BYP4DEV

BY-PRODUCT FOR DEVELOPMENT

PR1 Methodological Guideline and Framework V.1.

By Product for Development – **Byp4Dev**
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1. Introduction to the Methodological Framework

The objective of this document is to understand the current situation of the by-products and waste valorisation in the participant regions, related to agroindustry, perception of the companies, educational institutions, training offer, etc., in order to generate a baseline which, allow us to design the Expert profile in by-products and wastes valorization in agri-food sector.

This document will provide answers to the objectives described in the proposal:

- Integrate the designed profile into a global circular economy transition process in the agri-food sector.
- Research the existing learning/teaching methods related to our working areas and to analyse the pros and cons in order to integrate it into our expert profile.
- Establish an innovative methodology for the learning/teaching process in by-products and wastes valorization.
- Determine the life cycle model of the educational process

The document begins with an introduction about european strategies about by-products and biocompounds and a brief description the carbon footprint from the agroindustry in order to stablish a general framework to understand the state of the art and the challenges this new sector can tackle.

2. Introduction: By-products as a pillar to achieve a climate-neutral Europe by 2050

The **European Green Deal** is a response to these challenges. It is a new growth strategy that 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[1].

The Commission's proposals for the common agricultural policy for 2021 to 2027 stipulate that at least 40% of the common agricultural policy's overall budget and at least 30% of the Maritime Fisheries Fund would contribute to climate action (European Green Deal).

The Commission will prepare a European **competence framework** to help develop and assess knowledge, skills and attitudes on climate change and sustainable development. It will also provide support materials and facilitate the exchange of good practices in EU networks of teacher-training programmes.

2.1. Biocompounds obtaining from agri-food by-products: European Strategies and Agendas

Becoming the world's first climate-neutral continent by 2050 is the greatest challenge of our times for the EU. In this framework, the bio-based industry plays a crucial role, with special focus on the bioeconomy in the agri-food sector.

EU relies as well as a specific R&D agenda related to Bio-based products. This agenda concludes that a shift to biological raw materials and biological processing methods could save up to 2.5 billion tons of CO_2 equivalents per year by 2030, increasing markets for bio-based raw materials and new consumer products Private sector is moving towards a more sustainable industry in Europe. Circular bio-society in 2050[2], a report from Bio-based Industries Consortium, establishes a sustainable and competitive bio-based industry in the EU enabling a circular bio-society by 2050. According to "The Strategic Innovation and Research Agenda (SIRA 2030) for a Circular Bio-based Europe Realising a future-fit circular bio-society in Europe"[3], the promotion of bioeconomy can create 400 000 new green jobs by 2035 in particular in rural and coastal areas. This new challenge, besides the need of

[1] European Green Deal: https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en

[2] Circular bio-society in 2050: https://biconsortium.eu/sites/biconsortium.eu/files/documents/Vision%20for%20a%20circular%20bio-society%202050.pdf

[3] Strategic Innovation and Research Agenda (SIRA 2030) for a Circular Bio-based Europe: https://biconsortium.eu/about/our-vision-strategy/sira

technological advances, needs to rely on new professionals which can valorize the by-products and waste from the agri-food sector into new, innovative and high added value biocompounds.

The Circularity Gap Report 2021[4] demonstrates how vocational education and training (VET) is a key mechanism to ensure a skilled workforce that can drive the circular economy transition. It brings together thinking from skills development for green economies, innovation, sustainable development and the circular economy—all means for achieving a sustainable and just society. Strengthening VET and making skills development more accessible—while also realising that skills needs will shift across different stages of the transition to a circular economy—can help speed up the adoption of new technologies that increase efficient use of natural resources and reduce waste. As governments and businesses embark on greening economies, circular economy strategies and policies can be employed. When we narrow the scope and focus on bio-economy, as part of circular strategies, we found that to achieve a circular bioeconomic society, according to the report 'The circular bio-society in 2050', the primary sectors, operational actors, R&I institutions and market actors cooperate with education institutions to: Exchange of needs for skills and competences for the bioeconomy Standardise bioeconomic curricula and diplomas across Europe - Recognise input from all actors in terms of practical and 'real time' examples into curricula, educational programmes and materials - Encourage national and European innovation contests to stimulate exemplary performance by students and start-ups - Institutionalise lifelong learning facilities and trainings that are shared by industry, government and society.

2.2. Carbon footprint of agri-food sector

Sustainable Development[5] is a concept becoming more and more important in the agri-food sector and global economy. The main goal of this concept is to search for effective ways to solve the problems of the population around the world, including meeting their current needs, without limiting the possibility of meeting these needs for future generations. It addresses the challenges of increasing energy demand, climate change, environmental pollution, migration of people, ensuring food safety, …and many other issues. The principles of sustainable development should be considered already at the stage of designing products and processes.

Optimization includes the use of materials that have the lowest possible impact on the environment through the emission of pollutants and greenhouse gases, and their production

[4] Circularity Gap Report 2021: https://www.circularity-gap.worl

[5] Sustainable Development in the Agri-Food Sector in Terms of the Carbon Footprint: A Review. Magdalena Karwacka , A gnieszka Ciurzy´nska, Andrzej Lenart and Monika Janowicz * Faculty of Food Sciences, Department of Food Engineering and Process Management, Warsaw University of Life Sciences, SGGW, 02-787 Warszawa, Poland

does not require excessive water or energy resources. In addition, it is important to use the so-called clean technologies in production and packaging processes and enable *reuse*, *recycling*, or *ecological disposal* of waste.

On the other hand, the **agri-food sector** is the branch of the economy that has the greatest impact on the environment and is associated with a high demand for energy, water, land, and chemicals supporting agricultural production and packaging. Tools such as life cycle assessment of products and services are used to assess environmental indicators (footprints).

When calculating foodprints for foodstuffs, all production stages are considered, starting with the cultivation of plants or animals through harvesting, processing, distribution, and ending with waste treatment.

Investigating the impact of the agri-food industry on the environmental footprints, especially the carbon footprint, is becoming more common. The concept of **Carbon Footprint** (CF) appeared in the 1960s in connection with the growing interest in climate change, which became increasingly noticeable. According to the Kyoto protocol, **Carbon Footprint** is considered to be the ***total amount of CO_2 equivalent and other greenhouse gases coming from the product's life cycle, including its storage, use, and disposal.***

The Greenhouse gas emissions[6] from the **agri-food sector** in the different countries involved within the **Byp4Dev** project in 2019 are as follows (Table 01):

Table 1: The Greenhouse gas emissions from the agri-food sector in the different participant countries

Country	Greenhouse gas emissions	Comments
Spain	40.3 million t	In the third position among country sectors
Finland	5.8 million t	In the fifth position among country sectors
Greece	7.1 million t	In the fifth position among country sectors
Latvia	2.7 million t	In the second position among country sectors
Portugal	6.9 million t	In the fourth position among country sectors

Greenhouse gas emissions from the EU agriculture sector[7] are covered by national annual emissions targets. Between 2005 and 2019, agricultural emissions remained stable. Based on national projections, only a modest EU-level decline of 2% is expected by 2030. If currently planned additional measures are implemented, a 5% reduction is expected. These projected declines would be insufficient to meet most Member States' binding annual targets, highlighting the need for further action if the EU is to meet its goal of climate neutrality by 2050.

[6] Our World in Data: https://ourworldindata.org
[7] Greenhouse gas emissions from agriculture in Europe: https://www.eea.europa.eu/ims/greenhouse-gas-emissions-from-agriculture

The **Greenhouse Gas Emissions of the Agriculture sector** relative to other sectors, within the EU, ranks it in fourth position with 384.38 million t, after electricity & heat, transport and buildings.

The **Food and Agriculture Organisation, FAO**, maintains that 31 per cent of human-caused GHG emissions, originate from the world's agri-food systems. In 2019, deforestation was the largest source of GHG emissions, followed by livestock manure, household consumption, food waste disposal, fossil fuels used on farms and the food retail sector.

Therefore, not only the production, but also the method of **managing food/feed waste** is of key importance in the amount of greenhouse gases emitted in the product's life. And it is in this context where the **Byp4Dev** Project would be framed.

2.3. Bio-based society

According to the European Commission, shifting to bio-based products and processes means switching to using biological resources and biological processing methods in a sustainable way. This will help reduce Europe's dependency on oil, coal and gas and help meet its ambitious environmental, societal, industrial and climate policy targets for 2050.

The shift could save up to 2.5 billion tons of CO_2 equivalent per year by 2030 and help accelerate the transition to a green and circular economy. Bio-based system is an emerging sector of the bioeconomy that is expected to grow rapidly. It will help create new markets and jobs, especially in rural and coastal areas[8].

This transformation process requires new concepts and a new vocabulary for a better understanding, adapting and implementation. Some of these new concepts are by-products valorization or biomass or biobased value pyramid.

By-product valorization:

The term "by-products and wastes valorization" can be defined as any industrial processing activities aimed at increase the added value of these by-products or wastes through extraction, modifying, reusing, recycling, or bioprocessing, generating new products (defined as bio-products or co-products) directed toward different sectors.

[8] https://research-and-innovation.ec.europa.eu/research-area/environment/bioeconomy/bio-based-products-and-processes_en

There are different and complementary ways of valorize by-products from agricultural sector.

According the circular economy processes, which try to keep the resources in the market as long as ever, the by-product of the first valorization step can be the raw material for the following valorization steps, generating a valorization cascade of added value products generation.

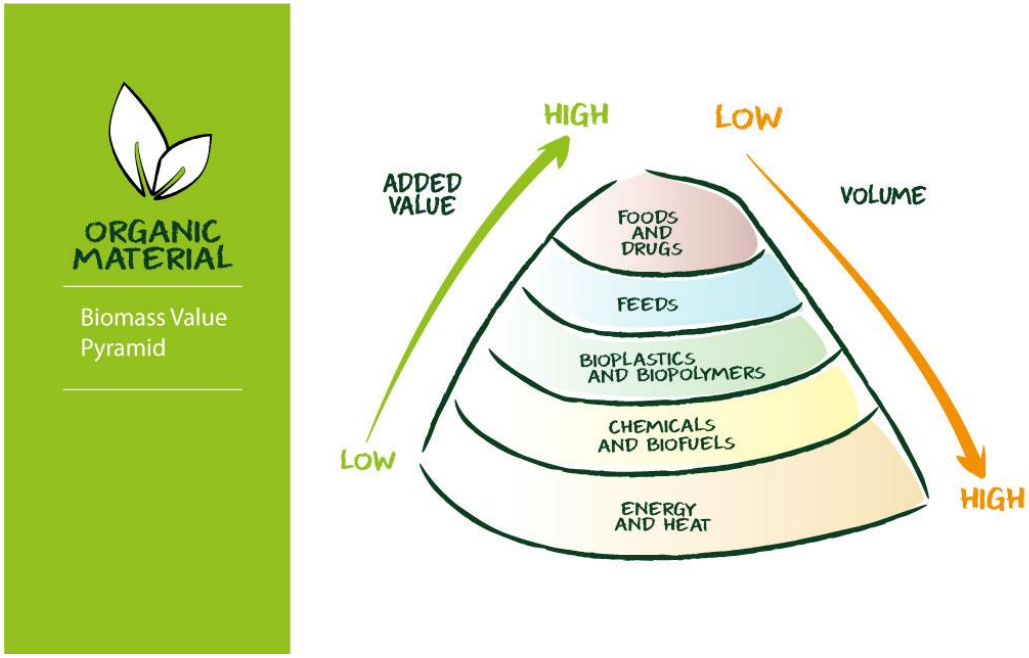
Biomass Value Pyramid:

The Biomass Value Pyramid shows the entire cascade of value adding products which can be produced from agricultural crop by-products and wastes and other left-over bio materials.

The lowest added value bioproducts generated during by-products valorization processes are achieved by burning the biomass and converting it into heat and electricity. On the other hand, higher added value bioproducts can be achieved by converting the biomass into ingredients directed towards pharmaceutical or fine chemical sectors.

In between, there are other possibilities of by-products valorization with different grades of added value levels. These relations among added value levels and types of bioproducts from agricultural by-products and wastes are represented in the biomass value pyramid.

Figure 1: Biomass Value Pyramid



This biomass value pyramid does also represent the relationships between the volume of bioproducts obtained and the agriculture by-products and wastes used for its obtaining.

In this way, the bioproducts directed towards pharmaceutical sector will have a high added value but high volume of raw material is required to obtain a low volume of final ingredients. On the other hand, almost all volume of raw material can be transformed into energy or heat (Lowest steps of the pyramid).

To understand and to develop this biomass value pyramid by the industry is necessary to carry out the transformation process form fossil-based economy to bio-based economy.

And the next challenge is to share, describe and to explain this pyramid to the society, involving them into the generation of the bio-based society.

3. State of the Arts

The main results to be achieved in this project during this phase are summarize in the following table and described deeper in the following pages.

3.1. Agro-industry sector analysis

Agrarian and agro-industry sectors account an important part of the economy in the participant regions/countries of the project. This representation can vary from the region Centro of Portugal, where this sector represents the 23% of the total regional GDP, or the region of Extremadura where the agrarian weight in the regional GDP is the 8.8 %, or the Latvian region of Vidzeme with 6.8 %, Greece with 6.5 till Kanta-Häme and Päijät-Häme region in Finland where the agrarian sector only represents the 4.5 % of the total GDP (Table 02).

Table 2: Percentage of the Agricultural sector GDP related to total (regional and national) GDP

Participant regions	Regional agrarian sector of the total GDP	National agrarian sector of the total GDP	European agrarian sector of the total GDP
Extremadura (Spain)	8.8 %	3.1 %	1.3 %
Kanta-Häme and Päijät-Häme (Finland)	4.5 %	2.1 %	
Grece	–	4.7 %	
Vidzeme	–	4.6 %	
Region Centro (Portugal)	23 %	1.6 %	

The total gross added value of agroindustry plays an important role in the regional economic accounts and give us an important picture about the socioeconomic structure of the region/country.

Despite the data does not provide of quality information “per se”. The balance between regional and national data added with other quality data gathered during the desk research will help us to understand the social and economic dynamics of each regions/countries.

Table 3: Regional agroindustry gross value added in the participant regions/countries

Participant regions	Regional agroindustry gross value added	National agroindustry gross value added	European agroindustry gross value added
Extremadura (Spain)	1.443,5 M €	28.570,4 M €	178.4 billion €
Kanta-Häme and Päijät-Häme (Finland)	500 M €	4.500 M €	
Grece)	–	45.850,20 M €	
Vidzeme (Latvia)	253 M €	1.224,4 M €	
Region Centro (Portugal)	2.505 mil €	3.140 mil €	

The importance of agroindustry is also represented by the companies which operate in this sector and the total labor force related to primary production and transformation processes. The following table (Table 04) describes the total number of agroindustry companies and the total number of employees in agroindustrial sector in the participant regions/countries.

Table 4: total number of agroindustry companies and the total number of employees in agroindustrial sector in the participant regions/countries

Participant regions	Number of agroindustrial companies	Number of employees in agroindustrial sector
Extremadura (Spain)	3.070	52.400
Kanta-Häme and Päijät-Häme (Finland)	3.400	9.183
Grece)	–	44.212
Vidzeme	2.489	16.745
Region Centro (Portugal)	–	–

Related to the main crops cultivated in the participant regions, the desk analysis determinate that there are important similitudes, which give us important inputs to determinate the final biocompounds to extract from their by-products, the technologies, or the main barriers or problems of these processes to introduce in the expert profile.

Table 5: Main crops in the participant regions

Extremadura	Kanta-Häme and Päijät-Häme	Exelia	Vidzeme	Region Centro
Olive oil	Silage	Olive oil	Wheat	Corn
Grape for wine production	Barley	Wheat	Rape	Grape for wine production
Corn	Oat	Grape for wine production	Potatoes	Apple
Industrial tomato	Wheat	Seeds	Barley	Pear
Rice	Sugar beet	Cotton	Open field vegetables	Potatoes
		Citrus fruits		Olive oil
		Tomatoes		Rice
		Potatoes		Milk
				Dairy products

The agroindustry sector is composed by the companies which operate in the sector, the human capital, vital for carrying out the processes and other structures which promote the collaborations, integration and promotion of the sector, generating and real agroindustry ecosystem.

These leaders, associations and clusters can play an important role in the transformation processes, and its knowledge is very important one the one hand, to collect inputs and on the other hand, to expand the project results and transfer al knowledge generated during the project lifetime.

The desk research process has been very useful to know these key stakeholders which will be useful to achieve the objectives of the project.

Agri-food Cooperatives of Extremadura (Cooperativas Agroalimentarias de Extremadura)	
Region	Extremadura (Spain)
Description	Cooperativas Agro-alimentarias Extremadura is the entity that brings together the agro-industrial cooperative movement in Extremadura, being a representative body before the regional, central and European administrations and a fundamental instrument to promote inter-cooperation between cooperatives as a reference in the agri-food sector. The entity is composed by 183 agro-livestock cooperatives and it represents more than 31.000 farmers. The main crops are Olive oil, rice, arable crops, fruits, grapes, etc.
Website	www.cooperativasextremadura.es

Päijät-Häme Grain Cluster (Päijät-Hämeen viljaklusteri)

Region	Kanta-Häme and Päijät-Häme (Finland)
Description	The Päijät-Häme Grain Cluster, founded in 2003, is a regional co-operation network of farmers and companies that process grain-based raw materials. Its purpose is to support the networking of local farmers and the companies of the cluster, increase co-operation between companies that process grain and promote the profile of the region's grain expertise. About the crops, grain, mainly barley, rye, oat, wheat (The Cluster represents the entire value chain from grain farmers to industry and retail. There are two separate grain chains, the bread chain and the drink chain, that include companies where the grains are processed to consumers or further processing purposes through industry, retail and restaurants.)
Website	https://viljaklusteri.fi/en/

Agricultural wine-working cooperative of Paiania

Region	Greece
Description	The main activity of the Cooperative is the gathering of grapes from the partner-producers, their processing into must and wine and the marketing of these products. It also actively contributes to cultural activities concerning the wider Mediterranean area by collaborating closely with the Municipality of Paiana and other local bodies. The annual import of grapes amounts to approximately 2,500,000 kg with a must production of approximately 2,125,000 kg and a final wine production of approximately 1,800,000 kg. This level of production makes our cooperative the strongest in the Mediterranean area
Website	www.aaspaianias.gr

Latvian Food and bioeconomy cluster

Region	Vidzeme (Latvia)
Description	In 2010 Vidzeme's bioeconomy cluster started its formation as an informal collaboration rapidly gathering more members in the years to come. In 2015 the cluster transformed into a legal entity and in February 2015 under the name of Latvian High Added Value and Healthy Food Cluster. In 2020 Latvian High Added Value and Healthy Food Cluster was rebranded to Latvian Food and Bioeconomy Cluster. The formal cluster provides a new governance model and is considered one of the most developed and internationally active bioeconomy clusters in the Baltic countries.
Website	https://viljaklusteri.fi/en/

InovCluster – Associação do Cluster Agroindustrial do Centro	
Region	Region Centro (Portugal)
Description	InovCluster – Associação do Cluster Agroindustrial do Centro, is based in the facilities of the Agro-Food Technological Support Centre in Castelo Branco and aims to contribute to the increase of competitiveness of local and regional productive systems and to affirm the Centre Region of Portugal at national and international level. To do so, it establishes a platform for concertation between the main actors in this sector, and supports companies in processes of innovation, IDT, transfer of knowledge, training, development of new products, services and processes, marketing and internationalization. To data, it has 184 members, including 148 companies and entities such as: Associations/Cooperatives, Academia, R&D Institutions linked to the agro-industrial and agro-food sector and several municipalities oh the Centre region
Website	https://www.inovcluster.pt

3.2. Challenges and Opportunities

During the desk analysis, the existing main barriers and opportunities were studies with the aim of determining the priorities during the training content development phase. Among the main common barriers determined during this phase are the low size of the agricultural companies and the high ages of the agricultural farmers, which result in companies with low levels of technological integration.

This low level of technological integration is that an important part of the agricultural companies of the participant regions produce low transformed products with low added value.

These weaknesses should guide to the project to consider not only the technological viability process, but only the scale-up and economic profitability processes.

Collaboration, educational and research aspects are very important to introduce in the by-products and wastes valorization expert profile to be generated during the rest project activities.

3.3. Educational Framework – Review of existing training

In order to understand partners' educational framework, first step is to analyse their educational systems, where we can find that all of them follow a very similar structure made by three levels of education: primary education, secondary education and higher education, with some peculiarities depending on countries. E.g Private education is not common in Finland and in Portugal most of institutions in charge of vocational education are private.
To identify the differences, and get a deeper knowledge on the systems, we have compared them in terms learning outcomes according to European qualifications framework (EQF) (Table 06 and Table 07).

Table 6. Description of the eight EQF levels[9]

Level	Knowledge	Skills	Competentes
Level 8	Knowledge at the most advanced frontier of a field of work or study and at the interface between fields	The most advanced and specialised skills and techniques, including synthesis and evaluation, required to solve critical problems in research and/or innovation and to extend and redefine existing knowledge or professional practice	Demonstrate substantial authority, innovation, autonomy, scholarly and professional integrity and sustained commitment to the development of new ideas or processes at the forefront of work or study contexts including research
Level 7	Highly specialised knowledge, some of which is at the forefront of knowledge in a field of work or study, as the basis for original thinking and/or research Critical awareness of knowledge issues in a field and at the interface between different fields	Specialised problem-solving skills required in research and/or innovation in order to develop new knowledge and procedures and to integrate knowledge from different fields	Manage and transform work or study contexts that are complex, unpredictable and require new strategic approaches; take responsibility for contributing to professional knowledge and practice and/or for reviewing the strategic performance of teams
Level 6	Advanced knowledge of a field of work or study, involving a critical understanding of theories and principles	Advanced skills, demonstrating mastery and innovation, required to solve complex and unpredictable problems in a specialised field of work or study	Manage complex technical or professional activities or projects, taking responsibility for decision-making in unpredictable work or study contexts; take responsibility for managing professional development of individuals and groups
Level 5	Comprehensive, specialised, factual and theoretical knowledge within a field of work or study and an awareness of the boundaries of that knowledge	A comprehensive range of cognitive and practical skills required to develop creative solutions to abstract problems	Exercise management and supervision in contexts of work or study activities where there is unpredictable change; review and develop performance of self and others

9 Source: https://europa.eu/europass/en/description-eight-eqf-levels

Level 4	Factual and theoretical knowledge in broad contexts within a field of work or study	A range of cognitive and practical skills required to generate solutions to specific problems in a field of work or study	Exercise self-management within the guidelines of work or study contexts that are usually predictable, but are subject to change; supervise the routine work of others, taking some responsibility for the evaluation and improvement of work or study activities
Level 3	Knowledge of facts, principles, processes and general concepts, in a field of work or study	A range of cognitive and practical skills required to accomplish tasks and solve problems by selecting and applying basic methods, tools, materials and information	Take responsibility for completion of tasks in work or study; adapt own behaviour to circumstances in solving problems
Level 2	Basic factual knowledge of a field of work or study	Basic cognitive and practical skills required to use relevant information in order to carry out tasks and to solve routine problems using simple rules and tools	Work or study under supervision with some autonomy
Level 1	Basic general knowledge	Basic skills required to carry out simple tasks	Work or study under direct supervision in a structured context

Table 3: Comparative table EQF Levels in Country Partners[10]

Level	Spain	Finland	Greece	Latvia	Portugal
Level 8	Doctor (PhD)	Universities' and National Defence University scientific and artistic postgraduate degrees (licentiate and doctor degrees) General staff officer degree Specialist degree in veterinary medicine Specialist training in medicine Specialist training in dentistry	Doctorate (Universities)	Doctor's diploma Professional Doctor's diploma in arts	Doctoral degree
Level 7	University Master's Degree Master's Degree in Higher Arts Education Bachelor's Degree in Medicine, Veterinary Science, Odontology, Pharmacy and Architecture	Master degrees at universities Master degrees at universities of applied sciences Professional specialisation programmes provided by universities and universities of applied sciences intended for holders of a Master's degree or a UAS Master's degree Advanced pastoral qualification Senior staff officer course Further studies in war economy and	Master degree (Universities/technological educational institutions (TEI)-higher education)	Master's diploma Professional Master's diploma Diploma of professional higher education, diploma of higher professional qualification (total lenght of full-time studies – at least 5 years)	Master degree

10 Sources: https://europa.eu/europass/en/compare-qualifications
https://www.universidades.gob.es/stfls/MICINN/Universidades/Ficheros/cuadro-meces.pdf

		technology Specific qualification on prescribing medicines			
Level 6	Bachelor's Degree Degree in Higher Arts Education	Bachelor degrees at universities Bachelor degrees at universities of applied sciences Professional specialisation programmes provided by universities and universities of applied sciences intended for holders of a Bachelor's degrees or a UAS Bachelor's degree Specialised training provided by the church Pastoral qualification	Bachelor degree (Universities/TEI-higher education)	Bachelor's diploma Professional Bachelor's diploma Diploma of professional higher education, diploma of higher professional qualification (lenght of full-time studies – at least 4 years)	Bachelor degree
Level 5	Higher Vocational Education Training Technician Higher Technician in Plastic Arts and Design Higher Technician in Sports Education	Specialist vocational qualifications Sub-officer qualification, Fire and rescue services General level (1 and 2) study module for non-commissioned officers Master level study module for non-commissioned officers	Vocational post-secondary school 'degree' for graduates of EPAL apprenticeship class, level 5 (post-secondary level) Vocational training diploma (vocational training institute) Vocational training diploma (post-secondary level) Post-secondary and not higher education diploma or 'degree'	Diploma of first level professional higher education (college education, length of full-time studies – 2 to 3 years)	Post-secondary non-higher level qualification with credits to pursue higher level studies
Level 4		General upper secondary school leaving certificate Matriculation examination Upper secondary vocational qualifications Further vocational qualifications Basic examination in prison services	Vocational school certificate Vocational upper secondary school 'degree' EPAL certificate General upper secondary school certificate	"Certificate of general secondary education " "Diploma of vocational secondary education Certificate of professional qualification (at secondary education level)	Upper secondary education and professional certification Upper secondary education and professional internship – minimum six months

		Fire fighter qualification Emergency response centre operator qualification Basic course for Border Guards Basic study module for non-commissioned officers			
Level 3		Preparatory studies for general upper secondary school (LUVA) Preparatory education for vocational training (VALMA) Advanced syllabus for basic education in the arts	Vocational training school - SEK certificate (post lower secondary level) IEK certificate (initial vocational training-post lower secondary level)	Certificate of vocational education Certificate of professional qualification (at vocational education	Upper secondary general education school leaving certificate
Level 2		Basic education certificate (9 years) Preparatory education for working life and independent living (TELMA)	Lower secondary school certificate (compulsory)	Certificate of general basic education Certificate of vocational basic education Certificate of professional qualification (at basic education level)	Third cycle of basic education Third cycle of basic education and professional certification
Level 1		Certificate of general basic education	Primary school certificate (compulsory)		Second cycle of basic education

Review of existing training

One of the issues during desk research stage is the identification of existing training related to our project topic, both in partners' regions or countries and outside the consortium. Only a few examples have been founded as specialized training related to by-products valorisation in agri-food industry, as it is detailed below:

Title	Bio-Technological Valorisation Of Agro-Industrial Waste and By-Products
Description	The main purpose of the course is to provide knowledges on by-product and waste valorisation by biotechnological management in different sectors of the agro-food industry. Moreover, the possible use of the by-products and wastes as a source of ingredients, molecules with added value and raw materials for food, feed and other industrial sectors, including pharmaceutical, alternative energy and cosmetic sectors will be critically discussed in relation to EU and national regulations. The course is aimed to provide the knowledge on the selection criteria of the microorganisms to be used in the bio-technological processes and on the optimisation of their performances in relation to the characteristics of the waste/by-products and the target product to be obtained
Educational Organization	University of Bologna (IT)
Website	https://www.unibo.it/en/teaching/course-unit-catalogue/course-unit/2021/413786

Title	Valuation of By-Products
Description	This course focuses on the management of by-products from wastewater treatment systems, organic by-products with a high recovery potential from economic activities (e.g. viticulture) or gaseous by-products produced by industrial systems. For wastewater treatment plant sludge, the aim is to integrate its management into the broader issue of the treatment (or production) process in order to reduce its source at the base or control its nature. The various recovery methods are then presented. The sizing of sludge treatment processes is discussed. The course outline is as follows: Characterisation of water treatment by-products Treatment of sludge from wastewater treatment plants Management and organic valorisation of winegrowing by-products Biogas recovery Management and treatment of gaseous effluents
Educational Organization	University of Motpellier (FR)
Website	http://formations-en.umontpellier.fr/fr/formations/licence-XA/l2-l3-licence-terre-eau-environnement-tee-ME135/geosciences-prevention-et-traitement-des-pollutions-KLTUXKZU/valorisation-des-sous-produits-KO9YHUX0.html

On the other side, partners analysed the training related to project topic in their regions and we can confirm that at this moment there aren't training profiles about by-products valorization as such, however, topics about sustainability, bioeconomy, technologies that could be used in valorization process, etc. are included in curriculum of different training programs such as- business management, nature sciences, food processing, as it is shown in the following table (Table 07):

Table 7: Different training programme related to the topic

EQF Level	Programme	Educative Organization	Website
7	Master Degree Bioeconomy Solutions	HAMK (FI)	link
7	Master Degree in Advanced Biotechnology Master Degree in Agronomic Engeneering	UEX (ES)	link
6	Degrees related to Biotechnology and Food Engineering, Agriculture and Rural Industries, Bioeconomy & Sustainable Development	HAMK (FI)	link
6	Degrees related science and technology of food Agricultural and food industry engineering Degree in oenology Degree in Biotechnology	UEX (ES)	link
6	Degree in Agriculture, Department of Food Science & Human Nutrition. School of Food, Biotechnology & Development	Agricultural University of Athens (GR)	link
6	Degree in Oenologist and Beverage Technologist Degree in Food Technologist	International Hellenic University (GR)	link
6	Bachelor Degree in Sustainable Agriculture	Latvia University of Life Sciences (LV)	link
6	Environmental Engineering	Universidade de Aveiro, Universidade de Coimbra, Instituto Politécnico de Leiria (PT)	link
6	Food and Technology Engieneering	Instituto Politécnico de Castelo Branco, Instituto Politécnico de Viseu, Instituto Politécnico de Coimbra, Instituto Politécnico de Leiria (PT)	link
6	Degree in Agronomy	Instituto Politécnico de Castelo Branco, Instituto Politécnico de Viseu, Instituto Politécnico de Portalegre (PT)	link
4-5	Vocational qualification in the fields of forestry (competence areas of forest worker/forest service's producer and bioenergy), food production (competence areas of dairy production or meat processing), agriculture (competence areas of agricultural technology,	Häme Vocational Institute (FI)	link

	animal husbandry or agriculture) and horticulture (competence areas of landscape industries or horticulture)		
4	Food production technician Crop technician	Valmiera Vocational Education and Training School (LV)	link
4	High vocational education in food production	Vocational training Institutes (ES)	link
4	High vocational training in quality processes in food industry	Vocational training Institutes (ES)	link
4	Basic vocational education in food industry	Vocational training Institutes (ES)	link

Finally, we can find a wide range of European initiatives aimed at increase capacity in the bioeconomy sector both in dissemination and awareness creation areas, as well as education, research and business promotion.
In the next table (Table 08), we have summarized some of these initiatives. This table will be updated during the project lifetime as we know more interesting initiatives.

Table 8: European initiatives related to research and education in bioeconomy and by-products valorisation

Title	Description	Programme	website
Power4bio	The POWER4BIO project aims at increasing the capacity of regional and local policy makers and stakeholders to structure their bioeconomy and to support the emergence of a thriving bio-based sector. Adequate knowledge and best practice exchange and networking within and among regions, across the EU.	Horizon 2020	https://power4bio.eu/
Agrimax	Agrimax is an EU-funded project that is developing and demonstrating the production of multiple, high-value products from crop and food-processing waste. The project aims to maximise the EU's sustainability, while providing new bio-based compounds for the food, packaging and farming sectors.	BBI Industries Consortium	https://agrimax.iris-eng.com /
Biobridges	BIOBRIDGES project was conceived to tackle the key challenge of improving the marketability of bio-based products (BBPs) by fostering close cooperation and partnerships among bio-based industries, brand owners and consumers' representatives.	BBI Industries Consortium	www.biobridges-project.eu
MpowerBio	MPowerBIO empowers Clusters to bring SMEs across the financial valley of death. In the MPowerBIO project 10 training the trainers' events will be arranged for a total of 90 clusters across the bioeconomy, covering most of Europe. The events are set up to help clusters understand how SMEs can obtain capital and grow.	BBI Industries Consortium	https://mpowerbio.eu/
Biovoices	BIOVOICES project comes in by ensuring the engagement of all these relevant stakeholder groups through a platform, that will involve a plurality of voices with different perspectives,	Horizon 2020	www.biovoices.eu

	knowledge, and experiences whilst also animating open dialogue, co-creation and mutual learning between them.		
Bloom	The project aims at bringing together partners from across Europe to debate, communicate, and engage the public in the potential of bioeconomy. An economy based on biomass promises to foster a circular economy and to enhance climate change mitigation, while reducing dependence on fossil fuels.	Horizon 2020	https://bloom-bioeconomy.eu
Pilot 4 U	Pilots4U creates a wide view of the availability, type of facility and equipment modules these infrastructures offer and helps actors to easy localise relevant facilities. So Pilots4U provides solutions that will support the faster and cheaper development of innovations into products.	BBI Industries Consortium	https://biopilots4u.eu/
Biobec	BIObec aims to build bridges between the bio-based industry and the education system by interlinking universities, innovation labs, and R&D centres with industrial actors and regions. In order to achieve this, the project proposes a holistic framework that merges the traditional idea of an education centre, with that of a knowledge hub.	BBI Industries Consortium	https://biobec.eu/
Valortech	Advanced food processing technologies, minimum waste and maximum utilization of raw material used as well as valorization of by-products constitute a highly relevant range of topics in the EU and worldwide. The main objective of the VALORTECH ERA Chair is to establish a new internationally recognized research team, and recruit a top-level researcher/research manager (ERA Chair holder) to lead this interdisciplinary, inter-unit entity, formed based on a joint effort by the Institute of Agricultural and Environmental Sciences and the Institute of Veterinary Medicine and Animal Sciences of EMU.	Horizon 2020	https://www.valortecherachair.com/

3.4. Political and Legal Framework

The EC is aiming at ensuring the sustainability of renewable bio-based materials, what is reflected in several aspects of policies.

According to new Circular Economy Action Plan[11] Biological resources are a key input to the economy of the EU and will play an even more important role in the future. The Commission will aim at ensuring the sustainability of renewable bio-based materials, including through actions following the Bioeconomy Strategy and Action Plan[12], where we can find 14 concrete actions aimed at strengthen and scale up the biobased sectors, unlock investments and markets, deploy local bioeconomies rapidly across the whole of Europe and understand the ecological boundaries of the bioeconomy.

On the other hand, the use of agricultural waste and residues for production of bio-fertilisers, protein feed, bioenergy, and bio-chemicals is also encouraged in the European Green Deal through Farm to fork strategy[13] which address comprehensively the food value chain aimed to accelerate our transition to a sustainable food system.

Regarding to legal framework, we can highlight the Waste Framework Directive[14] (2008/98/EC), adopted by Member Estates.

According to this Directive, by-products can be defined as a substance or object resulting from a production process the primary aim of which is not the production of that item, if some conditions are met:

- further use of the substance or object is certain;
- the substance or object can be used directly without any further processing other than normal industrial practice;
- the substance or object is produced as an integral part of a production process;
- further use is lawful, i.e. the substance or object fulfils all relevant product, environmental and health protection requirements for the specific use and will not lead to overall adverse environmental or human health impacts.

Thus differing it from the concept of waste, taking into account the subsequent use of this object that will take place after the primary production process.

[11] EUR-Lex - 02008L0098-20180705 - EN - EUR-Lex (europa.eu)

[12] https://research-and-innovation.ec.europa.eu/research-area/environment/bioeconomy/bioeconomy-strategy_en

[13] https://food.ec.europa.eu/horizontal-topics/farm-fork-strategy_en

[14] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02008L0098-20180705

It is important to bear in mind, that waste and by-products of agriculture fall into category "02 Wastes from agricultural, horticultural, hunting, fishing and aquaculture primary production, food preparation and processing" from The European Waste Catalogue[15] (a list of waste types, established by the EC, which categorises wastes based on a combination of what they are, and the process or activity that produces them.), are excluded of the Waste Framework Directive scope. The main explanation for this exception has probably to be related to the long history of the in situ reuse of farming, so it is therefore arguable that agricultural waste could not be included easily in the same policy as other categories of waste.

This gives us an important space to promote the use of by-product from agri-food sector, and include the legal aspects in the different contents to be designed aimed to the development of our professional profile.

[15] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:02000D0532-20150601

3.5. Good Practices

In spite this new sector is relatively new, some good practices in different fields are already carrying out in the participant regions. During the desk research process, the partners have identified several good practices in this area both public initiatives or research departments as well as companies which are already developing new and added value biocompounds from by-products.

This section tries to show these initiatives with the objective of gather a very useful information about the sector development in the participant regions.

Public initiative (Educational institutions, Research departments, business support initiatives, etc.)

Biomass Atlas

Region	Finland
Description	The source of data presented here is Biomass Atlas web service which is developed by the Natural Resources Institute Finland together with the Finnish Environment Institute, Tapio, the University of Eastern Finland and the University of Vaasa, and with funding from the Finnish Ministry of Agriculture and Forestry. Biomass Atlas is an open service that collects location data about biomass under a single user interface. The service enables users to calculate the amount of biomass in each geographical area, as well as examining the opportunities to utilise the biomass and restrictions on its use. The map user interface allows user to watch, analyse and report on biomass from forestry, agriculture, and biodegradable waste from communities and industry.
Website	https://projects.luke.fi/biomassa-atlas/en/

High-Tech Incubator focused on Bioeconomy and Circular Economy - IAT

Region	Extremadura (Spain)
Description	The High Technology Incubator specialized in Bioeconomy and Circular Economy has been designed to support technology-based business projects aimed at obtaining new high added value products/processes through purification techniques and biotechnological processes from the natural resources of the region and the use of by-products and waste of agro-food industry.
Website	www.iatex.es

Vioaxiopoio

Region	Greece
Description	VIOAXIOPIO project aims at the exploitation of fish by-products and discards (FBPD), which to date are thrown away through the current supply chain (handling, marketing and processing), towards the production of high added value biomolecules, such as gelatine, various forms of collagen, fatty acids and minerals-trace elements. The project will be implemented by two Enterprises (Central Market and Fishery Organizations SA and NAYS, Ioanna Argyrou, Project Planning & Development Consultants) and two research organizations (the Hellenic Centre for Marine Research and the National and Kapodistrian University of Athens, School of Pharmacy.
Website	www.vioaxiopoio.gr

Private companies

Fortum Ltd

Region	Kanta-Häme and Päijät-Häme (Finland)
Description	Fortum is an energy company which also has a variety of waste management services. Fortum is developing Bio2X -technology which has a goal to produce high-value products from wood raw material and agricultural residues. They strive to fractionate biomass into its main components and further process it into valuable end products. They focus especially on chemical fractionation technologies that enable the separation of biomass into pure lignin, cellulose and hemicellulose fractions with a high yield.
Website	www.fortum.fi

EntoGreen – Soluções Agroalimentares Sustentáveis, Lda

Region	Centro (Portugal)
Description	ENTOGREEN is a specialist in the development of biotechnological solutions for the production of animal protein and organic fertilizers, through the reuse and valorisation of waste and waste and by-products from the agro-food industry. It is dedicated to the valorisation of agro-industrial by-products, with the mission of reducing the nutritional waste that occurs in the value chain, restoring environmental sustainability to the sustainability to the agro-

	food sector and contributing to sustainable management and efficient use of natural resources. The biological system that EntoGreen develops is based on the principles of the circular economy and returns nutrients that would otherwise be the value chain, giving them a second life in the nutrition of both animals and plants. The link that enables the circularisation of nutrients are the larvae of the Black Soldier Fly (Hermetia illucens), an insect that has a great capacity to convert organic matter
Website	www.entogreen.com

NATAC

Region	Extremadura (Spain)
Description	A corporate group dedicated to researching, developing, manufacturing, and marketing natural ingredients to be used in food supplements, feed, pet food, as well as in functional foods, and as natural, active pharmaceutical ingredients, mainly plant extracts and functional lipids. Our by-products are: olive, artichoke, saffron, grape, pomegranate, horsetail, rosemary, lemon balm.
Website	www.natacgroup.com

ELEOTOPI

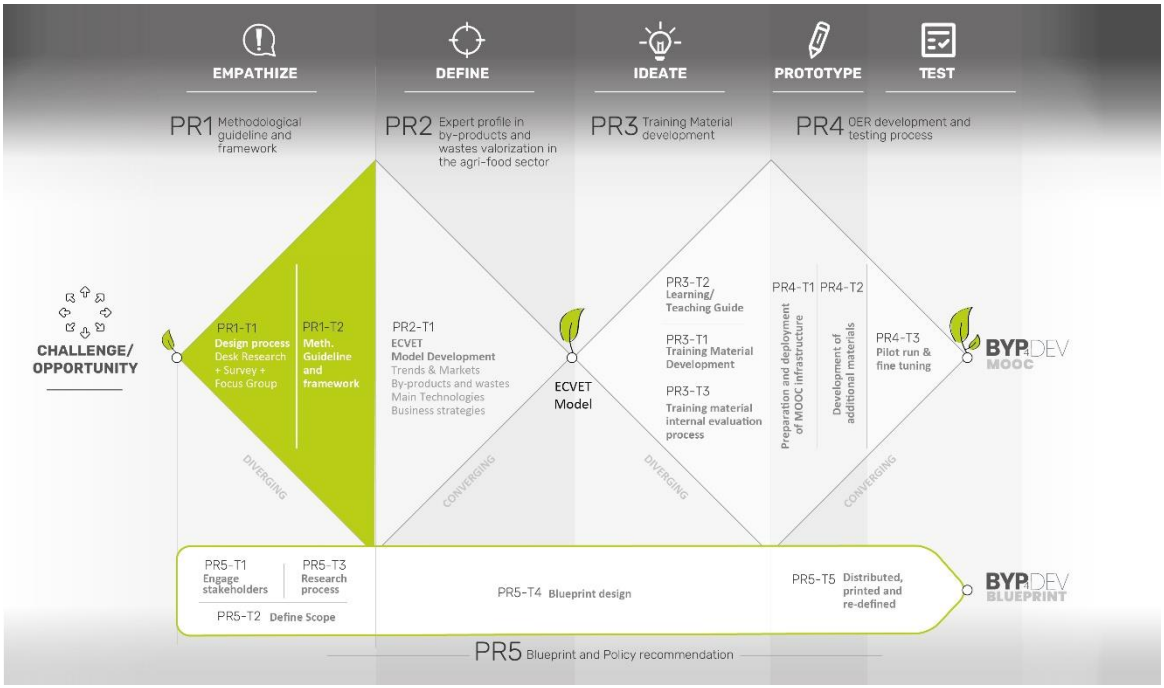
Region	Greece
Description	The purpose of the company is the processing, standardization, marketing and export of olives and olive oil as well as the comprehensive management of the by-products of olive processing. The main bioproducts of this company are: olive wood, olive leaves, waste water, olive kernels
Website	www.eleotopi.gr

4. Analysis of skills, knowledge and competences

4.1. Methodology

Design thinking methodology is guiding project partners throughout project lifetime (empathize, define, ideate, prototype and testing), in this Project Result, partners are depth in empathize with the agri-food sector in order to contextualize the knowledge, competences and skills needed for designing an Expert profile in by-products and wastes valorization in agri-food sector to lay the pillars of the following Project Results.

Figure 2: Byp4dev Project Methodology



As starting point for the analysis process, partners have identified target group in their regional scope gathering their information in the **stakeholder's ecosystem map**. On this regard, project target group can be differentiated in direct and indirect participants:

Direct target group:

- Professionals of agri-food sector (technical profiles).
- Vocational training students, graduates, masters in the agro industrial sector.
- Agro industrial entrepreneurs

Indirect target group:

- The Agro Industry sector: SME associations, business organizations and Clusters.

- The Educational sector: vocational training centres, organizations involved in adult education, universities - the Regional supporting services: business incubators and accelerators, Regional development agencies
- Policy-makers: local, national and European public authorities responsible for the definition of policies for employment and training

A total of 240 stakeholders have been identified in participating regions at the finalisation of this document. The stakeholders's ecosystem map is a live tool for partners that will continue growing and will be a key issue in different project stages.

Once the target group was defined, an online **qualitative survey** was developed to gather general information related to the state of the art about by-products valorization processes. The results obtained through the survey allow us to identify the contents that a professional profile capable of transforming by-products of the agri-food sector into new value-added products should know, thus facilitating the creation of qualified employment adapted to future opportunities.

The survey has been addressed to different target groups: the agro-industrial sector, educational organizations, research centers, and policymakers related to agro-industrial and educational policies, counting on specific questions depending on the type of respondent. Surveys have been translated to project languages and collected on-line, they can be found in following links:

- EN: link
- ES: link
- FI: link
- GR: link
- LV: link
- PT: link

Around 246 stakeholders were invited by partners to answer the survey, and a total of 106 stakeholders answered the survey.

As the survey focuses on a divergent paradigm, following step was related to converge all information and knowledge gathered previously into concrete and high value specifications, this is the contribution of the Focus Group.

The **Focus Group**, have been carried out in the 5 participating countries, as part of the research process, to converge all information and knowledge gathered previously into concrete and high value specifications, resulting in a report on the main skills, knowledge and capacities that the new profile should have. Focus Groups have been developed both face to

face and on-line organized in small groups (7-12), following a similar structure as it has been indicated in the methodology.

To complete the state of the art that it is contained also in different sections of this document, furthermore, partners carried out a desk research aimed to analyse the context of agro industry sector as well as the status valorization of by-products and in their regions, the educational framework, analyzing the existing training related to project topic,

- Agro-industry sector analysis
- Valorization of by-products and waste
- Educational Framework – Review of existing training
- Political and Legal Framework
- Best Practices

4.2. Survey results

A total of 106 questionnaires have been received during this phase from different stakeholders' typologies. The first aspect that must to be remark that in spite of no policymakers related to education have answered to the questionnaire, this weakness es counteracted by a large participation of educational organizations and a good industry representation (Table 09).

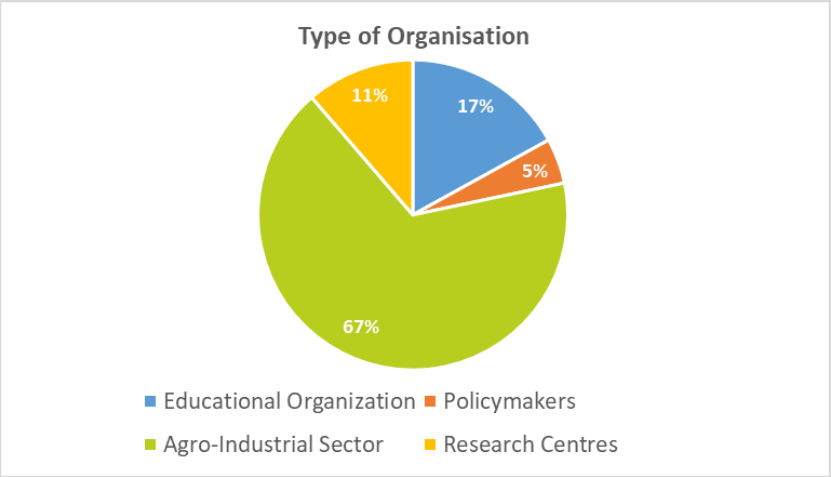
During the project lifetime, the contact with policymakers related to education will be enhanced in order to fill this gap.

Table 9: Description of questionnaires received

Region/Country	Number of questionnaires received
Educational organization	**18**
Vocational Training	4
University	13
Private training company	0
Other	1
Policymakers	**5**
Related to education	0
Related to agro-industry	5
Agro-industry	**71**
SMEs	60
Large Company	2
Cooperatives	2
Business Ass. or clusters	7
Research Centers	**12**
Public research center	7
Private research center	5

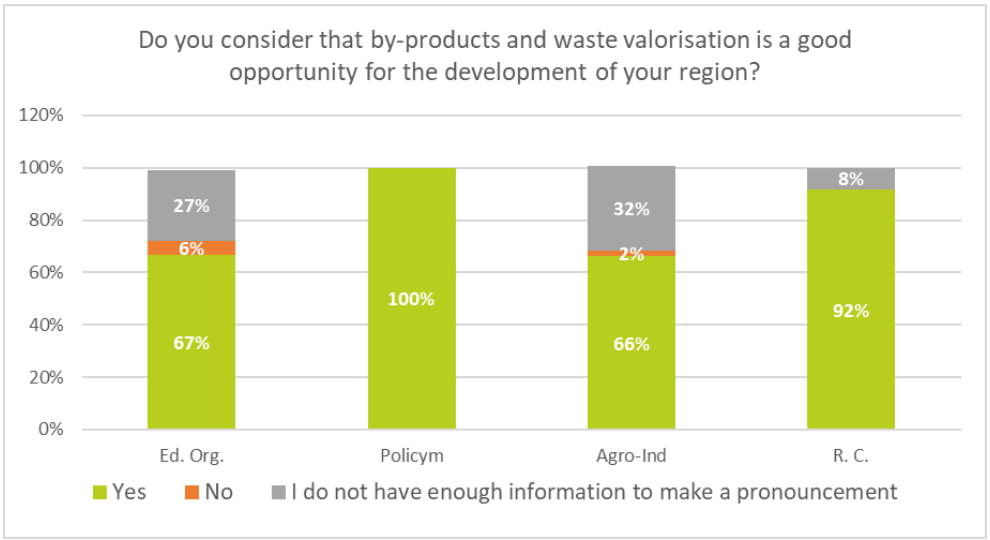
The following figure (Figure 04) shows that the 67% of total of questionnaires received come from agro-industry, and mainly, SMEs which denotes the importance of by-product valorisation to this sector. The second most representative type of organisation in the survey is the educative sector, which are aware of this opportunity and the need of recycling the existing knowledge and the generation of new ones to respond to society challenges.

Figure 3: Total received questionnaire by type of organizations



These society challenges can be transformed in opportunities for regional development. And these opportunities are reflected in the next figure (Figure 05), where the 67 % of educative organizations, the 100% of policymakers, 66 % of agro-industry and the 92 % of research centers consider that the by-product valorization is a good opportunity for their respective regions.

Figure 4: Consideration of by-products and waste valorisation as an opportunity for the regions

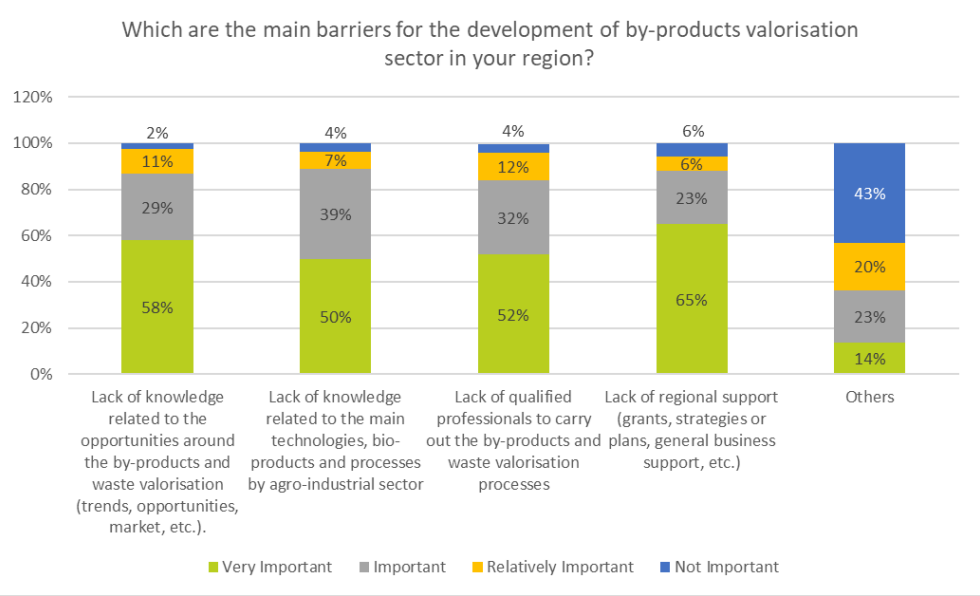


This figure also tells us that an important group of educative organizations and industry have not enough information about by-products valorisation possibilities, which give us an important input to introduce in the future expert profile, sections related to communication and disseminations issues.

To finally with the opportunities for regional development from by-products valorization processes, other question was focus on the main barriers for this development. From the following graph can be extracted that there are important barriers in several action lines, from general knowledge of the possibilities of this sector, to lack of knowledge of technologies, professionals and regional support.

Due to this project have to address educational aspects, this project will try to introduce concepts, topics, etc., which can support the gathered lack of knowledge.

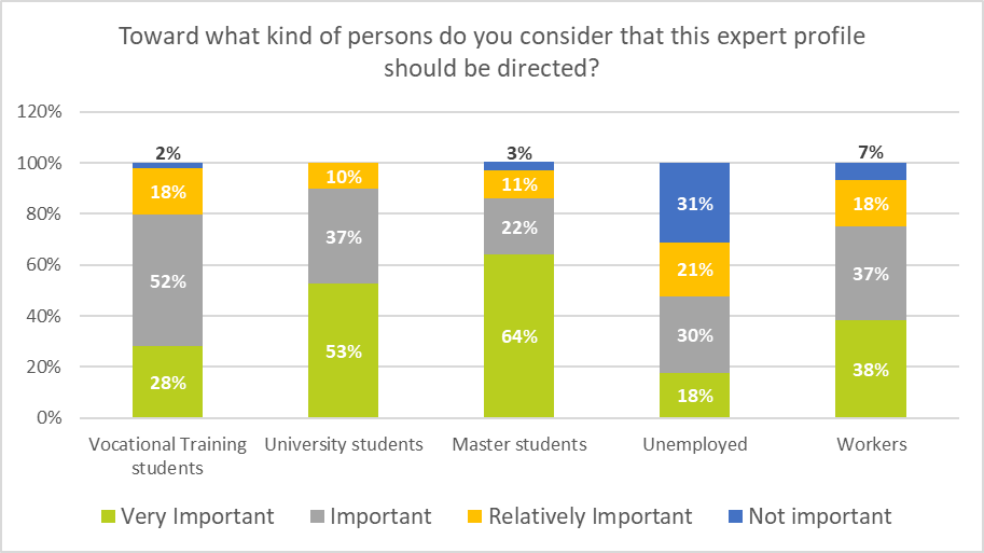
Figure 5: Barriers for the development of by-products valorisation sector



Concerning the expert profile destination, the results of the questionnaire tell us that 80% of total answers consider that the expert profile is "very important" and "important" for vocational training students, university students and master students (Figure 06).

The rest of the survey results and the conclusions of the focus groups will give us more information and details about the different profiles for the different target audiences. Important inputs for the design of our expert profile.

Figure 6: Destination of the expert profile



Although the sector considers the valorisation of by-products is a good opportunity for the regions (Figure 07), and they are real professional opportunities related to this area (Figure 08), the survey results also show a large unknowledge of the existing expert profiles related with the topic, which it makes impossible its deployment (Figure 09).

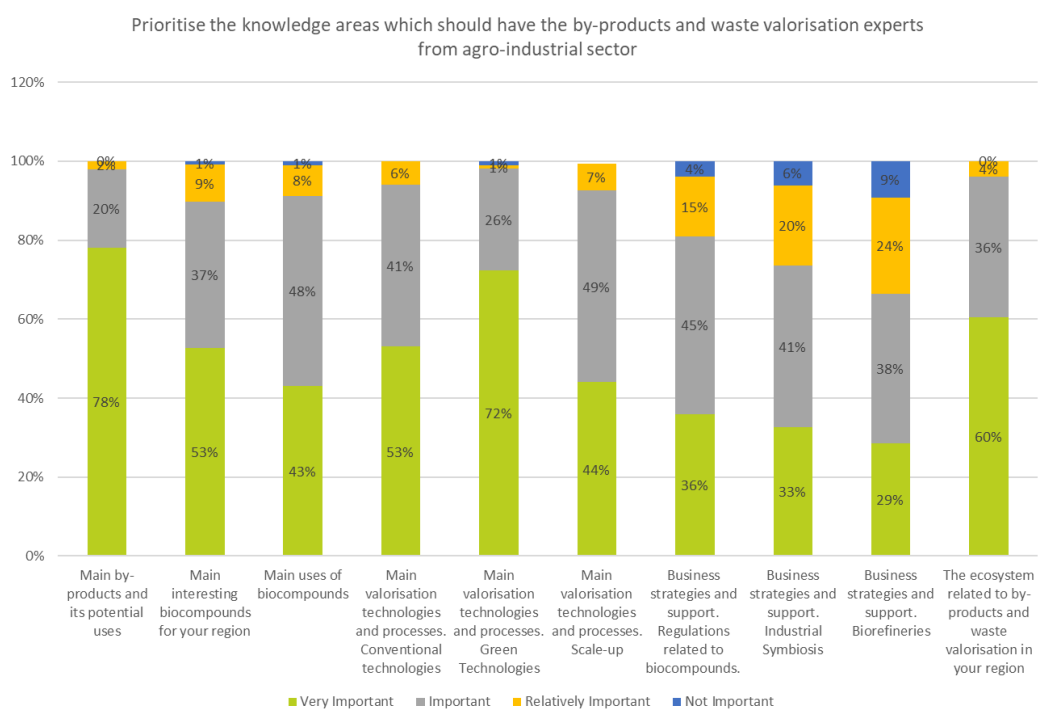
Figure 7: Consideration of professional opportunities related to this area

Figure 8: Knowledge of professional profile linked to by-products and waste valorisation from agro-industry sector

Other section of the questionnaire is focused on the necessary knowledge to extract all potential to by-product valorisation processes. We can extract from the next figure (Figure 10) that the knowledge of the main by-products and its possible uses is the most required knowledge by the organisations surveyed.

This result gives us a valuable information that we are in the first steps of the bio-based society defined in the section 2.3, and that along with knowledge, capabilities and skills related to technologies, regulations, business models, etc., a section related to describe the possibilities of the different by-products and wastes in the expert profile is very required.

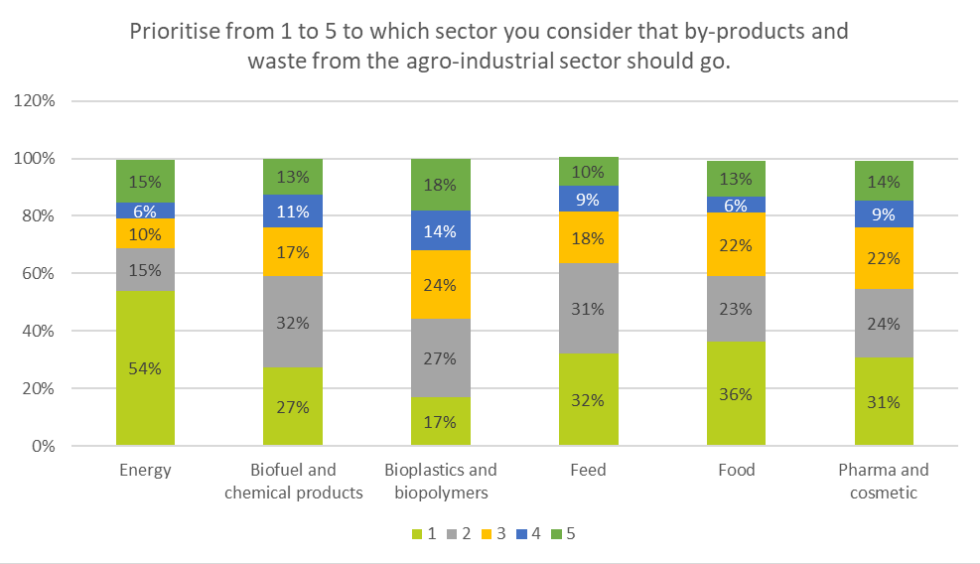
Figure 9: Priorization of the knowledge area which should have the by-products and waste valorisat ion experts from agroindustry sector



Knowledge about green technologies and about the supporting ecosystem related to this area in the region are the second and third most required knowledge for the future experts, what stand out that the sustainability and the collaboration are key in the by-products valorization sector deployment.

According the pyramid of biomass described in the section 2.3, the questionnaire also asked about which are the sector that they consider by-products valorisation processes should go, with the following results.

Figure 10: Main sectors that by-products valorisation processes should go



Together with the questions related to knowledge priorization, other questions directed to know more about the main technologies was included in the questionnaire with the results shown in the next figure (Figure 12):

Figure 11: Technologies importance valorisation in the valorisation process

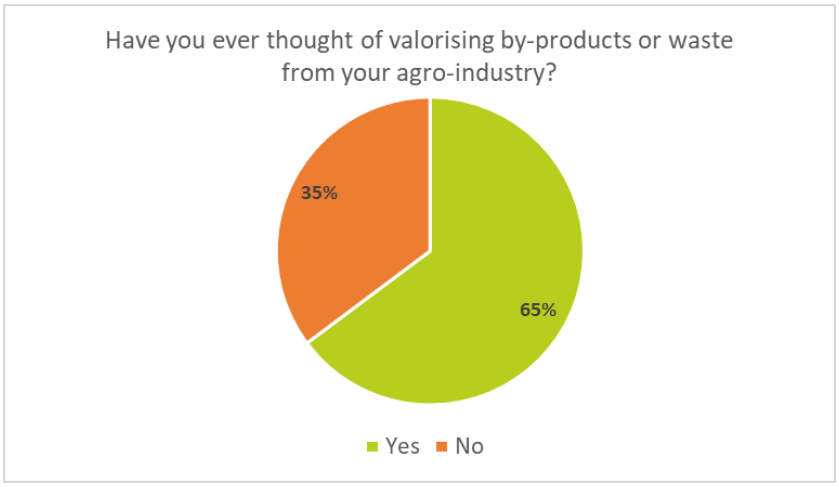
Which technologies do you consider the most important to know about related to by-products and waste valorisations processes from agro-industry sector?	Very important	Important	Relatively important	No important	TOTAL
Research Centers	41	71	56	13	181
Liquid-Liquid Extraction	5	4	3	0	**12**
Solid–liquid extraction - Leaching	3	6	3	0	**12**
Expression Technique	3	6	2	1	**12**
Incision or exudate	1	7	3	1	**12**
Steam distillation	1	7	3	1	**12**
Hydrodistillation	1	5	5	1	**12**
Maceration	2	3	6	1	**12**
Soxhlet Extraction	3	4	4	1	**12**
Solvent extraction	5	2	3	2	**12**
Microwave-assisted extraction	4	3	4	1	**12**
Ultrasound-assisted extraction	2	5	4	1	**12**
Pulsed Electric Fields-Assisted Extraction	2	4	4	2	**12**
Pressurized fluid extraction	3	5	3	1	**12**
Supercritical fluid extraction and subcritical water	3	4	5	0	**12**
Enzyme-Assisted Extraction	3	5	4	0	**12**
Filtration technologies, bioconversion by microbes	0	1	0	0	**1**

The table shows different technologies used in valorization process and the importance that researchers give them to each. Due the special characteristics of this questions, it was only requested to research centers.

Other important area of the questionnaire is directed toward the perception and introduction of these processes in the companies.

The first questions in this area asked about if the companies have thought or not to implement by-product valorisation processes and its capabilities to carry it out. The first question showed that the 65% of companies surveyed have thought of valorizing by-products or waste from agro-industry (Figure 13).

Figure 12: Percentage of companies that has thought of valorising by-products or waste



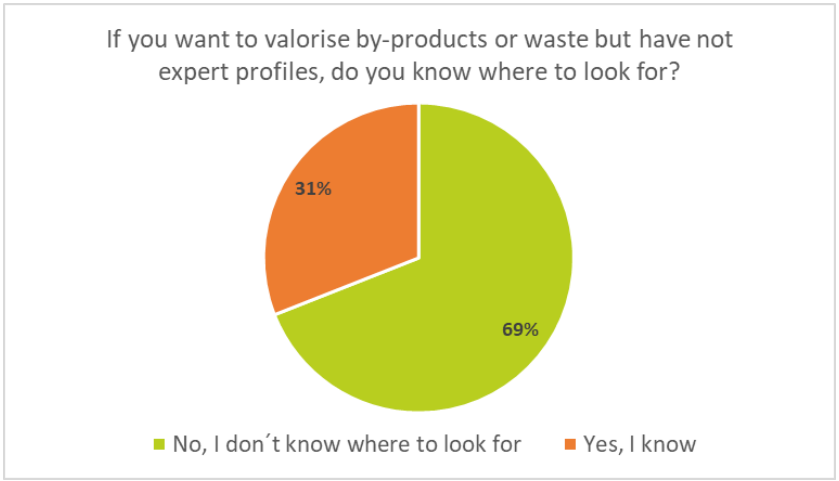
These positive answers give us a good starting point for the project, which it will completed with the results of the next figure (Figure 14), due to only 31 % of the companies consider that they have the necessary knowledge, capabilities and skills required to carry out these kinds of processes, validating the need for a specific profile adapted to these new requirements.

Figure 13: Existence of necessary profiles to carry out by-product valorization processes in companies.

Other results extracted from the questionnaire answers and it is very related with other results described before is that the companies consulted do not know where to look for knowledge and the expertise to develop by-products valorisation projects.

The figure 15 shows that the 69% of the companies do not know where to look for knowledge and capabilities to carry out valorization processes, which is very related to the results of the priorization of knowledge figure (Figure 10), which considered that knowledge about the support ecosystem is very important for deployment of this sector.

Figure 14: Knowledge about the search for expert profiles



Besides, this result also highlights the need to generate a support ecosystem which give help the companies to find the necessary knowledge, skills, and capabilities in all areas of their new processes and business models.

Last but not least, but closely linked to the project, the participation in training activities related to by-products and valorization process by the staff of the surveyed companies is very low (Figure 16), whereas the interest to take part in this kind of training is very high (Figure 17).

Figure 15: Participation in training activities by companies´ staff related to th is topic

Figure 16: Interest to take part in training activities of this topic by companie s´ staff

4.3. Focus Groups results

The focus groups organized by the partners attracted a total of 35 professionals which discussed the topics described in the focus group methodology:

- Knowledge, Capabilities & Skills
- Future students
- Learning/Teaching methodology
- Blueprint process

The first key idea of almost all focus groups was related with the lack of **a global vision** of the processes. There is a basic idea about the possibilities of by-products valorization process but the professionals are focused mainly in specific processes, side-streams or bio-compounds.

Greater knowledge would allow us to understand not only the processes, the final bio-compounds generated or the total by-product valorized, but it will give as a global knowledge about the process, including by-product valorization impact in the global challenges, the market needs, scale-up process (which it has been very commented), and the profitability of the valorisation process, which not always is profitable.

This global vision is in line with the bio-based society described in the section 1.3.

Other important key idea is related to the future expert profiles of the by-products and wastes valorisation in agri-food sector expert.

During the focus groups, some participants remarked that it is very important to differentiate between two profiles typologies:

- Focus on design Vs focus on implement
- Generalist Vs specialist

The objective of "**focus on design"** profile is to identify opportunities to agro-industry by-product valorization and to analyze if this valorization process can be carried out successfully, from an economic (market, profitability, viability, etc.), legal (regulations) and technical point of view (technological, scale-ups, etc.).

On the other hand, the "**focus on implement"** profile will focus their activities in the implementation process, giving more emphasis to technologies (green technologies, management, stability, etc.)

The different between **generalist** or **specialist** is that the first one would be more focused on market opportunities, business model, etc., and the specialist would be in charge of the technological part of the process.

These different "missions" or "responsibilities" opened the discussion about two different profiles.

The first proposed profile was a Level 5, with general knowledge, capabilities and skills related to opportunities, market, demands, etc., and with deeper knowledge, capabilities and skills in areas related to processes, technologies, etc.

The second proposed profile was more related to Level 7, and with the aims of managing the quality processes, designing the business models and profitability analyses association with the valorization process, designing and implementing the scale-up stages, or the knowledge the legislation and regulation of the bio-compounds generated.

Related to the learning/teaching methodology, the participants remarked the following aspects:

- Due to the knowledge, capabilities and skills might be different depending the future students (level 5 or 7), a modular structure of the training course is the best option to tackle almost of possibilities and needs. Having basic and advanced modules will allow us to cover a wider range of future students.
- A possible learning/teaching itinerary proposed by a University professor would be:
  1. By-products / Regulation
  2. Existing solutions or process to valorize it
  3. New and innovative alternatives
  4. Technology to use for its valorization
  5. Process and Market
- Best practices and guidelines are good tools for the acquisition of knowledge, capabilities and skills.
- These new process and technologies will need an important knowledge transfer approach. The connection among research centers, educators, industry and society is compulsory to extract the maximum potential of by-product valorization.
- It has to be remarked that the importance of connection between vocational training and industry has been commented for a large number of the focus group participants.

Finally, some of the suggestions related to the elaboration of the blueprint process are the following:

- Farmers' associations play an important role for promoting this new sector.
- The scale-up process is very important, due to not all valorization processes despite being viable, are not profitable.
- One interesting way of tackling this sector is understanding it as “sector by sector”, due to each sector has its concrete and specific regulations, possibilities and market. On the other hand, industrial symbiosis could be an interesting framework for connecting them in order to getting benefit from the scale-up economy.

5. Recommendations for the development of the Professional Profile *"Expert in the valorisation of by-products and waste in the agro-industrial sector"*

The following recommendations contains the summary of the main questionnaire results, coming from both close and open questions, besides main considerations and recommendations obtained during the focus groups organized within the project framework.

The main recommendations for the development of the professional profile "*Expert in the valorisation of by-products and waste in the agro-industrial sector*" are the following:

- The participant regions are in the first stage in this process of building a bio-based society where the knowledge about the possibilities to valorize their products is vital in order to open their minds and explore the new possibilities of this sector development.
- The knowledge of the ecosystem associated to this topic has been revealed as an important support for the transformation process. To know "who is who" is crucial in this moment, due to the knowledge is scattered in different actors.
- The expert in valorization of by-products and waste in agro-industrial sector should have technical knowledge, but also knowledge about scale-up processes and market opportunities. The technological viability must be completed with scale-up and marketability processes in order the by-products valorisation initiatives to be successful.
- By-product valorization processes can be carried out by different expert profiles with different missions. These different experts will need different knowledge, capabilities and skills. To know how to distinguish these roles is a challenge for the next steps of this project.
- The good practices dissemination, public and private ones, is a very good way to make known the opportunities, the processes, the technologies and possibilities to generate new added value products.
- The depth and breadth of knowledge has been discussed during the different focus groups. "Focus on design Vs focus on implement", or to be "generalist Vs specialist" must be analyzed and developed along the next project stages.
- Almost all barriers analyzed during the survey (lack of knowledge opportunities, technologies, human capital and regional support) must be tackled in order to generate complete professionals in this topic.

- By-products valorization processes are not independent processes but continuous ones from where it is possible to extract different biocompounds from a by-product leading to biorefinery concept. This interconnexion of processes and by-products should be integrated into the expert profile.
- Last but not least, future experts in this area can be integrated in companies or can support specific valorization processes as expert consultants. Both situations require soft and communications skills which should be part of the future expert profile.

These recommendations are not a rigid path to travel, but a very important and intuitive map for guiding us during the expert profile design we have to elaborate within this project framework.

At this project stage, our challenge is to be able to integrate these recommendations within the existing possibilities, supporting the unstoppable transformation process to a bio-based society.