Region of Central Macedonia, the priority sectors for the bioeconomy include Agriculture, Livestock, Agroindustry, Chemical Industry, and Energy. The region has a high territorial sensitivity, and a sustainable bioeconomy addresses global challenges like climate change and ecosystem degradation while meeting the growing demand for food, feed, and energy. This dual approach helps modernize industries and protect the environment.

The bioeconomy in Central Macedonia is still in its early stages but significantly impacts the region. Environmentally, it reduces CO_2 emissions, water consumption, and enhances soil fertility. Societally, it boosts employment in agriculture, waste management, and energy sectors. Economically, it fosters the growth of startups and other enterprises, promoting modernization.

A SWOT analysis of Central Macedonia's bioeconomy revealed the following:

Strengths

- government and public sector services enhance knowledge about the bioeconomy
- management systems support recycling and implementation
- presence of consulting engineering companies
- development of waste-to-energy plants, like biogas facilities
- high production capacity of biomass from agriculture, livestock, agri-food, forestry, and fishing

Weaknesses

- lack of regional bioeconomy governance models
- absence of mandatory systems for monitoring and improving small enterprises' productivity
- farmers focus more on compensations than on enhancing agricultural management skills
- overuse of certain plants, excluding others
- limited knowledge of diverse biomass resources for innovative bioproducts

Opportunities

- availability of European and governmental funding for new systems, techniques, and processes
- potential for new intra-European trade and business opportunities
- growing interest in sustainable investment

Threats

- possible negative impacts of increased biomass use on society
- reduction of biomass resources due to climate change
- entrepreneurs prioritize livelihood issues over new technologies and bioeconomy approaches

- bureaucratic and administrative obstacles hinder entrepreneurship

Bio-Products target market

At this stage of market development in the Central Macedonia Region, there does not appear to be any specific market targeting documented.

R&D system associated with biomass valorization

The Institute for Bio-Economy and Agri-Technology (iBO) is one of the five institutes within the Centre for Research and Technology – Hellas (CERTH), which operates as a private non-profit entity under the oversight of the General Secretariat for Research and Technology (GSRT) within Greece's Ministry of Development and Investments.

iBO specializes in agri-technology and bio-systems engineering, integrating various interdisciplinary research fields. Its research focuses on effective environmental management, sustainability assessment of bio-production processes, and enhancing human interactions in these activities, all aimed at promoting circular economy principles.

Support and financing policies

The Regional Development Fund of Central Macedonia (RDF CM) was established in 1997 under the legislation of L. 2218/94, amended by art. 12 par. 10 of L. 2307/95 and art. 4 par. 3 of L. 2503/97, and is overseen by the Ministry of Interior (Home office). It operates as a Private Law Legal Entity and is managed by a nine-member board comprising representatives from various productive bodies, chambers, officials, economic and executive committee members, and the major opposition. The Governor of Central Macedonia serves as the President of the Management Board.

The RDF CM has a dual function: it acts as an accountant project manager for the Public Investment Programme and supports the region's development process by leveraging its expertise in implementing European Programmes, Initiatives, and various studies, research, and services. Its goal is to promote dissemination, entrepreneurship, innovation, and new technologies in the region's priority areas.

The RDF CM's responsibilities include:

- managing credits from the Public Investment Programme, funding for public sector bodies and other legal entities, and funds from European Union Programmes and other international organizations related to regional (ROP CM) and sectoral (OP FM, RDP, FEAD, etc.) development programmes,
- submitting proposals and implementing European Programmes and Initiatives (such as INTERREG and HORIZON), and supporting the region's participation in international networks and collaborations,
- providing technical support to the region through studies, research, and services assigned by the region, aimed at more efficient resource utilization. This support also includes dissemination actions targeting the region's priority areas, such as agri-food, tourism, and health.

Analysis of Operational Groups

Operational groups characterization

Within the region of Central Macedonia, there are four (4) OGs with active participation in the bio-mass industry.

(1) Aeforika Kipeftika is an OG that aims to incorporate non-commercial oregano into (greenhouse/outdoor) vegetable crops for the protection against soil fungi. Specifically, they aim to control downy mildew, caused by soil fungi, with negative effects on production in the context of circular economy and the adoption of good agricultural practices. They investigate optimum doses of oregano that must be incorporated into the rhizosphere in order to obtain best results and assess disease and productivity and quality indicators.

(2) BioAnimalChar is an OG for the exploitation of agricultural biomass for the production of animal food supplements. They aim to utilize agricultural biomass by-products to create a new, low-cost, biochar-based feed supplement, which will significantly improve the quality of pig feed.

(3) SoilCircle is an OG that aims to implement all the procedures for the certification of compost of agri-food origin in order to create an environmentally friendly business model for the conversion of agri-food waste into a value-added product (organic production). However, it is not clear if and how they are involved in the utilization or production of BBTs.

(4) Innovative Rice Residue Management Practices return rice production residues to the soil for improved soil health and fertilization.

Two additional examples of OGs that operate within the wider region of Macedonia are also included, given that some of them have dynamic potential in the field of bio-mass valorization.

(1) Proud Farm, in Kozani (Western. Macedonia) is an OG that envisions a sustainable future for Greek sheep and goat farming. Services provided to new and existing sheep and goat farmers include incubator support for young farmers, education, production of educational audiovisual material, management support services, and many others. They have already produced a market ready product, utilizing residue sheep wool pellets for supporting soil health, fertilization needs and soil water retention.

(2) HEGIARTOS in Eastern Macedonia is an OG aims for the development of a yogurt dessert from goat's milk enriched with antioxidants from espresso coffee residue extract.

Bio-based technologies (BBT) developed by OGs

Fertiwool is an organic fertilizer produced from 100% Greek sheep wool. It is a unique product suitable for all types of crops. Rich in nutrients, it has the ability to retain water and expand, reducing irrigation needs by up to 30% and improving soil structure. It requires only one application every six months due to its slow-release nutrient properties. Additionally, it is 100% biodegradable. This sheep wool-based organic fertilizer is a product of 100% circular economy.

Crete

General description of the region

Geographic description of the region

Figure 8: The region of Crete.

Crete is an island in the eastern Mediterranean Sea that is one of 13 administrative regions of Greece. Crete is the fifth largest island in the Mediterranean and the largest of the islands forming part of modern Greece. It is relatively long and narrow, stretching for 160 miles (260km) on its east-west axis and varying in width from 7.5 to 37 miles (12 to 60km). The administrative centre is Irákleio (Heraklion; historically Candia), on the north coast. Crete is dominated by harsh mountains rising out of the sea. The island's east-west mountainous range consists of four main groups that rise to the island's highest point, Ídi mountain, 8,058 ft (2,456m) in elevation. To the west the Lefká ("White") Mountains reach 8,045 ft (2,452m), and to the east the Díkti Mountains extend to 7,047 ft (2,148m) in elevation. Those mountains rise above the high upland plains of Nída, Omalós, and Lasíthi and are marked by several gorges, the best known of which is the Samariá Gorge. The gradually sloping northern coast provides several natural harbours and coastal plains, where such major towns as Chaniá (Khaniá; historically Canea), Réthymno (Réthimnon; historically Rhithymna), and Irákleio are located. The Mesara (Messára) Plain extends along the south-central part of the island for about 18 miles (29km) and is Crete's major expanse of flatlands. Crete has six small rivers as well as springs, seasonal watercourses and ponds, one natural freshwater lake (Lake Kournás), and several artificial lakes.

Agriculture and forestry sectors in the region

The primary sector holds a dominant position both in terms of product and employment, but it is characterized by small and scattered landholdings, dependency on traditional models and crops, and structural deficiencies with incomplete infrastructure. Production systems are largely outdated and offer low post-production added value. Additionally, the percentage of irrigated land in Crete is much lower than the national average of Greece, while the structure of crops emphasizes traditional cultivation. Livestock farming is also scattered, with very few organized livestock units, although there are significant conditions for the development of dairy products.

The Prefecture of Heraklion has the greatest area of cropland. The most extensive cropland in Heraklion is located in the Messara valley. Olive and vine plantations are the main trees, covering a

large part of the lowlands and hilly areas, but also parts of the uplands. The most significant expansion of olive groves occurred during the last forty years after maquis and shrub vegetation were eliminated. Vine plantations declined significantly due to destruction by phylloxera. New plantations, with increased resistance to phylloxera, have appeared in the area in the last decade. Cereals drastically declined in Crete after 1950 and were replaced mainly by olive trees or vines.

Olive groves are found across Crete. The island of Crete, and especially the Messara valley, faces significant problems of water resource over-exploitation due to the expansion of irrigated cropland, such as olive groves. Although the Valley receives on average about 600mm of rainfall per year it is estimated that about 65% is lost to evapotranspiration, 10% as runoff to sea and only 25% goes to recharging the groundwater. An extensive network of pumping stations has been installed since 1984 in which rain-fed olive groves have been converted to irrigated olives. The consequences are an increase in crop production accompanied by a dramatic drop of up to 20m in the groundwater level in some places, and intrusion of brackish water in the aquifers.

According to the 2021 Annual Agricultural Statistical Bulletins of ELSTAT for Crete, the total agricultural land amounts to 3,346 721 acres. The largest percentage of agricultural land (40.3% or 1 347 693 acres) pertains to tree crops, mainly olive groves. The arable land, with 137,689 acres, accounts for 4.1% of the agricultural land. The largest areas of cultivation are tomatoes and cucumbers, which are mainly grown in greenhouses, the area of which is 0.5% of the cultivated area with 15,509 acres while significant areas are also occupied by barley, oats, potatoes, vetch, alfalfa, etc. In some places, significant areas are also occupied by clover, peppers, watermelons, spinach, green beans, fresh broad beans, etc. In addition to the large-scale crops and greenhouses, arable land also includes fallow land and areas maintained in good agricultural and environmental condition. Vineyards and raisin-producing vineyards account for 2.7% of the agricultural land in the Region.

Table 2: Crete's cropland areas.

Geographic region in Crete	Cropland area (in acres)					
	Total (including fallow land)	Arable land	Vines and grape vines	Greenhouses	Crop trees	Other crops
Crete	3346721	137689	91947	15509	1347107	1754468

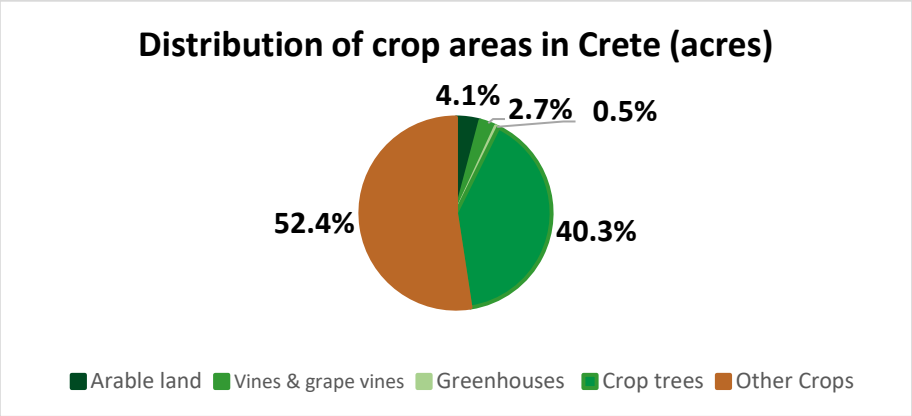

Figure 9: Pie chart - Crete's cropland areas.

Cultivated land covers 42% of the island, while dry land is used mainly as pasture as the next most important land use covering 39.3% of the island. Climatic and soil characteristics accompanied by EU policies on subsidizing crops in the last two decades, have greatly favoured the extensive expansion of olive and vine plantations in the area which provides farmers with higher incomes. Olive groves in Crete occupy an area of about 193,813 ha covering almost 23.3% of the island. The olive oil production in Crete is up to 150,000 tons per year. Orange plantations and vegetables grown in greenhouses have been mainly expanded in the lowland areas of the island. High amounts of fertilizers have been applied up until the last decade. However, farmers have realized the negative impacts on the environment and the increasing cost of crop production and thus the amount of applied fertilizers have steadily decreased. Drip irrigation has been expanded in the cropland areas to ensure increasing crop production. However, the over-exploitation of the aquifers has resulted in deterioration of water quality (high soluble salt content), thereby affecting soil salinization. The lack of good quality water has stimulated the construction of small reservoirs for increasing water availability for irrigation. The intensification of agriculture resulted in accelerated rates of soil erosion in the hilly areas of the island. Furthermore, water pollution of the aquifers has become an important issue due to over-fertilization of the land and overuse of plant protection chemical products. Land desertification due to salinization in the lowlands and due to soil erosion in the sloping areas has become an important issue. Organic farming and integrated land management practices have been established in some areas for the protection of soil quality and ecosystem functions.

Crete has less forest wealth compared to other regions of the country and a very low percentage of forest cover. Nevertheless, its forest wealth is significant and rare, with important and notable forests such as the Samaria National Park in the Chania region, the Rouvas Forest in the Heraklion region, and the Palm Forest in the Lasithi region, among others.

The forest ecosystems on the island of Crete have been degraded in terms of both area and quality. The main causes are grazing, tourism, and extensive monocultures. Where forests exist, oak species (Quercus spp.) and conifers (Cupressus sempervirens in the west and Pinus brutia in the east) are predominant.

According to ELSTAT, in 2021, the number of purely livestock farms in the Region of Crete was 898, down from 1 056 in 2009. These are categorized into 80 farms with cattle, 10 348 with sheep, 7 394 with goats, 700 with pigs, and 10 711 with poultry. The respective reductions since 2009 are 61.7% for cattle, 21.6% for sheep, 39.8% for goats, 60.7% for pigs, and 52.9% for poultry.

Economic indicators

The evolution of the GDP of the Region of Crete presents a similar picture to that recorded for the country as a whole, albeit with more pronounced characteristics. Specifically, during the period from 2013 to 2018, the Region of Crete experienced an increase in its GDP by 6%, rising from €8,596 million in 2013 to €9,071 million in 2018.

This growth in Crete's GDP reflects a broader trend seen across the nation, although the region's growth rate is notably more robust. The increase in GDP is indicative of the region's economic resilience and its ability to recover and grow despite the economic challenges faced during that period. The sectors contributing to this growth likely include tourism, agriculture, and other key industries that have historically been strong in Crete.

In parallel, the evolution of the per capita GDP in the Region of Crete also mirrors the national trend,

with even more pronounced characteristics. From 2013 to 2018, the per capita GDP in Crete increased by 5%, rising from €13,634 in 2013 to €14,302 in 2018.

This increase in per capita GDP suggests not only an overall economic improvement but also an enhancement in the average economic well-being of the residents of Crete. The growth in per capita GDP indicates that the economic benefits of the region's growth are being distributed among its population, leading to improved living standards. The sustained economic development during these years can be attributed to various factors, including effective regional policies, investments in infrastructure, and the thriving tourism industry, which is a significant contributor to the island's economy.

The Region of Crete's economic performance between 2013 and 2018 demonstrates a robust growth trajectory that exceeds the national average, both in terms of overall GDP and per capita GDP. This performance highlights Crete's strategic importance within the Greek economy and underscores the region's potential for continued economic prosperity.

Bioeconomy regulatory framework

Crete has started to link bio-economy development with their Research and Innovation Strategies for Smart Specialization (RIS3). The Region of Crete, for the planning of entrepreneurship actions in the field of circular economy within the framework of the Programming Period 2021-2027, conducted a mapping of the existing circular economy actions in the Region, with the creation of a calendar for the agri-food sector. Based on the mapping data of existing circularity actions and relying on the responses of the participants, it is found that from the studied sample (34 participants), 2 out of 3 businesses (23 out of 34 participants) either implement or participate in symbiotic circular economy actions (regardless of whether they are aware of it or whether these actions are capitalized on). Due to the very small sample size, it is extremely risky to generalize this -at least impressive- performance to the entire food and beverage processing industry in Crete. It is also extremely risky because the experience with the profile of participants in similar surveys through questionnaires, especially for businesses, has shown that the participants are particularly sensitized in the relevant field and that is precisely why they participate in the research. Even so, this performance is a strong indication that circular actions exist in Crete, even if they do not fully constitute a business model, highlighting at the same time the enormous potential of the agri-food sector in this direction.

Regarding the "closing the loop", that is, the products or raw materials produced from the identified circular actions, four (4) levels of added value emerge based on the value of corresponding competitive products in the conventional market. Specifically, depending on the output product - raw material, these levels include the following emerging value chains:

- soil improver - compost and hydro-fertilization means as competitive products against corresponding products containing chemical instead of biological additives
- solid biofuel (dry biomass and/or olive pomace) as a competitive product against conventional fossil fuels (oil and natural gas)
- organic substances with high nutrient content (e.g., waste fractions from brewing and winemaking, biomass fractions from fruit processing, certain special categories of plant residues, etc.) for the production of animal feed as a competitive raw material against animal feed with chemical additives

- raw materials of biological origin (e.g., olive kernel for the production of olive pomace oil and soaps, grape marc for the production of high-distilled alcoholic beverages, etc.) for the production of high-added value products, potentially innovative ones such as snail shells as a raw material for the production of exfoliating cosmetics.

Further investigation is needed into the capitalization potential of each stage of the value chains, considering factors beyond business operations. A significant issue is the lack of a framework for waste declassification and quality criteria for produced products, affecting the competitiveness of circular value chain products. Additionally, there is a transition gap in the commercial availability of agri-food products to consumers. Circular actions by businesses do not outwardly target consumers to add value to the sector's products, meaning the environmental benefits are not communicated to consumers through information about environmental performance.

State of the art of biomass valorization

Biomass resource availability

The levels of lignocellulosic biomass in Greece are estimated to be 2.132.286 tons annually, values that are very close to the cases of other Mediterranean countries like Italy and Portugal. In respect to the total agricultural residues, Crete produces 1.959.124 tons/year. The most significant streams in Crete are identified to be olive pits and olive pruning.

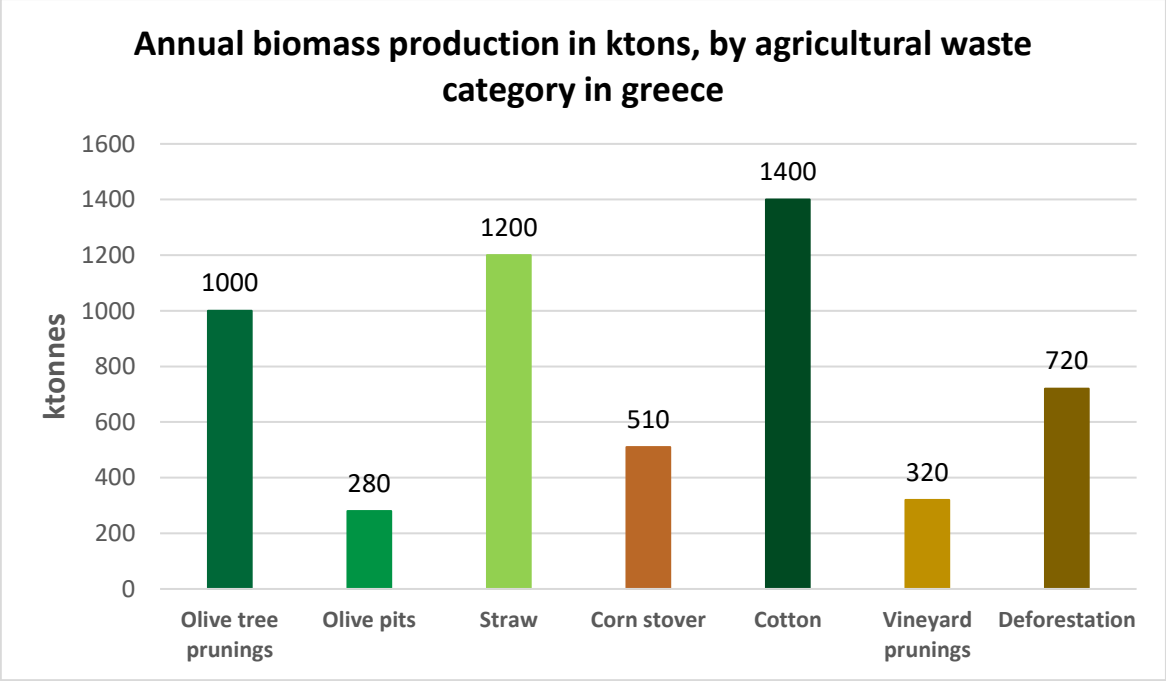

Figure 10: Annual biomass production, in ktons, by agricultural waste category in Greece.

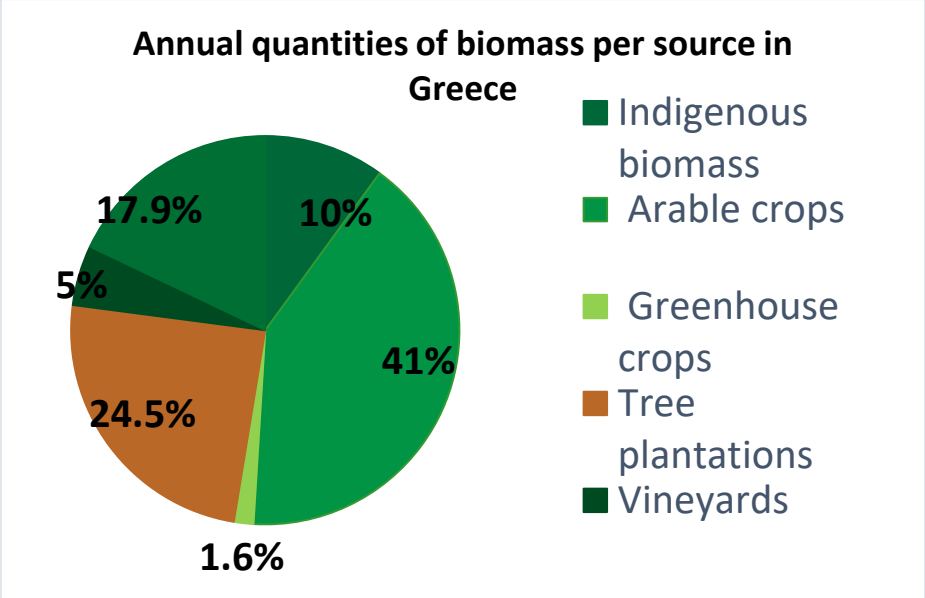

Figure 11: Annual quantities of biomass per source in Greece.

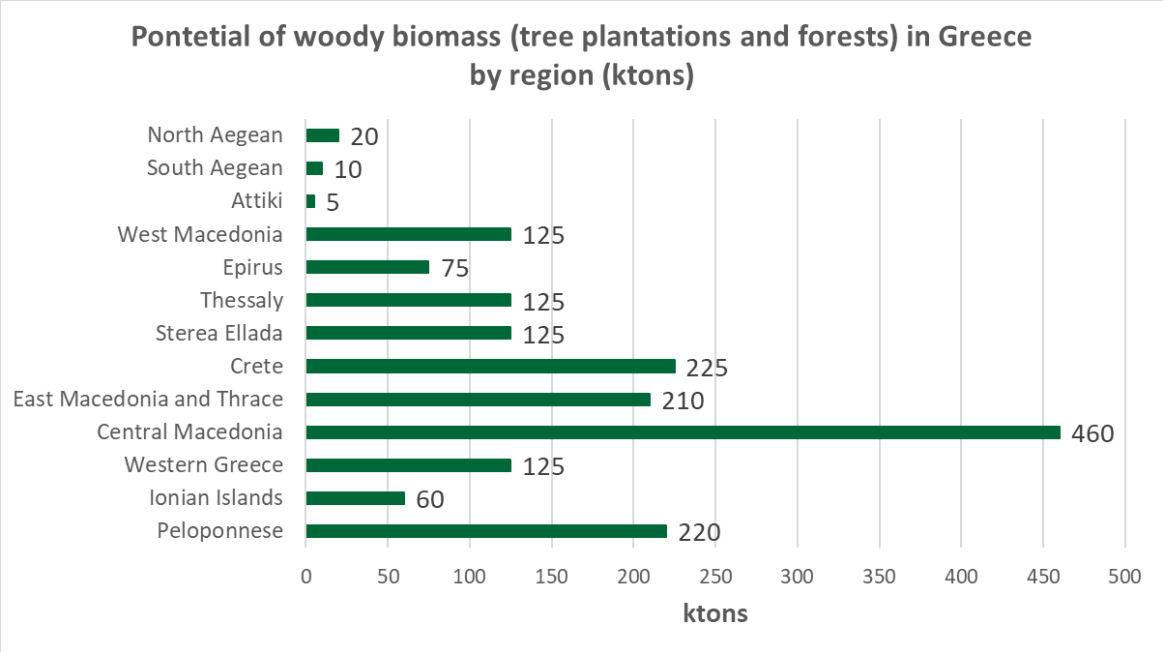

Figure 12: Potential of woody biomass (tree plantations and forests) in Greece by region (ktons).

For the quantities of biomass from tree crops and forests, Central Macedonia is again the first, producing 460,000 tons, followed by Crete with 225,000, and Peloponnese with 220,000 annual tons. Crete, due to its geomorphology and insularity, a single biomass collection system can be designed more easily, with cooperation of locals and farmers and then to be exploited in a gasification unit. The electrical and thermal energy could be used for the needs of the island of Crete.

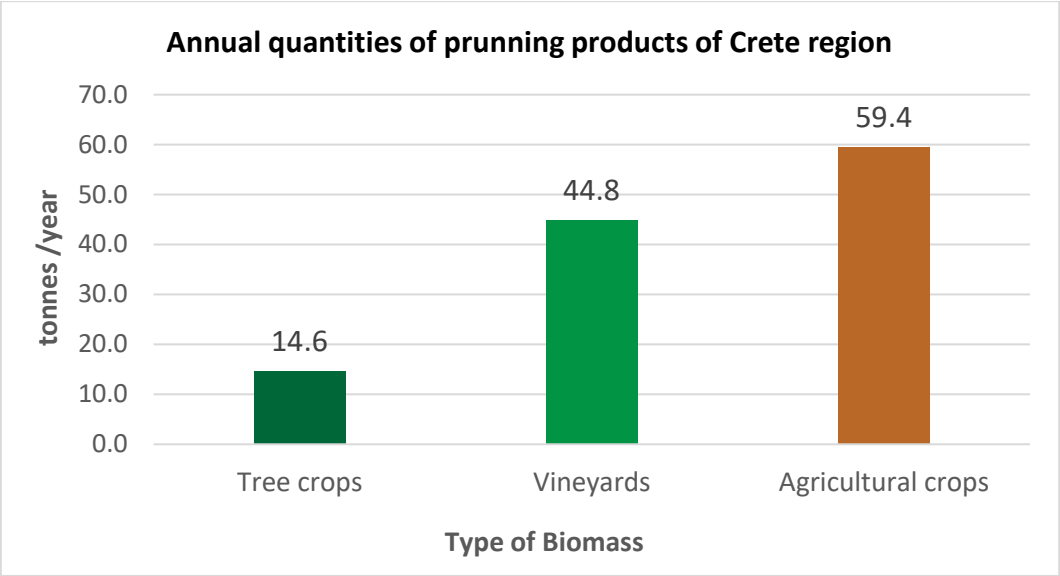

Figure 13: Annual quantities of pruning products, Regional Unit of Crete.

Of particular interest is olive mill waste, due to the large quantity of olive oil production on the island. The main part of the biomass is a byproduct of the primary processing of olives. The estimation of the residual biomass of the mills is based on the view that the two-stage mills, in the near future, will eliminate those with three phases. The main type of waste is olive oil, containing the olive-pomace and the rest of the plant walnuts. Three-phase oil mills can be completely absent of liquid waste but are characterized by a high moisture content (62-65%). The following table shows the estimated quantities of solid waste from the two-phase oil mills per peripheral unit of Crete.

Table 3: Agricultural holdings in the Region of Crete (land in thousands of acres).

Agricultural holdings in the Region of Crete (land in thousands of acres)	Total Trees		Olive Trees		Trees Except Olive Trees	
Sub Regions	Tree crops	Areas	Tree crops	Areas	Tree crops	Areas
Iraklion	41409	691	41236	680	3777	11
Lasithi	12344	195	12341	192	1987	3
Rethymno	1252	253	12489	241	2449	12
Chania	20165	334	19622	302	5266	32
Total	86439	1474	85688	1416	13.479	57

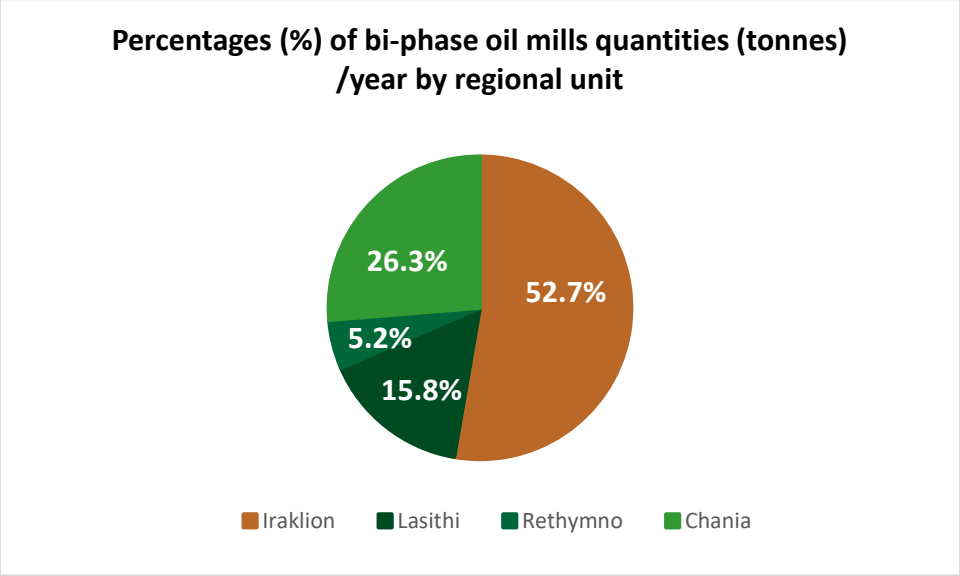

Figure 14: Quantities of bi-phase oil mills.

The following figure illustrates the biomass potential by source and regional unit in Crete. Iraklion has substantial biomass from tree plantations and greenhouses, while Lasithi follows with significant, though slightly lesser, biomass potential. The energy available from tree plantations can reach 1,950 124GJ per year, highlighting a significant renewable energy potential. Regional variations are crucial for developing targeted biomass utilization strategies. In Iraklion, efforts could focus on optimizing tree plantations and greenhouses, while in Lasithi, enhancing existing biomass sources could significantly impact Crete's energy landscape.

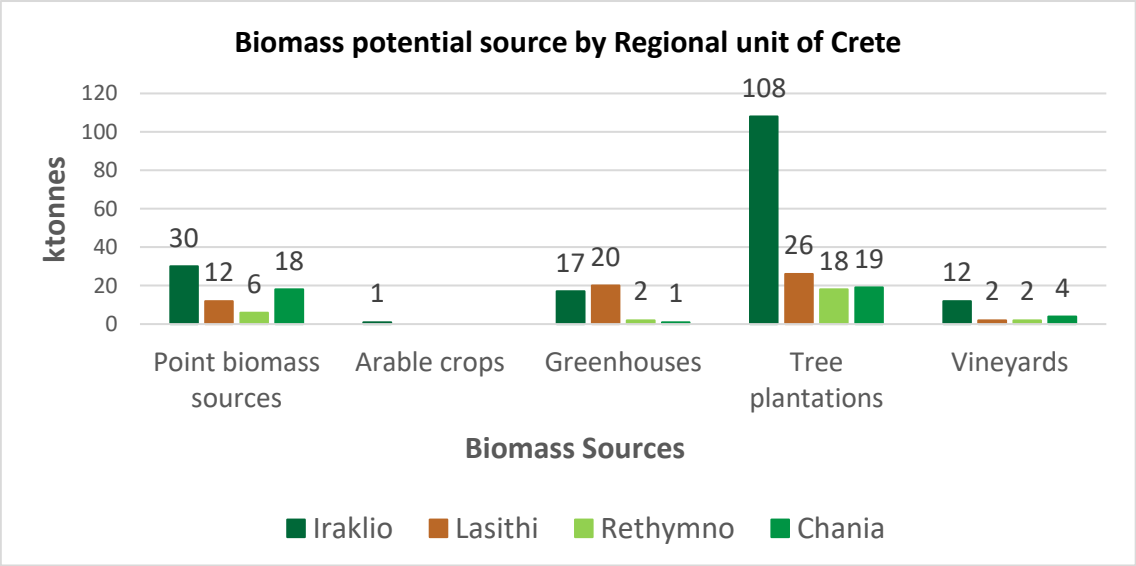

Figure 15: Biomass potential by source and Regional Unit of Crete (in ktons).

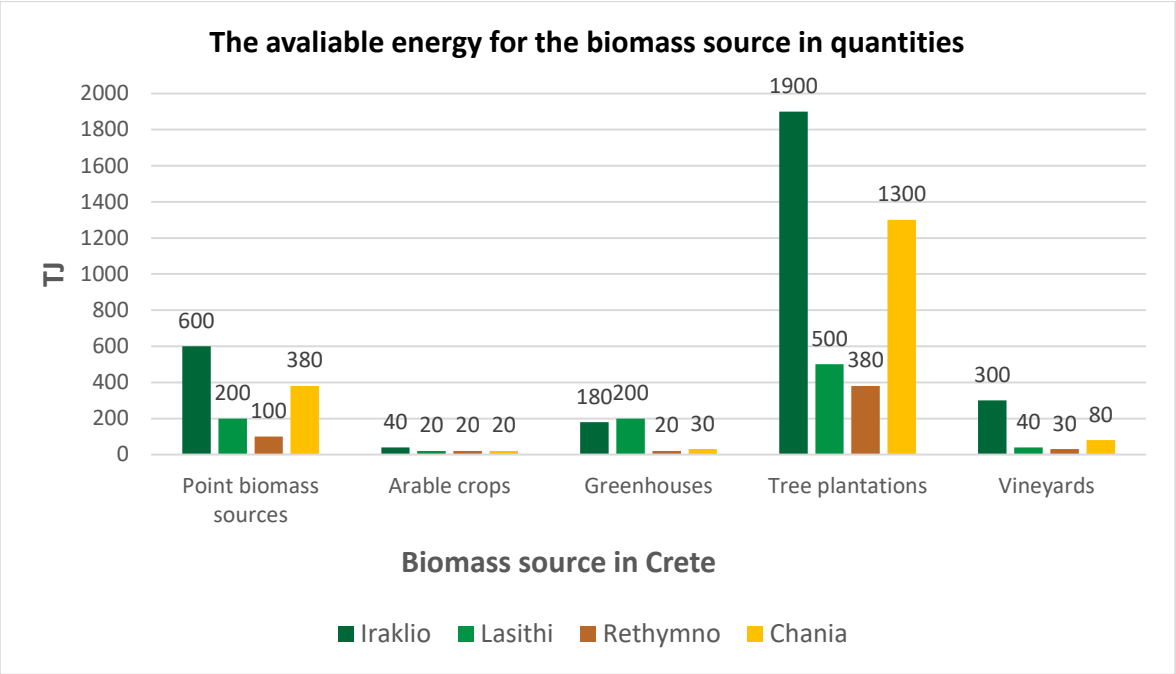

Figure 16: Biomass sources in Crete

In this figure, there is a calculation of the annual tons of biomass potential from all biomass sources, with tree plantations in first place with 234,741, followed by point biomass sources, with 77,607 annual tons of productivity.

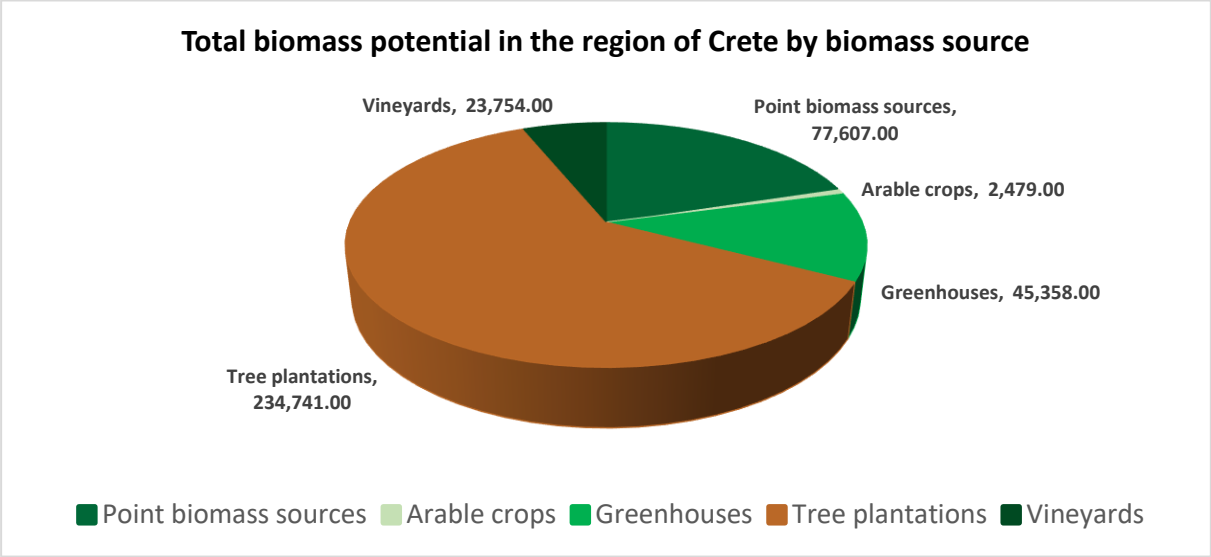

Figure 17: Total biomass potential in the Region of Crete (in tons) by biomass source, 2010.

Regarding the renewable energy installations in the Heraklion Regional Unit that have production licenses, there is only one biomass installation with a capacity of 1.5MW, which is located in the Heraklion Industrial Area by the company "Yfantis Alexandros & SIA EE". The rest of the renewable energy production comes from wind farms.

Management and logistics of biomass resources

On May 26, 2017, the first biomass power plant was inaugurated in Heraklion, Crete. This "green" investment, amounting to €6 million, was constructed by a private investor (Sychem group of companies) and financed under the European program Jessica–Crete Operational Program. In addition to environmental protection, this station contributes to the local community by creating new jobs (starting from the construction phase) and by supporting farmers and livestock breeders who can dispose of their waste.

The station incorporates particularly advanced technologies at critical points in the production process, such as in the reception and management of organic waste, the deodorization process, and the system for utilizing the heat produced by the station. Additionally, it has an advanced system for the biological treatment of liquid residues, which is particularly important for the Heraklion region and Crete, where tourism flourishes and waste disposal into the environment is not an option.

This station produces biogas and electricity. The main sources of raw materials are agricultural (farming and livestock waste), which, as analyzed above, are abundant on the island, as well as expired food from food service establishments, hotels, and supermarkets.

Bio-products target market

At this stage of market development in the region of Crete, there does not appear to be any specific market targeting documented.

R&D system associated with biomass valorization

The Technical University of Crete (TUC) is a leading institution in biomass valorization through its School of Environmental Engineering. The school focuses on converting organic waste into valuable products such as biofuels and biochemicals, emphasizing sustainable waste treatment and resource recovery processes. In renewable energy, TUC improves the efficiency and sustainability of biomass-based systems while integrating biomass valorization with circular economy principles.

TUC participates in numerous EU-funded projects, collaborating with international academic, research, and industry partners to advance biomass technologies. Their research includes developing technologies for converting agricultural residues and other biomass sources into high-value products, using both thermochemical processes like pyrolysis and biochemical processes like anaerobic digestion. The university partners with local and international companies to pilot and scale biomass technologies, aiming to bridge the gap between research and commercial application. TUC's state-of-the-art laboratories and interdisciplinary approach enhance research quality and innovation. Through its robust research infrastructure, interdisciplinary approach, and strong industry collaborations, TUC is at the forefront of developing sustainable biomass utilization solutions, contributing significantly to sustainable development and renewable energy advancements in Crete and beyond.

Support and financing policies

Support and financing policies in Crete do not differ from the corresponding broader national framework.

Analysis of Operational Groups

Operational groups characterization

There are no documented OGs for the region of Grete at the moment, despite the regions' impressive potential for bio-mass production and utilization. However, here we will report on a dynamic organisation that coordinates a number of unofficial OGs and other producer organisations and they plan to make their operations official in the next call for financing OG formations. The Mediterranean Agri-Food Competence Centre (MACC) is dedicated to advancing the bioeconomy within the Mediterranean region's agri-food sector. Its mission centers on fostering innovation, sustainability, and competitiveness through research, development, and technology transfer. MACC focuses on the adoption of advanced technologies and innovative practices in agri-food production and processing, driving efforts to create a more sustainable agricultural landscape.

Key activities include collaborative projects with academic institutions, research organizations, and industry stakeholders to develop new technologies and sustainable practices. MACC also provides training programs to enhance the skills and knowledge of farmers and food producers, ensuring they are equipped to adopt sustainable bioeconomic practices. Networking and partnerships are crucial, as MACC builds collaborations within the Mediterranean agri-food ecosystem to share knowledge and resources effectively. Policy advocacy is another essential aspect, with MACC engaging policymakers to support bioeconomic innovation and sustainability.

The centre's efforts are particularly focused on sustainable agriculture, promoting practices that improve soil health, water efficiency, and biodiversity. Food safety and quality are also prioritized, ensuring products meet high standards through better practices and technologies. Climate change adaptation is a significant area of focus, with MACC developing strategies to help the sector respond to environmental challenges. Additionally, optimizing the agri-food value chain from production to consumption is key to their strategy.

Bio-based technologies (BBT) developed by OG

MACC, in collaboration with Mills of Crete, ABEA and Quality Plus, developed calcium soap from olive oil fatty acids for use in animal feed. This product enhances the reproductive performance of ruminants and contributes to higher milk yield, improved fertility and better animal health. This project promotes the economic value of olive oil by-products, reducing their environmental footprint and enhancing sustainability through the circular economy.

Peloponnese

General description of the region of Peloponnese

The Region of Peloponnese is located in the Southern part of mainland Greece and consists of the Regional Units of Argolis, Arcadia, Corinthia, Laconia, and Messenia. Its capital is Tripoli in Arcadia.

Figure 18: The region of Peloponnese.

The Regional Unit of Argolis has its capital in Nafplio and covers an area of 2,154 km². It borders the Regional Units of Corinthia and Arcadia and is washed by the Argolic and Saronic Gulfs. Points of particular interest include Mycenae and Epidaurus. The Regional Unit of Arcadia is the center of the Peloponnese and borders all the counties that belong to the Peloponnese. A notable feature of Arcadia is its rivers and lakes, specifically the Alfeios and Ladon, which irrigate the land, the Erymanthos, used for water supply, and the Lousios, whose natural beauty is ideal for water sports. Additionally, there is Lake Taka, the artificial Lake Ladon, which aids in irrigation, and Lake Moustos, a haven for wild birds. The Regional Unit of Corinthia covers an area of 2,289 km², is washed by the Corinthian and Saronic Gulfs, and borders the Regional Units of Argolis, Arcadia, Achaia, and Attica. It has small water streams, but it is home to Lake Stymphalia, known from the labors of the mythical hero Hercules. The Regional Unit of Laconia covers an area of 3,636 km² and is located in the southernmost part of mainland Greece. It borders the Regional Units of Arcadia and Messenia and is washed by the Myrtoan Sea, the Messenian Gulf, and the Laconian Gulf. Its most touristy spots are Mystras and Elafonisos, the only island of Laconia. The Regional Unit of Messenia covers an area of 2,991 km² and borders the Regional Units of Elis, Arcadia, and Laconia. Natural borders are formed between Messenia and the Regional Unit of Elis by the Neda River. The Mani Peninsula is shared between Messenia and Laconia and features coves known for their natural beauty.

Geographic description of the region of Peloponnese

The Peloponnese is a large peninsula in southern Greece, notable for its diverse and dramatic geography. The region is almost an island, connected to mainland Greece by the narrow Isthmus of

Corinth, which is cut by the Corinth Canal. Peloponnese is mountainous, with several significant mountain ranges, including the Taygetus, Parnon, and Aroania (or Chelmos) mountains. It is also characterized by a highly indented coastline with numerous gulfs and inlets, including the Gulf of Corinth, Gulf of Patras, Argolic Gulf, and the Messinian Gulf. The climate varies from Mediterranean along the coast, characterized by hot, dry summers and mild, wet winters, to more continental conditions in the interior, with colder winters. The region is rich in natural resources, with fertile plains, especially in Messinia and Laconia. Major agricultural products include olives and olive oil, citrus fruits, grapes and wine, and various vegetables. Livestock farming is also significant, with sheep and goat herding being prevalent.

The Peloponnese follows the majority of the Greek Regions, dominating the rural character of the area. Primary sector accounts for 7.1% of the GVA of the region with the vast majority of businesses (90.2%) in the plant and animal production, hunting and related activities. Although the turnover of enterprises engaged in plant and livestock production is below the turnover of fisheries and aquaculture enterprises, it is over 20.2% above the national average.

Agriculture sector in the region of Peloponnese

The agricultural sector is generally characterized by fragmentation of agricultural land into plots smaller than the national average, a high coefficient of spatial dispersion, and a high average age of those employed in agriculture. Additionally, the production model of mountainous agriculture includes livestock farming, forestry, and to a lesser extent, some tree crops. The primary sector is of major importance to the Peloponnese Region, which has unique characteristics and positively contributes to shaping its economy. According to data available from regional services, the Peloponnese produces:

- 40-45% of the national olive oil production, with 120 000 tons produced and 7 PDO products (1 in Messinia, 3 in Argolida, and 3 in Laconia) and 1 PGI product (Laconia)
- over 20% of the national production of Kalamata table olives, with 1 PDO product (Kalamata)
- 70% of the national citrus production, with over 550 000 tons produced (Argolida, Laconia, and Corinthia)
- pome fruits with a production of 6 000 tons and 1 PDO product (Arcadia)
- wines with over 70 000 tons produced, featuring 3 PDO products and 9 PGI products, and two "national ambassador" varieties: Agiorgitiko from Nemea and Moschofilero from Mantineia, out of the 4 national varieties
- 35% of the national production of Corinthian raisins, with a production of 10 000 tons.

In 2016, the Peloponnese Region produced 100 860 tons of milk, of which 46 386 tons were sheep's milk, 46 801 tons were goat's milk, and 7 673 tons were cow's milk. The largest milk production was in the Regional Unit of Laconia with 28 066 tons, followed by the Regional Unit of Arcadia with 24 116 tons. According to the Hellenic Statistical Authority, the key figures for agricultural and livestock productions are as follows:

number of agricultural holdings and utilized agricultural area	
number of holdings	68 576
holdings with utilized agricultural area	68 357
utilized agricultural area (hectares)	2 558 637

holdings with irrigated areas	38 975
irrigated areas (hectares)	798 288
purely agricultural, purely livestock, and mixed holdings	
purely agricultural	61 875
purely livestock	488
mixed	6 213
distribution of holdings by main categories of use	
arable crops	6 855
vineyards and raisin vineyards	10 556
tree crops	65 705
greenhouses	644
other areas	20 601
distribution of utilized agricultural area of holdings by main categories of use (hectares)	
arable crops	244 299
vineyards and raisin vineyards	150 533
tree crops	1 818 893
greenhouses	3 400
other areas	341 510
holdings with animals by type of animal	
cattle	514
sheep	4 001
goats	3 563
pigs	334
poultry	6 856
number of animals by type	
cattle	16 403
sheep	354 190
goats	365 201
pigs	67 043
poultry	1 390 470

Economic indicators

The relative position of the primary sector in the Region of Peloponnese, compared to the sector's size in the country, is particularly significant. In 2016, the Region of Peloponnese contributed 9.06% to the Gross Value Added of the primary sector in the country. The secondary sector holds particular importance in the economy of the Region of Peloponnese, contributing 22.21% to the total Gross Value Added of the Region, compared to 14.53% contribution of the secondary sector at the national level.

The gross domestic product of the Peloponnese was €8.2 billion in 2018, representing 4.5% of the Greek economy. The per capita GDP adjusted for purchasing power was €17,400, which was 57% of the average of the European Union of 27 member states that year. The GDP per worker was 68% of the EU average.

Bioeconomy regulatory framework

The bioeconomy regulatory framework in Peloponnese does not differ from the corresponding broader national framework. Although Greece has not yet established a dedicated national strategy for the Bio-economy, there are several government initiatives that prioritize resource efficiency, energy-efficient practices, and low-carbon investments. Currently, these governmental efforts are somewhat sporadic and dispersed. The Ministry of Environment and Energy in Greece leads bio-economy policies through key strategies such as the National Strategy for the Circular Economy (2018), which focuses on waste management and supporting green businesses. Supporting documents like the Green Growth Strategic Action Programme (2010-2015) promote green procurement and facilitate easier access to capital for biotechnology centers. The National Renewable Energy Action Plan (2010) aligns with EU targets, and Law 4414/2016 introduces a support scheme for renewable energy and climate change mitigation. Collectively, these policies highlight Greece's commitment to sustainability, circular economy principles, and the adoption of renewable energy.

State of the art of biomass varolization

Biomass resource availability

The biomass potential in the area is notably high, largely stemming from agricultural land primarily dedicated to tree crops, comprising 62.6% of the region's agricultural landscape. Other land types contribute 18.9%, while annual crops occupy 12.5% of the area. Olive cultivation dominates in the Peloponnese, particularly in Messenia, where approximately 16 million olive trees exist. Annual olive oil production exceeds 50 000 tons, driving economic growth in the region. Tree plantations alone contribute around 3 800 000 GJ of biomass energy potential, predominantly from olive trees.

The inevitable byproduct of olive cultivation is its waste, particularly significant in our research domain: biomass, specifically olive pomace. A substantial portion of this waste remains unutilized daily, contributing significantly to local environmental pollution due to the absence of restrictions or legal mandates for its processing.

Quantities of agricultural waste (in tonnes/year, 2007)					
Regional Unit of Messinia - Cuttings Quantities (tonnes/year)					**Pomace (tonnes/year)**
Olives	Vineyards	Orange	Mandarins	Lemons	waste of two-phase oil Mills
382, 589	14,324	3335	781	101	194,072

In managing waste, including agricultural waste such as pruning residues, the aim for the Peloponnesian region is sustainable practices (reuse, recycling, energy recovery, and safe disposal), with significant participation from the private sector in commercially viable areas. Furthermore, efforts prioritize the adoption of best available techniques, considering both technological feasibility and economic viability.

In recent years, there has been a growing emphasis on further developing renewable energy sources by harnessing natural resources. The Peloponnese region contributes about 8% of the total national electricity production, primarily through thermoelectric and hydroelectric power stations in

Megalopolis and Ladona. However, the Megalopolis station has significant environmental impacts, including gas emissions, waste generation, and changes to geomorphological features. There is a strategic shift towards gradually phasing out fossil fuels in favor of renewable energy sources, focusing exclusively on wind and photovoltaic technologies to leverage the region's abundant wind and solar potential. Biomass, which previously played a minor role, has been sidelined due to changes in the national institutional framework for renewable energy sources. Currently, photovoltaic stations lead with a total installed capacity of 297.4 MW, followed by wind power stations at 254 MW, and hydroelectric stations at 3.99 MW.

Management and logistics of biomass resources

The proposed technology for gasification is the Pyrox TYPE P850 CHP gasifier, a small-scale cogeneration unit that begins with wood chips. These wood chips undergo a thermo-chemical process to convert them into a combustible gas, which is then cleaned, cooled, and fed into an internal combustion engine. This system will use 7 956 tonnes of biomass annually, producing 6 630 MWh of electricity and 8 580 MWh of thermal energy, with a total cost of €4.3 million.

The raw material must meet specific standards (dry matter ≥ 60%, maximum moisture content 40%, and particle size 20-100 mm for at least 90% of the material). The plant's annual heat consumption is 4 773.6 MWh for processing 7 956 tonnes of raw material, as the drying system requires a 10% reduction in moisture, using 0.6 kWh/kg (2.16 MJ/kg). The excess thermal energy generated will be repurposed for other uses, such as greenhouse crop heating, to minimize environmental discharge. Combustion residual ash will be collected from the bottom of the bed, transported by a screw conveyor, and stored. This ash will contain 10–20% unburnt coal in addition to inorganic components.

The raw material will consist of deciduous olive residue from nearby areas. Trucks will regularly deliver the biomass as it is produced, and it will be stored appropriately before being chopped and dried according to the plant's requirements. Ensuring the raw material's quality and size is crucial, as is verifying its origins and sorting out any unsuitable pieces before they enter the shredder.

Also, the Municipality of Kalamata has created "green spots" where pruning and gardening waste can be deposited. The purpose is the composting of wooden chips for use in the parks and the flower beds of the Municipality of Kalamata.

Bio-Products target market

Once lagging in waste management, the Peloponnese Region has now (2023) emerged as a national leader, boasting the three most advanced Waste Management Units (WMUs) in Greece and among the most modern in Europe. Through a €167 million investment (€70 million funded by the National Strategic Reference Framework - NSRF), the region is embracing the circular economy by recovering and utilizing over 80% of biodegradable materials, recycling high-quality recyclables, diverting at least 50 000 tons of liquid waste from landfills, and generating green energy sufficient for 6 000 households, all while preventing 24 000 tons of carbon dioxide emissions.

The largest of these units, the Arkadia Waste Processing Unit, currently handles more than 50% of the urban solid waste produced in the Peloponnese. The remaining waste is processed at Transitional Units in Messinia and Laconia, which are expected to be fully operational by 2024.

In just a few months of operation, the Arkadia unit has surpassed conventional waste handling

capacities thanks to modern technology, demonstrating the urgent need for effective waste management in the region. Furthermore, since its implementation, the Peloponnese has been freed from European fines for past illegal practices and has achieved the lowest operational cost among similar facilities in Greece. This cost will decrease further with the introduction of the Green Fund and the completion of the Waste Transfer Stations (WTS) network by Regional Association of Solid Waste Management Bodies, resulting in significant savings for residents.

The project encompasses three main Subsections - Management Units within the Peloponnese Region, including:

- three Integrated Waste Management Units (IWMUs), specifically:
  - three Waste Processing Units (WPUs)
  - three Sanitary Landfill Sites (SLSs)
  - two Waste Transfer Stations (WTSs)
- three Transitional Management Units (TMUs), which will function until the IWMUs are fully completed
- improvements to access roads to WPUs and WTSs.

The TMUs/WMUs-SLSs are situated in Arkadia, Messinia, and Laconia, while the WTSs are in Corinth and Argolis. This strategic placement ensures that waste collection occurs within a 50km radius from the regional capitals, minimizing transportation needs from municipalities.

Utilizing cutting-edge technology, the project maintains a minimal environmental and energy footprint, aligns with the Peloponnese Regional Waste Management Plan, complements local municipal recycling programs, and adheres to the best practices of the circular economy.

The project has created 800 jobs during the construction phase and will provide 200 permanent jobs over the next 27 years of operation. Additionally, it will generate indirect employment and benefits in related sectors such as transport, recyclable trading, and personnel accommodation.

R&D system associated with biomass valorization

The University of Crete, a leading academic institution in Greece, plays a significant role in advancing the bioeconomy through its research and educational programs. Located on the island of Crete, the university leverages the region's rich agricultural and natural resources to drive innovation in sustainable practices and renewable energy. Its Department of Biology, Chemistry, and the Institute of Molecular Biology and Biotechnology (IMBB) are at the forefront of research on biomass utilization, bioprocessing, and environmental sustainability. The university's researchers are engaged in various projects that explore the conversion of agricultural residues, such as olive mill waste and grape pomace, into biofuels, bioplastics, and other high-value bioproducts. Through collaborations with local industries, government agencies, and international bodies, the University of Crete facilitates the development and implementation of cutting-edge technologies that support the circular bioeconomy. Additionally, the institution offers specialized courses and training programs that equip students and professionals with the skills needed to contribute to the bioeconomy sector. The university also participates in numerous EU-funded projects aimed at promoting sustainable agricultural practices and renewable energy solutions. By integrating research, education, and community engagement, the

University of Crete significantly contributes to regional and national efforts to transition towards a more sustainable and circular economy. This integration helps create a knowledge-based economy that not only addresses environmental challenges but also promotes economic growth and social well-being in Crete and beyond.

Support and financing policies

Support and financing policies in Peloponnese do not differ from the corresponding broader national framework.

Analysis of Operational Groups

Operational groups characterization

The region of Peloponnese, hosts 2 official OGs, described below:

(1) HIPO-ENERGY, focuses on the utilisation of the leaves of the Hippophae plant, which is characterized as a super-food, for the production of high nutrition additives for soft drinks. They extract the bioactive elements from the leaves for the production of added value nutritional products.

(2) OLIHERB, aims for the exploitation of olive leaves (rich in polyphenols and other bioactive ingredients) to produce herbal infusions and natural food additives. They utilize the significant quantities of olive leaves produced as by-products during cultivation (pruning), harvesting of olives and olive oil production (milling stage) for developing innovative products with special chemical and nutritional properties.

As with the region of Crete, here, we also describe the operations of an organisation that supports and facilitates many different unofficial OGs and other producer formations. The Centre of Agricultural Entrepreneurship of Messinia (CAEM) is an essential initiative in the Peloponnese, focusing on promoting the bioeconomy through innovation, sustainability, and entrepreneurship in agriculture. This center enhances the productivity and competitiveness of the region's agricultural sector, particularly known for high-quality olives and olive oil. CAEM supports local farmers and entrepreneurs by offering specialized training programs and workshops on bioeconomic practices, sustainable farming, and value-added agricultural products. These programs aim to educate participants on modern farming techniques, business management, and market opportunities, ensuring they are well-equipped to thrive in a bioeconomy-focused environment. The Center collaborates with universities and research institutions to promote research in agricultural science, focusing on crop improvement, pest management, and sustainable practices. By encouraging the adoption of innovative technologies such as precision farming, smart irrigation systems, and renewable energy sources, the center helps enhance productivity and sustainability. Sustainable practices are a key focus, with CAEM promoting environmental stewardship and organic farming methods. The center supports sustainable farming practices that protect the environment, conserve natural resources, and ensure long-term agricultural productivity.

Bio-based technologies (BBT) developed by OG

As part of CAEM's activities, no bio-based technology has been developed yet.

Discussion

In Greece, the regions of Crete, Central Macedonia, and Peloponnese are beginning to embrace the concepts of circular economy and bioeconomy, reflecting a growing recognition of their potential to foster sustainable development and economic resilience. Although these initiatives are still in their early stages, there is an optimistic outlook for their future.

The circular economy in these regions aims to minimize waste and make the most of resources. Crete, known for its rich agricultural heritage, is exploring ways to reduce waste in the food production sector. By reusing agricultural by-products and improving recycling practices, the region hopes to create a closed-loop system that enhances resource efficiency. Similarly, this approach not only reduces environmental impact but also stimulates innovation and economic growth.

In Peloponnesus, efforts are being made to integrate circular economy principles into everyday life, a key economic driver. By promoting sustainable everyday practices, the region aims to preserve its natural beauty while attracting environmentally conscious agri-food consumers.

The bioeconomy, which involves the use of renewable biological resources to produce food, materials, and energy, is also gaining traction. In Crete, there is significant potential for developing bio-based industries due to its abundant agricultural resources. Central Macedonia is leveraging its strong agricultural and food processing sectors to explore bio-based products, such as bioplastics and biofuels. The Peloponnese is similarly looking to harness its agricultural by-products for bioenergy production, contributing to energy sustainability.

It could be argued that Crete and Peloponnese are "yellow" for implementing bio-based technologies and Central Macedonia could be considered as a "green" region.

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BBioNets

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Document information

Title	BBioNets – Creation and promotion of Forest and Agriculture Networks to boost Bio-Based Technologies adoption and Value Chain development (GA No 101133904)
Start – end date	1/11/2023 – 31/10/2026 (36 months)
Project type	Coordination and Support Action
Programme	Horizon Europe – Cluster 6
Funding	1,998,636.20 €
Coordinator	Munster Technological University Ms. Carmen Girón Domínguez (carmen.dominguez@mtu.ie)
Project overview	BBioNets constitutes a thematic network that relies on, promotes, and further advances the work carried out by EIP-AGRI Operational Groups (OGs) with respect to **management and/or processing of agricultural and forest biomass with Bio-Based Technologies (BBTs)**. The project has set up 6 regional Forest and Agriculture Networks – FANs (IE, ES, IT, EL, PL, CZ) that identify local needs, prioritise specific BBTs and share BBT knowledge ready for practice to farmers and foresters, boosting the (re)definition of value chains, stimulating cross-fertilisation beyond borders, and bringing Europe to the forefront of farming, forestry and bioeconomy with economically viable and sustainable practices.
Consortium	MTU, Teagasc, IUNG Institute of Soil Science and Plant Cultivation State Research Institute, crea, CTA, American Farm School Thessaloniki · Greece, TEPRO, FOCUS, BIO EAST HUB

info@bbionets.eu

/bbionets-eu /bbionets.eu @bbionets_eu

@bbionets-eu.bsky.social @bbionets_eu @BBioNetsEU

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