



GREENOMED Training Material

Responsible Partner: Plastipolis

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List of abbreviations

RP : Reporting Period

1. Executive summary

The current document includes the materials for transfer of the acquired knowledge and developed methodology to clusters and policy makers. The main training material to this end is a handbook which a draft of it is presented in this deliverable. The final version will be delivered by the end of the 6th RP. The GREENOMED handbook aims at providing user-friendly manual to the stakeholders to whom the GREENOMED methodology will be transferred especially clusters and regional authorities. Moreover, the GREENOMED handbook will be a summary of the main results and knowledge acquired during the project which will be available to public and everyone interested. The handbook is divided into four chapters. In the first chapter we have presented an overview of the concept of green manufacturing, its relevance, drivers and barriers for uptake, the role of pilot plants and trans-regional collaboration for uptake. The second chapter is dedicated to description of GREENOMED methodology including different stages, services and tools. In the third chapter we have described the experience of each testing partner implementing the GREENOMED methodology, how they went on through the process, the challenges they faced and the benefits they gained. Eventually the fourth chapter is dedicated to definition of a number of recommendations for policy makers and clusters based on the lessons learnt throughout the project.

2. Objective of activity

The main objective of the GREENOMED training material is to be a user-friendly manual to clusters and policy makers who will receive the methodology during the transfer process as well as other interested stakeholders. It also aims at providing a comprehensive summary of the acquired knowledge and lessons learnt throughout the project.

3. Choice of training material

To reach the objectives defined in the previous section, three types of training materials were selected to be developed: 1) a presentation describing the complete methodology, services and tools with practical examples that have taken place in testing regions 2) A word document as an introductory reference to be shared with external clusters and policy makers prior to the transfer sessions and 3) a handbook as proper training tool for transferring. The decision was also based on the feedback received from external clusters during the working session in GREENOMED testing seminar on 29 January 2019 in Lyon. As indicated by clusters, they would rather to receive a user-friendly book as a manual to understand the methodology and how to implement it step by step and through real examples. Such a handbook will be a reference point not only for clusters and policy makers as the main targets of transferring, but also to other stakeholders interested in GREENOMED methodology and its implementation.

3.1. Structure of the handbook

The GREENOMED handbook is structured in a way that it provides important knowledge to relevant stakeholders in a concrete and easy-to-understand manner with clear examples and best practices. To this end, the handbook is divided into four chapters : 1) Green manufacturing and Regional innovation ecosystems in Europe 2) GREENOMED cooperative transnational

methodology 3) Implementation stories by clusters in different MED regions 4) Lessons learnt and recommendations.

In the first chapter an introduction to the concepts such as green manufacturing, regional innovation ecosystem and trans-regional collaborations will be presented to establish the required background for the reader to understand the necessity of GREENOMED methodology and how it is going to address the issue of trans-regional collaboration and pilot plants for green manufacturing.

Chapter 2 is dedicated to introduction of GREENOMED methodology, its services and tools with concrete examples of exploitation of tools by testing partners during the project.

In chapter 3 we will present the stories of each testing partners (region) in terms of implementation the GREENOMED methodologies highlighting their starting point, the challenges they face, the benefits they gained and the results they reached.

Finally chapter 4 is dedicated to definition of a set of recommendations to clusters and policy makers for a smoother and more effective implementation of the methodology.

3.2. Exploitation of the handbook

The draft of handbook will be used during the transfer sessions as a reference point to facilitate the transfer activity. Moreover a final version will be submitted by the end of the project and during the 3rd GREENOMED conference which targets policy makers. The handbook will be also publicly available on the website of GREENOMED and its social networks and will be shared among the Green Growth Community stakeholders.

4. GREENOMED Handbook



GREENOMED Handbook



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List of abbreviations

MED: Mediterranean

EU: European Union

1. Introduction

2. Green manufacturing and Regional innovation ecosystems in Europe

2.1.Green manufacturing

2.1.1.An overview of green manufacturing in Europe

Manufacturing is a fundamental pillar of European economy. It represents approximately 21% of the EU's GDP. There are 2.1 million manufacturing companies across Europe, creating jobs for more than 30 million European citizens (ANNUAL REPORT ON EUROPEAN SMEs 2017). This highlights the fact that the future of European economy strongly relies on its manufacturing sector.

In recent years green manufacturing and circular economy has received significant attention in Europe. The manufacturing sector consumes approximately 30% of the world energy production, generates 28% of the total CO2 emission, and produces around 410 million tons of waste each year. Thus the shift towards circular economy and green manufacturing is an inevitable strategy for the manufacturing sector to limit the environmental impacts and to create a sustainable economy. Such a shift would contribute to reinforcement of economic, environmental and social sustainability.

In 2015, The European Commission implemented an action plan to support the transition of Europe towards a circular economy, boost global competitiveness, promote sustainable economic growth and generate new jobs. “The action plan sets out 54 measures to “close the loop” of product lifecycles. This transition is supported financially through the European Structural and Investment Funds, Horizon 2020, the European Fund for Strategic Investments (EFSI), and the LIFE programme.” The Green Action Plan of the European Commission aims to help SMEs take advantage of the opportunities offered by the transition to a green economy with the objective to raise SMEs’ awareness of resource efficiency improvements and the potential of the circular economy for productivity, competitiveness and business opportunities.

On 4 March 2019, the European Commission adopted a comprehensive report on the implementation of the Circular Economy Action Plan. The report presents the main achievements under the Action Plan and sketches out future challenges to shaping our economy and paving the way towards a climate-neutral, circular economy where pressure on natural and freshwater resources as well as ecosystems is minimized.

2.1.2. Drivers and barriers for green manufacturing

Embracing green manufacturing by companies especially SMEs has been promoted through several external and internal drivers. These drivers encourage the shift of enterprises toward uptake of innovative green manufacturing and pursuit of sustainable practices. In general these drivers can be categorized into the following main groups (Gandhi et al. 2018, De Jesus et al. 2018; Ariffin et al. 2015; Seth et al. 2018, Mangla et al. 2016; Neto et al. 2017, Thanki et al. 2016, De Jesus et al. 2016, Kumar et al. 2018; Islam et al. 2016).

- Managerial and organizational drivers which are the result of internal the internal factors affecting pursuit of green manufacturing by companies play an important role in this regard. These drivers include enablers such as top management commitment and organizational support, perception of strategic relevance of green manufacturing, long-term strategic orientation and strong R&D capabilities around green manufacturing which is mainly the case of Large enterprises rather than SMEs.
- Regulation drivers are being among the strongest drivers to push companies towards uptake of green innovation. Environmental regulation and stringer execution backed by legislation, penalties for noncompliance of regulation and standards as well as Incentives and public support are considered to be effective factors.
- Financial drivers such as provision of incentives and assistance to companies for pursuit of green manufacturing as well as cost saving due to reduced consumption of resources.
- Technological and process drivers such as green technology performance, Availability of technologies that facilitate resource optimisation, remanufacturing and re-generation of by-products as input to other processes, Recycling practices and reverse logistics process and green product design.
- Market and external partnership drivers such as trends both in demand- side (Awareness of customers about environmental sustainability and their increased demand for greener products) and supply-side (Stakeholders' involvement and their green concerns, increased volatility and cost of resources), Cooperation and partnership within green supply networks and Commitment from various business stakeholders towards green manufacturing practices.

On the other hand, despite of various drivers, the implementation of green technologies is still quite challenging for companies in particular for SMEs. While Large enterprises have more capacities and resources for shifting towards green practices, SMEs operational model is mainly based on their day to day business to ensure economic sustainability. Thus, they struggle to uptake the green manufacturing technologies even though the supply side is ready. The main barriers are summarized in following (Gupta et al. 2018, Ariffin et al. 2015, De Jesus et al. 2018, Trianni et al. 2013, Kumar et al. 2014, Aboelmaged et al. 2019, Jaegersberg et al. 2011) .

- Technology barriers such as complexity of green technologies, Lack of access to technical support on green manufacturing practices, Lack of flexibility in the implementation of green manufacturing practices, and Technological uncertainty
- Know-how barriers including Lack of skilled professionals to plan and implement eco-innovation, Lack of training and consultancy programs related to green innovation practices, Lack of human resources for green innovation
- Organisational barriers such as Lack of commitment from SME entrepreneur, Weak organizational structure to support green manufacturing practices, Lack of corporate social responsibility for green manufacturing practices.
- Market barriers including Market risks and uncertainty, Lack of customers' responsiveness towards green products, and Lack of favorable market environment in competitive, media, advertisement, etc.
- Financial barriers such as High change over costs from traditional to the green system, Existence of sunk costs in green manufacturing which can cause organization to incur losses, High cost of green certification/verification which disproportionally penalizes small organizations, Unavailability of bank loans to promote green practices, and Lack of access to government subsidies and financial incentives.
- Cultural barriers especially lack of awareness and efficient communication and information sharing in value chain about the existing service offerings on green manufacturing in the ecosystem and the stakeholders that could offer the services as well as Lack of platforms and forums for SMEs to discuss problems related to green innovation
- Policy barriers such as Difficult communication between SMEs and Policy-makers and under-representation of SMEs in policies and strategy development

2.2. Pilot plants and technology infrastructures for green manufacturing

The traditional concept of “Pilot Plant” entails the generation of a pre-commercial production environment “smaller than a full-scale production plant” in order to test and learn about a new manufacturing technology and/or new technology-based products processing prior to mass-production. In this regard, traditional Pilot Plants usually are generated by large private companies, focusing their activities on a very concrete application and market, or sometimes used for training internal personnel.

Lately though, a new meaning for “Pilot Plant” has emerged in Innovation Policy circles, evolving such specific purpose into a broader concept of “Open physical facilities” to validate and up-scale promising research projects results and innovative technologies in an extensive applicative domain, facilitating their industrialization and final access to the market. This openness refers to their accessibility by all market players as independent managed assets, which enables SMEs to use such facilities without the traditional

cost-investment barriers, and transform Pilot Plant into strategic promoting tools for regional industrial innovation and competitiveness inducers for sectorial value chains.

The Pilot Plants will also integrate highly skilled and educated personnel to run them, servicing the industry players and R&D actors on their field, aggregating knowledge on multiple competences (technology, business and innovation), connecting and transforming the value chains, and stimulating innovative industrial environments.

These infrastructures are still mainly a missing link for the innovation ecosystem to properly function and have a strategic role to cover the gap for transforming R&D investments into market and societal impacts, the so-called “Valley of Death” that hinders mostly EU competitiveness. This role links Pilot Plants and technology infrastructures at EU framework with the ongoing push for Regional Innovation Specialization under RIS3 (*) or transnational-regional innovative actions like S3P for Industrial Modernisation from DG Regio(*) and Vanguard Initiative (*). Moreover it also connects them directly to similar or related concepts currently used by European Agencies such as Open Innovation Test Beds for nanotechnologies and advanced materials promoted by DG RTD(*), or Innovation HUBs by DG CONNECT (*).

Regarding Green Manufacturing as a new field for innovative manufacturing technologies that have to compete and economically outperform traditional methods while being much more sustainable, such Pilot Plants are essential to test, validate and transfer disruptive solutions to the market.

2.3. The collaborative innovation ecosystem for green manufacturing

Nowadays the ability to generate knowledge and its transfer to the knowledge users is quite essential for the competitiveness and growth of organizations, especially companies and industrial stakeholders. There isn't a single entity that integrates all the resources and competencies needed to innovate constantly. This is why innovation ecosystems play a crucial role to support the regional stakeholders in being at the front border of competitiveness.

According to one of the latest definitions by Reynolds and Uygun (2018), an “innovation ecosystem refers to the economic relationships between actors (university faculty and students, entrepreneurs, industry leaders, government officials) and entities (market and non-market organizations) whose functional goal is to enable innovation. Innovation ecosystems can be seen as “inter-organizational, political, economic, environmental, and technological systems through which a milieu conducive to business growth is catalyzed, sustained, and supported”. Each region presents a unique regional innovation ecosystem according to its regional features, among them the population, the regional funding schemes, the regional initiatives to promote innovation, the level of industrialization, or the sectors of specialization.

Concretely, some of the European regional innovation ecosystems have been influenced in the last years by the definition of the regional Smart Specialization Strategy and its roadmap of implementation due to the creation of new value chains that respond to the regional needs in line with European Directives. This process has led to the reorganization and improvement of regional innovation ecosystems in European

regions, for instance, grouping entities according to identified interests and giving new responsibilities and roles to intermediate organisations that group different agents of new value chains, such as clusters.

Manufacturing, in particular advanced manufacturing, is a pillar of the Smart Specialisation Strategy in many European regions. Specifically, green manufacturing has been identified as hot topic for competitiveness in many regions for the next years. For this reason, several European initiatives have been put in place to support the successful uptake of advanced manufacturing by companies under the light of Smart Specialisation Strategy. The most relevant ones are Vanguard Initiative (mentioned before), and the Smart Specialisation Platform for industrial modernisation (a tool which combine smart specialisation and interregional cooperation to boost industrial competitiveness and innovation). Both initiatives have two aspects in common:

- (i) The identification and implementation of regional advanced infrastructures (pilot plants) based on the Smart Specialisation Strategy.
- (ii) The role of clusters and technology centres as facilitators and animators of the initiatives and, consequently, of the regional innovation ecosystem.

Pilot plants have emerged as technological infrastructure in the region that could be perceived as a spot where companies, especially SMEs, can have access to the latest advanced manufacturing technologies to understand and test them (prior to uptake). Moreover, pilot plants can be considered as the infrastructure to facilitate collaboration for innovation among different regional stakeholders such as companies, RTOs and universities. This highlights the strategic relevance of pilot plants in a collaborative innovation ecosystem. Obviously, they need huge investments to be regularly upgraded with the aim to maintain a leading position in Europe. That is why pilot plants should be in line with the regional Smart Specialisation Strategy and regional authorities should support their existence and establish the link at policy level with other European regions.

On the other hand, clusters and technology centres have adopted an important role as animators and orchestrators of the regional innovation ecosystems and the initiatives promoted in the regions to boost competitiveness. The success of an innovation ecosystem significantly relies on the fruitful and effective collaboration among agents taking part of it. However, collaboration doesn't simply appear. There are certain organizational mechanisms that need to be put in place in order to foster and boost the collaboration. In this context clusters have appeared as the ideal intermediaries which facilitate the constant convergence of knowledge and facilitate the exchange and transfer of knowledge throughout the ecosystem on a regular basis.

Not all the European regions have the figure of clusters in their innovation ecosystem and when they have it, sometimes clusters are not structurally prepared to lead these activities. For this reason, other similar entities that group different agents of the ecosystem within a value chain can perform the activities of a cluster as well.

In many regions, technology centres are usually the bridge between research and industry. This makes them a key actor of the regional innovation ecosystem and an ideal partner to coordinate the pilot plants thanks to their advanced knowledge in applied research. In some occasions they also act as animators of

the regional innovation ecosystem, performing the role of a cluster, due to the broad reach of different entities they usually have.

2.4. Pushing green manufacturing innovation within the innovation ecosystem and through trans-regional cooperation

Under the light of Smart Specialisation Strategy, many European regions move on to establish a momentum to facilitate uptake of advanced manufacturing technologies, in particular green technologies. However, such a shift is not feasible without considering the integrated value chain perspective in Europe. In this regard, an inter-regional collaboration among different regions would facilitate not only the transfer of knowledge from service providers to service users, but it also generates more opportunities to create a critical mass and provide tangible added values for European industry to be competitive at the global scale.

The trans-regional cooperation among different actors of the regional innovation ecosystems, facilitated by clusters and other intermediaries, would also foster the process of design of a European network of pilot plants to facilitate the implementation of green manufacturing. Such a network of pilot plant will be a trans-regional network of infrastructure for green manufacturing in different regions which links key stakeholders and capabilities across regions, create inter-regional critical mass and provides opportunities for collaboration by gathering different parts of the value chain for green manufacturing from all over Europe. The Efficient and Sustainable Manufacturing pilot of Vanguard Initiative, follows such an objective.

Establishment of such a network requires a structured and standards methodology that can be implemented by clusters and intermediaries of regional innovation ecosystems in order to create a critical mass in the region around the strategic relevant topics for green manufacturing. Such a consolidated critical mass, in the format of a working group, is the core motor of the regional ecosystem to design and implement pilot plants for green manufacturing that could satisfy the specific needs of the companies in the region.

2.5. GREENOMED project and trans-regional collaboration for green manufacturing

Several instruments at European level are designed to promote the inter-regional and trans-national collaboration in Europe. Interreg is one of the key instruments of the European Union supporting cooperation across nations and regions. Its aim is to jointly tackle common challenges and find shared solutions. Within the frame of Interreg initiative, the Interreg MED is a transnational European Cooperation Programme for the Mediterranean area which brings partners from 13 countries across MED regions together. The main objective of the Interreg MED Programme is to promote sustainable growth in the Mediterranean area by fostering innovative concepts and practices and a reasonable use of resources and by supporting social integration through an integrated and territorially based cooperation approach.

GREENOMED project has been developed and funded as a modular project in the frame of interreg-MED programme and under the theme of Green Growth. The main objective of the project is to foster green manufacturing in MED regions through design and implementation of a network of pilot plants for green

manufacturing. To do this, GREENOMED tests a methodology that is designed to be implemented by clusters and intermediaries in order to conceive the pilot plants as the required technological infrastructure for uptake of green technologies, under the light of Smart Specialisation Strategy.

3. GREENOMED cooperative transnational methodology

The establishment of a structured and shared transnational cooperation methodology will support companies and the other actors of the ecosystem to overcome the challenges and the barriers foreseen in cooperation actions. Indeed, it allows to have a common framework in which develop regional activities and connect regional ecosystems. Recently, also the European Commission recognized the benefit of defining a methodological process to guide and support the establishment of interregional investment projects formalizing a methodological manual for the thematic partnerships established in the framework of S3Platform. However, while it is more focused on the partnership journey toward investment and addressed to regional authorities as well as partnership coordinators, GREENOMED methodology and its handbook are designed for Clusters and other intermediaries providing guidelines for the creation and management of regional working groups that will be involved in interregional pilot plants projects.

3.1. Why GREENOMED methodology

The methodology formalized by GREENOMED was conceived and firstly applied in the frame of Vanguard Initiative, to allow the identification and development of pilot plants strategic projects through an interregional bottom-up approach. In particular Lombardy and Catalonia, as co-leader of the ESM-Efficient and Sustainable Manufacturing pilot applied a structured trans-regional cooperation process, governed by clusters aimed at i) bottom-up identification of companies priorities; ii) clustering of priorities and identification of synergies and complementarities among different regions; iii) creation of European working groups for the development of interregional pilot projects; iv) development of pilot projects business plan and implementation. The formalization and diffusion of such a structured process will allow the systematic exploitation of regional synergies to conceive and implement innovative technologies and practices in different areas. Accordingly, GREENOMED has developed a set of guidelines and tools to be transferred to other regions and stakeholders for the definition of interconnected network of regional pilot plants that will exploit local smart specialisations to provide services for the diffusion of innovative solutions in different fields (i.e. Green Manufacturing)

Summarizing, GREENOMED methodology can provide to its users:

- Tools and services for involving companies, especially SMEs, in interregional networks and let their priority needs emerge
- Structured approach for identifying and exploiting synergies and complementarities of different regions
- Guidelines and methods to raise awareness on regional authorities and transfer them companies needs as well as engage them in strategic interregional projects

3.2. Users of GREENOMED methodology

The main target users of the GREENOMED methodology are:

1. Clusters and other intermediary organisations that coordinate regional innovation eco-system (companies, RTOs, policy makers, etc.) and act as facilitators and intermediaries to link different types of

stakeholders. Being the direct users of the GREENOMED methodology they will implement step by step the phases of the methodology, using its tools to provide the defined services to regional stakeholders.

2. Companies, RTOs and universities will be involved as actors of the ecosystem in the implementation of the methodology. They will be guided by clusters or intermediaries in each step exploiting the benefit of the services they will receive.

3.3.The GREENOMED methodology

3.3.1.Main phase of methodology

The GREENOMED methodology (Figure X) consists of seven of phases which specify the process and activities that should be implemented by clusters.. Through each phase clusters or intermediaries will offer services to the regional stakeholders, exploiting a set of tools defined for each phase of the methodology

Phase 0- Vanguard framework setting: Considering the final goal of GREENOMED to design and implement inter-regional pilot plants for green manufacturing, achieved within the framework of Vanguard Initiative, a clear understanding of this initiative is a crucial. Accordingly, as starting step, clusters and intermediaries will raise awareness about Vanguard by explaining to regional stakeholders its history, goals and state of the art.

Phase 1- Identification of key topics for pilot plants: When the substantial information about Vanguard Initiative as the EU framework for inter-regional pilot plants is provided in phase 0, stakeholders will go on with identification of key topics for pilot plants, using either a bottom-up approach (triggered by industrial stakeholders and RTOs) or a top-down approach (triggered by the existing strategic and political initiatives in the region). The topics identified in this phase have to be aligned with the the regional Smart Specialisation strategy of the region and they will pass through a preliminary check with Vanguard network to verify the coherence with the scope and the goals of the initiative Indeed, Vanguard pilot leaders provides each region a feedback on the proposed ideas in terms of: 1) general alignment with Vanguard vision and goals, and in particular with the existing pilots domains 2) synergy and complementarity of the proposed ideas with respect to the ongoing demo-case projects.

Phase 2- Establishment of regional core groups: Once defined the focus topic(s), the core teams of stakeholders that will further develop the ideas for pilot plants will be created. The core groups have the responsibility of preliminarily describing the ideas in order to communicate them to policy makers and other potential stakeholders as well as to prove the relevance of the ideas proposed. These groups should be heterogeneous and involve representative of industries, research and associations. In this phase, clusters have the role of guiding the creation of such groups pushing the participation of key stakeholders.

Phase 3- Motivating ideas: After their establishment, the regional core groups are required to motivate the relevance of the proposed ideas in terms of:

- Innovation relevance and potential impact for the regional industry and for Europe;
- Regional capability to develop pilot plants;
- Synergy/complementarity with other ongoing projects.

After this phase the regions will go through a second check-gate where they will receive a go/no go feedback from Vanguard. Vanguard will assess detailed ideas motivation and provides a go/no go feedback with respect to:

- General Vanguard ESM goals and vision;
- Synergy/complementarity/overlapping with other on-going projects;
- Overall strength of the idea;
- Capability of the Region and alignment with specialization.

Phase 4- Consolidation of regional working groups: While the regional group receives a positive feedback from Vanguard, it will proceed to phase 4 where the core group contacts and integrates additional stakeholders around the pilot ideas in order to create and consolidate a stable regional working group sharing a common strategic interest. The working group should have a significant critical mass to represent regional interests in front of authorities as well as a structured and stable governance identified with one or two people from academia and/or industry who lead the group with the support of the cluster or other intermediaries.

Besides the feedback on the alignment with Vanguard Initiative in terms of vision, objectives and topics addressed, Vanguard representatives will communicate to the groups if their idea can be integrated in on-going demo-case projects. In that case the working group will be supported in joining a specific projects through the following steps:

Phase 5.1- Design of regional pilot plant node: the regional working group will design the regional pilot plant concept in coherence with the network configuration and the designed proposed by the other Regions in the demo-case. The design will be focused on:

- Thematic scope of the pilot node
- Technologies
- Services offered to companies
- Mapping of existing facilities and infrastructures
- Novelty compared to the state of the art
- Linkages with other Vanguard pilot nodes

Phase 6.1- Business plan: After the design phase, the Working Group will proceed with development of a business plan for the implementation of the designed pilot node. The generated business plan addressed different topics including:

- Implementation work plan;
- Future business model of the pilot plant, in coherence with the business model of other regional nodes;
- Financial needs at Regional, National and EU level;
- Investment plan with the indication of private co-funding
- Sustainability analysis;
- Risk analysis.

Phase 7- Implementation: Finally having the design and business plan of the pilot plant, the working group works at the implementation of the pilot node assisted by Vanguard and exploiting the financial support that could be available at Regional, National and EU levels.

In case, after phase 4 of consolidation of regional working group, Vanguard evaluates the pilot idea is a new to its network and not suitable to be consolidated with other demo-cases. , the working group will go through the following steps:

Phase 5.2- New concept note: The working group elaborates a formal concept note to be presented to Vanguard in order to motivate the new concept and to aggregate other Regions around the idea. This document will be also very useful to further details the pilot plants idea highlighting the alignment with S3 strategies, objectives and expected impacts.

Phase 6.2- Involving other regions: Once the new concept note is defined, the working group proposes it to other Vanguard Regions in order to create a critical mass of participants around the new demo-case. In case the concept is interesting for some non-Vanguard Regions, it would be possible to include them by formalizing their position with the Vanguard association. Accordingly, non-Vanguard Region can be supported in the dialogue with the Board for their admission as formal member or observer.

When the required critical mass is reached, the working group follows the phases 5.1, 6.1 and 7 to design the regional node, develop the business plan and eventually implement the pilot plant.

3.3.2.Cluster services and tools

Clusters and intermediary organisations, as the direct users of the GREENOMED methodology, will support its implementation providing a set of services (Figure X) to regional stakeholders. While some of them will be offered during the whole implementation phases, some others are very specific and they will be offered only in some phases.

A set of sub-service are defined for each of the 8 macro-services.

Service I: Communication and awareness raising on Vanguard/pilot plants

As the coordinator of the regional eco-system, clusters will provide information about Vanguard Initiative and the concept of pilot plants to different stakeholders of the regional innovation system. It is specifically important to raise awareness about VI and pilot plants among companies, RTOs and regional authorities considering the focal role of these stakeholders in the regional working groups in future steps. In particular clusters will offer the following sub-services:

- SI1- Vanguard Communication campaign: clusters will organise raising awareness and communication campaigns to inform regional stakeholders about Vanguard, its context, how it works, potential benefits for regional stakeholders to become a Vanguard member, etc. The campaign can be managed through different channels to reach different types of stakeholders such as GREENOMED website, social networks, bi-lateral meetings, workshops, etc. They will also use their internal newsletters, website and other communication channels to publish about Vanguard.
- SI2- Dedicated Vanguard meeting organization: Clusters can raise awareness about VI by organising meetings to explain the initiative in detail to regional stakeholders, especially to companies and RTOs, presenting also the existing the pilot nodes and demo-cases.
- SI3- Press release: Clusters will exploit social media (TV, radio, newspaper, etc.) to publish information about Vanguard and pilot plants.
- SI4- Invitation to Vanguard meetings and events: Clusters will invite regional stakeholders in particular companies, RTOs and other intermediaries to attend Vanguard events and meetings where they can get detailed information about activities and operations of different demo-cases, and getting in contact with the acting members, discovering the potential benefits of pilot plants for their regions and potential opportunities for regional stakeholders.

- S15- Meeting with Regional Authorities: Clusters will organise meetings with policy makers and regional authorities to diffuse information about Vanguard and explain the potential opportunities that pilot plants could bring to regional industrial stakeholders to have access to innovative technologies. In particular, this will be strategic to establish the background to involve regional authorities in next phases of the methodology ensuring their support for designing and implementing pilot plants in the region. Moreover, during these meetings, regional authorities can be informed about the formal procedure for becoming Vanguard members.

Supporting tools:

- TI1- Vanguard presentation
- TI2- Vanguard website
- TI3- How a region becomes a Vanguard member
- TI4- Vanguard white paper
- TI5- Pilot concept note

Example of service within GREENOMED

To be added in the final version

In which phases the service should be offered?

The first macro service S1 and its sub-services will be offered as an ongoing activity during all the phases of the GREENOMED methodology in order to raise awareness about Vanguard and pilot plants.

S II: Regional mapping

One of the first steps to design pilot plants is to have a concrete and clear view of the regional innovation eco-system and its actors. Clusters, as the intermediaries, should be involved in creating this view by mapping regional stakeholders and the services that they offer as well as their competences and capabilities. Such a mapping should be started to support the generation of a new pilot plant idea and it should be continuously updated. Such a mapping will be crucial to identify the most relevant stakeholders of the ecosystem and transfer them the information about Vanguard and pilot plants ideas, engaging them

in the regional core groups activities. The mapping is essential for an effective execution of the methodology and its should be started since the very beginning. Indeed during phase 0, it supports clusters in the identification of suitable stakeholders for setting the framework, and preparing an efficient communication campaign. Then, during phases 1 and 2, it allows the cluster to keep track of stakeholders which expressed interest in one or more of the topics, and therefore support the creation of core interest groups. During phase 3, it allows the cluster and each core group to keep track of the changes in number and commitment of stakeholders supporting each idea. It is also useful in planning a data-gathering campaign (ask reports, execute expert interviews, meeting interpreters, etc.). During phase 4, it allows each WG to keep track of possibly interested, old and new stakeholders, and to manage better their operating activities

The following sub-services can be considered for regional mapping.

- S II1- Continuous mapping of regional stakeholders: Clusters should identify the players and stakeholders of the regional innovation system such as companies, RTOs, universities, associations, policy makers, business support organisations, etc. along with services that each of these stakeholders offer. Having this information clusters can create a map of regional stakeholders and their capabilities. The mapping should be updated on a regular basis.
- S II2- Inter-regional benchmarks:
- Mapping of Regional champions: During the mapping process, clusters should identify the most important and pioneer stakeholders in the region to target them for communicating Vanguard, pilot plants and GREENOMED methodology, to invite them in the regional testing events and later on to involve them in regional core groups to design and implement pilot plants for green manufacturing.

Supporting tools:

- T II1- Common methodology for mapping
- T II2- Inter-regional mapping tool

Example of service within GREENOMED

To be added in the final version

In which phases the service should be offered?

The first macro service S2 and its sub-services will be an ongoing service offering starting from the phase 0 and will continue till Phase 5 when the regional nodes will be designed.

S III: Regional orchestration for the identification of strategic topics within the Region

During phase 1 of the GREENOMED methodology, clusters should support and facilitate identification of key topics in the region. The key topics can be identified using a bottom-up or top-down approach. In both cases, clusters play a crucial role to come out with the most relevant topics for regional stakeholders. In the case of a bottom-up approach, clusters should organize the events with regional stakeholders and moderate the discussion in the events where different stakeholders express their needs and interests. In the case of top-down approach clusters should set the background to identify the already strategic topics in the region which have been already expressed by regional authorities and according to the capacity of the region and needs of the stakeholders.

In particular clusters will offer the following sub-services:

- S III1- Top-down topics identification: In the top-down approach, cluster will analyse the regional S3 documents to identify the regional priorities. Thereafter, the cluster will extract the key general topics for green manufacturing in the region. They will also interact with regional authorities to get aligned with their perspectives about the strategic topics at regional level.
- S III2- Strategic workshop organisation (bottom-up topics identification): In the bottom-up approach, cluster will do the same analysis of the regional S3 documents to come out with the regional priorities. Afterwards, the cluster will organise events/creative workshops involving regional champions and other relevant stakeholders to provide a platform where they can discuss about their interests and needs. During the event, cluster will moderate the discussions so that at the end the key topics can be identified by stakeholders also by using some tools such a survey to identify topics (see T III5).
- S III3- Elaboration of document with preliminary topics: Using the results of workshops, surveys and regional S3 documents; the cluster will generate will generate a document of preliminary topics to do the first check with Vanguard and set the basis for the creation of the working groups.
- S III4- Interaction with Vanguard to check alignment of topics: The cluster will share the document of preliminary topics with Vanguard to receive the feedback about the suitability of proposed items and to understand the most-relevant topics to go on with creation of core groups.

Supporting tools:

- T III1- Common method to identify key topics
- T III2- Creative workshop format
- T III3- Presentation of Vanguard demo-cases
- T III4- Concept notes of ESM Demo Cases
- T III5- Questionnaire/survey to identify/validate topics
- T III6- Regional S3 documents

Example of service within GREENOMED

To be added in the final version

In which phases the service should be offered?

Clusters will start offering the orchestration service from phase 1 when the activities to identify the main topics for pilot plants will be initiated. Thereafter the service will be continuously offered by clusters during phase 2 and 3 for setting up of the regional working groups and motivating the identified topics.

S IV: Set-up and animation of regional Working Groups

While the key topics are identified, clusters should go on with creation of a working group consisting of a number of key regional stakeholders that shape the core group. The cluster should act as the moderator and animator of this working group during the following phases of the methodology. The animation of WG is a continuous service that to be provided by clusters in different phases of methodology especially during motivating ideas and consolidation of WGs. The more detailed sub-services are:

- S IV1- Set up of Working Groups (WGs): Once the key topics are generated, the regional Cluster gathers together a number of champion stakeholders including innovative companies, universities, and RTOs to set-up the regional WG. Each working group is focalized towards one particular thematic, which has to be relevant for both research and the industry. The theme of the WG should be aligned with the regional S3 and with the Vanguard Initiative topics.
- S IV2- Animation of WGs: The cluster, as the intermediary, will act as the animator and moderator of the regional WG and it is responsible for orchestration of the WG. The cluster identifies the strategic thematic area, and put in place a process to appoint the coordinators for WGs. It also gives operative support to the working group activities and ensures the smooth operation of the WG to move to the next steps of the GREENOMED methodology.

Supporting tools:

- T IV1- WGs mission and rules document
- T IV2- Standard agenda format of WG meetings
- T IV3- Stakeholder register of attendants template
- T IV4- Resources to animate WGs
- T IV5- Examples and best practices from existing WGs

Example of service within GREENOMED

To be added in the final version

In which phases the service should be offered?

Clusters will start offering the setting up and animation service from phase 2 when the activities to establish the regional working groups start. The service will be an ongoing activity till the final phase of the methodology.

S V: Coaching of WG to design Regional pilot plants

Once the regional WGs are established, the identified topics are motivated and eventually a consolidated working group has been formed, the cluster should continue its animation activities to support and coach the WG to design the pilot plants. In particular clusters are expected to offer the following sub-services:

- S V1- Design of topic node supported by regional mapping: The cluster will support regional WG to transform the identified topic to the form of a pilot plant node. This could be a design of a regional node of an already existing pilot plant in Vanguard or it could be design of a regional node for a new pilot plant with a new topic that already doesn't exist in Vanguard.
- S V2- Design of interactions with other regional pilots: The cluster should establish and facilitate the interaction of WG with other regional pilot plants in order to generate the required base to integrate the new regional node to Vanguard. If the new regional node is supposed designed within a topic of an existing pilot plant, the cluster should create effective interactions with other regional nodes of the pilot plant in order to facilitate the integration of new regional node. If the new regional node is supposed to be a part of a new pilot plant, the cluster should actively establish very effective interactions with other regions with potential capacities that could be eventually for other nodes of the new pilot plant.
- S V3- Business Planning: While the pilot plant is designed, the WG should proceed with development of a business plan for the implementation of the designed pilot node. During this phase, the cluster should effectively support the WG to generate a proper business plan that could ensure acquirement of funding for implementation of pilot plant. The cluster should support WG to define future business model of the pilot plant, ensure its incoherence with the business model of other regional nodes, define financial needs at Regional, National and EU level, and present a sustainability and risk analysis.
- S V4- Implementation plan: The cluster should also support the WG to define clear phases of implementation of the designed pilot plant, required resources to do that from financial, human and infrastructure point of view, and expected targets.

Supporting tools:

- T V1- Guidelines for ESM demo-cases
- T V2- Pilot design format
- T V3- Pilot business plan format
- T V4- Maps of companies and actors in the Region
- T V5- Formats for letter of intents

Example of service within GREENOMED

To be added in the final version

In which phases the service should be offered?

This service will start from phase 3 to initiate the activities in order to motivate identified topics and will be a continuous service till the final phase of the methodology.

S VI: Service for internationalisation of WG

Improving, promoting and internationalisation of the regional WG is a continues activity of the cluster. This is especially important during the design phase of the pilot plant. In particular clusters are expected to deliver the following sub-services:

S VI1- Benchmark with other WGs: The cluster should collect information and documents from other regional WGs especially the most advanced ones, to analyse their operating process and make a benchmark in order to improve the new regional WG.

S VI2- Contacts and meetings with other WGs: In order to promote the regional WG and establish links with other regions, the cluster should organise meetings and events to establish interaction between the regional WG and other WGs in other regions. This can take place in the form of site visits, matchmaking events, etc.

S VI3- Organisation and animation of interregional cooperation and matchmaking events: cluster should support the organisation of interregional events and matchmaking leveraging on their network established within cooperation projects. Indeed, this activities can promote the matching among complementary and/or synergic stakeholders resulting in a value added for the pilot projects

Supporting tools:

- T VI1- Contacts and references of organisations and initiatives supporting inter-regional cooperation
- T VI2- Collection of documents and presentations of WGs in other Regions
- T VI3- Interregional events format (workshop, matchmaking, site visit)

Example of service within GREENOMED

To be added in the final version

In which phases the service should be offered?

This service will start from phase 4 to initiate the activities in order to consolidate the regional WGs and will be a continuous service till the final phase of the methodology.

S VII: Support for the identification of funding for pilot plant projects

As the intermediaries of the regional innovation system, the cluster has a critical role to promote and advertise the design of pilot plant to other regional stakeholders in order to acquire funding for implementation of pilot plant. Moreover, cluster should provide the regional WG with an overview of the existing funding mechanisms that they can base the business plan on them and potentially use them for implementation phase. In particular the cluster is supposed to deliver the following sub-services:

- S VII1- Diffusion of available funding opportunities at EU, national and Regional level: One of the main activities of clusters is to provide an extensive mapping of existing funding opportunities for regional stakeholders. Regarding the regional WG, clusters should map and analyse the existing funding opportunities that can be exploited by the WG to design and implement of pilot plants. These funding opportunities could be at regional, national or EU level. Based on the identified funding opportunities, the most suitable ones will be chosen and further analysis will be done to understand the mechanism to acquire the opportunity and include it in business plan.
- S VII2- Support in the identification of funding mix: As the intermediary of the regional eco-system, clusters have an extensive overview of different types of available funding mechanisms including public and private funding. Thus they can guide the WG to shape the most suitable funding mix taking into account the existing opportunities.

- S VII3- Presentation of pilot ideas to funders and stakeholders: Clusters should promote and advertise the designed pilot ideas to potential funders and stakeholders to acquire required funding as well as engaging critical stakeholders to get their support for design and implementation of pilot plants.
- S VII4- Lobbying with Authorities: Clusters should establish an effective link with regional and national authorities to promote the pilot plant idea and acquire their commitment and support for implementation of the pilot plant and regional node.

Supporting tools:

- T VII1- Presentation of the concept of mixed funding model
- T VII2- Mapping of EU Calls suitable for demo-case funding
- T VII3- Presentation toolkit for lobbying

Example of service within GREENOMED

To be added in the final version

In which phases the service should be offered?

This service will start from the beginning phase of the methodology and will be a continuous service till the final phase of the methodology.

S VIII: Support for the definition of a new demo-case and proposal to Vanguard pilot

In case that the identified topic for the demo case is a new topic which already does not exist in Vanguard, the regional WG should present the idea of a new demo-case to Vanguard and upon receiving the approval from VI, it can go on with design and implementation of a new pilot plant. In such a scenario, clusters should support the WG intensively to define the new demo-case concept as to promote and present the new pilot plant idea to Vanguard in order to acquire its approval to go on. In particular the cluster should provide the following services:

- S VIII1- Coaching in the elaboration of the new demo case concept: The cluster should support and coach the regional WG in defining and elaborating the new demo-case concept making sure it provides the expected value proposition to be presented to Vanguard. Moreover, it should identify the state-of-the-art of other existing capacities in other regions that could potentially engage and shape the other regional nodes of the demo-case.

- S VIII-2 Interaction with Vanguard for its proposal and follow-up: While a concrete concept note of the new demo-case is prepared, the cluster should propose it to Vanguard and promote its potentiality to be included as new Vanguard pilot plant.

Supporting tools:

- T VIII1- New demo-case proposal format
- T VIII2- Collection of existing demo-case concepts as a benchmark
- T VIII3- Manufacturing observatory in the Region

Example of service within GREENOMED

To be added in the final version

In which phases the service should be offered?

This service will start in the last phase (Phases 5.2 and 6.2) of the methodology to support the regional stakeholders in design the new concept node and involve other regions.

Figure xx shows a summary of all the tools developed within the GREENOMED methodology.

4. Implementation stories by clusters in different MED regions

4.1. Marche Region, Italy

Marche is one of the most specialized and craft regions in Italy, one of the most industrialized in Europe, ranked 16th for GDP among the 272 EU Regions. It holds the national record of the production centres, hosting leading companies that are complemented by small companies in manufacturing sector. Marche's economy is mostly based on clusters of SMEs ("distretti industriali"), working in traditional manufacturing sectors (e.g. typical Made in Italy products such as shoes, clothing, electric appliances, machinery, furniture etc.) distributed through the region (European commission). Marche productive model is also recognised as a successful model, which is able to attract important national and international brands. The strong entrepreneurial attitude, the manufacturing tradition (especially in footwear, furnishing, mechanic), the handcraft and intellectual know-how are the competitive success factor of Marche manufacturing sector, characterised by a large and widespread network of SMEs. In the last few years, the green manufacturing topics received considerable attention worldwide and in line with this trend Marche Region is paying particular attention to the topics focusing on the development of methodologies and solutions aimed to support the design and implementation of efficient and sustainable production system.

Besides its strong manufacturing focus, Marche Region is working on the improvement of its innovation ecosystem, with the aim to create a strong regional network composed of a variety of stakeholders and capable of exploiting the opportunities coming from interregional collaboration and capitalise them to ensure companies growth.

4.1.1. Implementation of Greenomed methodology

GREENOMED has been recognised as an opportunity to implement a structured approach for establishing and orchestrating a regional ecosystem seeking innovation opportunities and leveraging on the engagement of the Regional Authority.

ACMM, as cluster for advanced manufacturing in Marche region, started its dialogue with the Regional Authorities in order to raise awareness on Vanguard Initiative, focusing on the governance, the activities and the benefits for regional stakeholders especially companies. To this end, several events were organised to gather regional stakeholders and inform them about the ongoing project and the Vanguard Initiative purpose and benefits. Once the Vanguard Initiative was properly spread and the interest of an initial group of stakeholders was gathered, ACMM started the process for the identification of key topics for pilot plants within the regional territory, by adopting a bottom up approach through innovative workshops with regional stakeholders. Thanks to the involvement of regional stakeholders 3 topics of interest emerged: **i) De- and re manufacturing**, with the goal to understand how to recycle and re-use the production waste from different manufacturing sectors, including the waste of composite materials and convert them into revenues through the development of a Pilot Plant; **ii) Waste treatment and recycling**: with a particular focus on special and dangerous wastes. **iii) Energy efficiency**.

Having these key topics clearly outlined, regional core groups around these thematic were established and animated to better define the sub-topics to be developed according to the industrial needs and interests emerged. In this phase **GREENOMED methodology and its tools** were crucial to support ACMM in the orchestration of the groups. Moreover, the proper **identification of key stakeholders was strategic** to ensure the critical mass necessary to define the group strategy and sub-topics development. This action was started through a preliminary online call for expression of interest among ACMM associated partners and then formalized through letters of intent. ACMM is constantly working to collect the commitment of other interested companies to extend the established working groups and to further increase the stakeholders committed to the innovation ecosystem. However, while two of these groups were successful and collected the interest of a number of stakeholders, the energy efficiency topic encountered some difficulties in being developed further by the actors involved and so the efforts were focused on De-and Remanufacturing and Waste treatment and recycling.

Alongside the establishment of the working groups, ACMM worked hard to motivate ideas by organizing regional meetings during which the overall objective of the working groups were clarified. Accordingly, concrete actions have been identified to be realised within the working groups and start formalising some ideas and concepts based on the regional competences and the industrial needs emerged. Thanks to a first mapping exercise, a detailed overview of the topics has been elaborated with the identification of related key technologies and possible developments as well as barriers and needs emerged when it comes to the industrial applications.

4.1.2. Main results

One of the main critical concerns regarding Marche innovation system includes the low capacity of the region to invest in R&D. In fact the poor infrastructure facilities and the low level of investment in R&D affect adversely the competitiveness of the Region (European Commission). The implementation of the

GREENOMED methodology let us move forward with the **consolidation of the innovation regional ecosystem, which was disaggregated at the beginning**. By adopting a bottom up approach and by involving several actors: universities, research centres and local stakeholders, ACMM succeeded in identifying the key topics to be developed in alignment with the stakeholders needs and keep them engaged to the working group activities ensuring the development of its content.

Being part of an interregional network, which is implementing the same structured methodology aiming at the same achievements facilitates a constant identification of synergies among the working groups operating at regional level and establishes key links to empower interregional collaboration. For instance, **ACMM connected its “De and Remanufacturing” working group with the counterpart orchestrated by AFIL in Lombardy** and coordinated by Professor Marcello Colledani. This connection, facilitated by the absence of cultural and language barriers, has started with a bilateral meeting in Milan between the groups coordinators and a visit to the Living Lab in STIIMA-CNR. The collaboration will be further expanded thanks to the organisation of interregional working group meetings involving the stakeholders of the two regions.

Following the example of Lombardy partners, ACMM has identified a laboratory of Università Politecnica delle Marche to be involved in the working group as Living Lab. This allowed to complement the ecosystem with a collaborative environment where companies can access advanced technologies and competences to boost innovation in green manufacturing.

From the political perspective, ACMM promoted the participation of their Regional representatives to GREENOMED Political meeting, giving them the opportunity to better understand the challenges experienced by stakeholders when it comes to the implementation of green manufacturing innovations and discuss on the instruments that can be provided by Regional Authorities supporting to overcome the barriers emerged. Moreover, to obtain a stronger engagement of the Regional Authority on the key topics identified ACMM organised a regional event "Closing the Loop: Promoting Circular Economy in Marche Region", in the framework of the European Industry Days 2019, with the aim to create an optimal business environment for sustainable growth, job creation and innovation. As a result, Marche Region recognised "Circular Economy" as a priority to improve the development of the region and for the first time the Region is opening targeted regional calls on circular economy. and will continue the alignment with ACMM in order to open specific trajectories on circular economy for the next Programme 2021-2027.

4.1.3.Lessons learnt

From the activities implemented through Greenomed, several lessons and recommendations can be exported:

- **Identify carefully the main topic for the working group:** it was fundamental to better define a specific idea to develop and engage committed companies around it.
- **Define the right coordinator to consolidate and lead the activities of the working group:** without a strong coordination the working group could not have the chance to work properly. This happened to the energy efficiency group, where the leading company decided to leave the group and the actions could not be continued.
- **Involve the regional authorities since the beginning of the process** to rise more awareness on the topic across the territory.
- **Cooperate with regional living labs** to avoid overlapping of activities and at the same time complement the groups with physical assets where technologies can be tested.

4.1.4. Main challenges

Besides the results achieved and the lessons learnt from the implementation of the GREENOMED methodology

- **Engage local stakeholders and actively involve them in the working groups.** This challenge was faced during the initial phases of testing activities and several GREENOMED tools were exploited to overcome it.
- **Involve Living Labs from the region** due to the difficulty to let them understand benefits and opportunities coming from the participation in GREENOMED project. Thanks to dedicated meetings, it has been possible to formalize the partnership with 2 Living Labs: Meccano and Università Politecnica delle Marche.
- **Raise awareness on the benefit of interregional networks to Regional authorities** Let the regional administration be aware of the benefits coming from the Vanguard Initiative and the importance of its network. Thanks to the support of the Lead Partner and the participation to events, we were able to spread more awareness around the Vanguard methodology.

4.2. Auvergne- Rhone-Alpes, France

With a GDP of 250 Billion euros, a population of almost 8 Million inhabitants and half million industrial jobs, Auvergne-Rhône-Alpes region is classified in the top 4 European region regarding advanced manufacturing. Its Research and Innovation Scheme for Smart Specialisation aims to improve the innovation ecosystem performance, with a special focus on SMEs based on 8 domains of smart specialization including two dedicated to advanced manufacturing. The first is industry of the future and industrial performance and the second is digital technologies and smart robotics. Auvergne-Rhône-Alpes region is connected with Vanguard Initiative, and also part of the “Four Motors for Europe” which gives a strategic objective on industry competitiveness and innovation capacity common with Baden-Württemberg, Catalonia and Lombardy since 28 years. Other interregional collaborations through the regional smart specialisation has been set up, with for example SILICON Europe in ICT and KETs with Saxony, East & South Netherlands or Flanders.

Within the advanced manufacturing the region has been moving towards plasronics specialisation. In concrete, there is the “City of Plasronics” project in Oyonnax, lead by a local public authority and supported by the region because the main stakeholders regarding smart plastics are located nearby in order to create a short distance innovation ecosystem. Besides, universities and laboratories are leading different collaborative projects with regional stakeholders in smart plastics for several sectors. Clusters are also taking part of the orchestration of the innovation ecosystem.

Now the region is in the process of consolidating the topic of smart plastics within the regional stakeholders, but also to get the critical mass to develop smart plastics activities in the region and out of it.

4.2.1. Actions implemented during GREENOMED

Auvergne-Rhône-Alpes became a member of Vanguard initiative in ?? (before start of the GREENOMED project). Thus the region, through Pastipolis cluster, has dedicated its main actions during the project to come out with a detailed design of the pilot plant and to increase the critical mass around its main topic identified: plasronics and smart plastics.

Thanks to the experience of the Auvergne-Rhône-Alpes region in Vanguard Initiative and having a thematic working group active in smart plastics already, the phase of identification of the topic was quite clear and

straightforward for Plastipolis. The main challenge was to involve more critical mass, mainly companies, to the initiative and the working groups. GREENOMED project provided a good opportunity for attract more stakeholders interested in the topics and to reinforce the critical mass. That is why Plastipolis organised a dedicated events to make companies, universities and public authorities understand the objectives of such a project and to make them involve in the next steps of GREENOMED. In order to strengthen the link with other regions out of France working on Smart Plastics, Catalonia and Lombardy pilot plants representatives were also present in the event.

Then, identification of key stakeholders and starting of regional working group began. This regional working group has currently ?? members that meet regularly in Plastipolis office but also in members' site. After some discussions and regarding the progress of the "City of Plastronics" and the development of other projects, for example the creation of a Master Degree "plastronics project manager" at the Lyon University (INSA of Lyon), the details of the pilot plant were defined.

In parallel, Plastipolis worked together with the stakeholders mentioned, including the extra-regional ones, to continue with the definition of the technologies that the pilot plant should have to meet the demand already identified.

4.2.2.Main results through GREENOMED

The GREENOMED pilot plant in Auvergne-Rhône-Alpes aims at offering a specific support to regional innovative key players in order to continue to develop new solutions and applications using smart plastics technologies, but also a clear vision and strategy of this topic, which is still on the edge of two worlds, the plastic industry and electronic industry. These technologies will not only be the result of regional work, but also from extra-regional partners.

As part of smart plastics activities in the Auvergne-Rhône-Alpes and GREENOMED project,, Plastipolis has achieved several results and opportunities.

First of all, Plastipolis could reach and establish the link with regional Smart Plastics ecosystem in other MED regions with the identification of collaboration stakeholders, for example with Catalonia. This has been an important benefit since previously most of activities were focused at regional level. Now there is a regular contact with Catalonia working group. Other potential collaborations may be established with other MED regions as a result of internationalisation activities under the frame of the GREENOMED methodology, and even with other regions out of MED regions.

Second, Plastipolis could extend and consolidate its regional ecosystem by attracting new stakeholders, with a focus on start-up companies, or on R&D departments of bigger companies. This has resulted in the incorporation of these new stakeholders in the regional working groups.

Finally, Plastipolis started with the GREENOMED pilot plant structuring regarding the business plan as a crucial step to capitalise the pilot plant. Currently there are all the elements to develop a concrete business plan and potential expansion strategy thanks to the consolidation of the regional stakeholders mapping and the identification of potential interregional partners. Meanwhile, the tools and best practices (from other regions) that provided in the methodology for the phase of business planning significantly support the working group in this phase.

4.2.3.Lessons learnt

The main lessons learned that came out from the participation to the GREENOMED project are mainly related to the needs of motivation of the ecosystem:

- **Improve communication:** There is a specific need for an intensive communication during all the phases of the methodology to diffuse information in particular about the short-term benefits and advantages for companies. Without such a structured communication, it will be very challenging to convince industrial stakeholders and engage them in the collaborative innovation process.
- **Improve contents of communication:** Need to define in advance the potential benefits of such a project, for example identification of potential extra-regional partners or identification of complementary skills to develop new projects
- **Satisfy companies' needs and getting aligned with their constraints:** It is very important to make sure that the activities of the working group and the emerged topics and industrial applications not only satisfy the needs of big companies but also (and most importantly) the ones of the SMEs considering that they will be the main beneficiaries of the pilot plants due to limitation in their resources to access the innovative green technologies.

4.2.4. Main challenges

Some challenges appeared to Plastipolis during GREENOMED project progress:

- The involvement of companies was quite challenging mainly because they already have their ongoing technical monitoring, activities and projects regarding smart plastics. Thus unless they do not find a tangible benefit, they will not get involved.
- Timing misalignment between important initiatives in the region. « la Cité de la Plastronique » in Oyonnax as a main hub for smart plastics was planned to be operative in 2020 and thus it was a unique opportunity to link it with the established WG and designed pilot in GREENOMED. However, the start of the project is postponed to 2022. There is still a direct connection between Plastipolis demo case and « la Cité de la Plastronique » but needs to be strengthened regarding the project time frame.

4.3. Slovenia

Circular Economy is one of Slovenia's strategic development priorities. It is closely tied to the Sustainable Development Goals (SDG's) and included in key national documents such as **A Vision for Slovenia in 2050** and **Slovenian Development Strategy 2030** as well as in Slovenia's Smart Specialisation Strategy. Sustainable and efficient manufacturing is also present in the Slovenian Industrial strategy. However, awareness of connectedness of Circular economy and Efficient and sustainable manufacturing has room for improvement.

The Slovenian Smart Specialization Strategy has 3 pillars and 9 sub-thematic areas, one of them pillars being **Circular Economy**, with 3 sub-thematic areas: **Networks for the Transition to a Circular Economy, Sustainable Food, Sustainable Tourism**. Circular economy is therefore a strong focus point of the Slovenian government in line with the Greenomed project goals.

In Slovenia, there is a **strong political commitment** and **involvement of decision makers** to promote circular economy and green manufacturing initiatives within the activities of the innovation ecosystem. In particular, Slovenia is a member of the Vanguard initiative since November 22, 2017 and from January 2019 also for the first time a Board Member, thanks to the support provided at political level. This has been in parallel with the first year of GREENOMED project which is born on the concept of Vanguard Initiative. Nevertheless, there is still room for

improvement regarding consistency and coordination between actors of S3 and policy level. Moreover, the long-term benefits of initiatives such as Vanguard and S3 should be significantly more promoted between the final beneficiaries. The impact of Vanguard and S3 platforms is already visible. However, this impact is seen due to efforts made by ecosystem and individuals' stakeholders (institutes, individual major industrial companies) than a systematic approach by decision makers on an operational level. However it needs to be stressed the decisionmakers are very committed on a strategic level as well. On the other hand several companies and stakeholders still face lack of recognition of benefits and trust issues.

4.3.1. West Slovenia

Slovenia has 2 cohesion regions – the Western and the Eastern cohesion region. Technology park Ljubljana represents the Western and Pomurje Technology Park represents the Eastern cohesion region. Traditionally the development gap between both regions has been present as the Western region is more centrally located innovation and IT oriented region industrially oriented, with better traffic connections – the region has the geographical proximity to advanced industrial Member States such as Italy and Austria. As the Cohesion regions are only in place since 2013 the exact statistical data is not available historically. In 2017 GDP per capita was 120% of national average in Western Slovenia and 82% for Eastern region. But East Slovenia is slowly catching-up with Western Slovenia, which still has a 16% higher productivity level. Altogether, when we are talking about the case of Slovenia, we are always referring to the **national level and consider Slovenia as one region.**

Trade and economy: the most important sectors of Slovenia's economy in 2016 were industry (27.6 %), wholesale and retail trade, transport, accommodation and food services (20.7 %) and public administration, defence, education, human health and social work activities (16.9 %).

The **technological and innovation profile** of Slovenia is relatively high, especially when compared with other Balkan regions. Slovenia's innovation environment is regarded as generally friendly, with strong human resources and private sector investments. What Slovenia is lacking is more focused and larger scale public funding support at national level and a stronger international market presence related to export of good and services in niche fields, commercialisation of excellent research and knowledge, innovation commercialisation. Both, the European Innovation Scoreboard and Global Innovation Index confirm that international market presence and commercialisation of knowledge can be improved. In terms of innovation and knowledge generation, Slovenia is ranked among top 50 economies in the world, with one of the highest numbers of scientific papers published, but there is room for improvement in efforts to commercialize the knowledge. By GII 2018 research Slovenia thus ranks 3rd in the world by the Scientific and technical articles per researcher but is ranked 91st when measured to the computer software spending as % of GDP. When market capitalization as percentage of GDP is concerned Slovenia ranks as 75th.

4.3.1.1. Implementation of GREENOMED methodology

TPJ got engaged as partner in Greenomed project in order to use the established momentum at policy level to spread the concept of Efficient and sustainable manufacturing through regional stakeholders and member companies, and to support the creation of integrated value chains under a trans-regional collaboration perspective. TPLJ, as a business support organization and ecosystem facilitator, has green technologies as a priority pillar in its strategy and is constantly working with member companies on encouragement to enhance sustainable practices and connecting them on an international level. Due to the market size of Slovenia, it is extremely important for TPLJ as the largest ecosystem facilitator in the country to contribute to creation of the integrated value chains.

In this sense, the main goal of TPLJ is to connect Slovenian companies and research organizations to establish Vanguard demo cases or connect the stakeholders to join an existing demo case. Using the Greenomed methodology we are testing this approach through Greenomed in order to have a better success rate in the future. To implement concretely such goals, it was necessary to connect with concrete business associations like Chamber of commerce, clusters and therefore cooperation with SRIP Circular Economy and SRIP Factories of the Future were just two of the ongoing Greenomed projects' activities.

TPJ started with the implementation of the methodology with phase 1: Vanguard Framework setting. Several events/meetings were organized with Slovenian stakeholders (including companies, SRIPs, policy makers etc.) about the opportunities of pilot plants. One of the main events was the Vanguard conference in December 2017. A Vanguard and Greenomed promotional event was organized in June 2018 with the Institut Jožef Stefan and SBRA – Slovenian Business and Research Association. Various meetings with S4 office (Slovenian smart specialization strategy), Ministry of science, RTOs and SRIPS have been organized in this phase with the aim of promoting Vanguard and aligning interests among crucial stakeholders. In Phase 2 TPLJ tried to identify key topics with the help of the revision of SRIP action plans, intense desk job preparation and a focused event in July 2018 (Vanguard demo cases presentation). Potential demo/use cases discussion was held in November 2018 where some topics have been identified within bilateral meetings – SRIP Factories of the future, SRIP Health, SRIP Circular economy, SRIP Food and several other individual meetings with companies.

In the next phase some topics have been identified (Magnets, remanufacturing of glass fibers for construction purposes and Remanufacturing of materials), but due to lack of interest, motivation, IPR and NDA issues the topics had to be reviewed and other emerging themes/topics were identified. Following the Greenomed methodology there was enough room for identification of new topics and the revision of the former topics, so this process proved to be very efficient and helpful in implementing the Greenomed results.

4.3.1.2. Implementation of GREENOMED methodology

The main benefits gained through implementation of GREENOMED methodology have been:

- Linking R&D facilities internationally for more successful implementation of state-of-the-art achievements (i.e. providing a mechanism to facilitate trans-national collaboration, enhancing the role of clusters, etc.).

- Creation of potential value chains in several economic/research field such as batteries, photonics and plasma for Industry 4.0. For this created TPLJ together with stakeholders first reviewed existing interests of SRIPs – Strategic research and innovation partnerships and organized several meetings with stakeholders to check their interest. Based on that members of value chains were invited into creation of working groups and experts were engaged to develop real business cases.
- GREENOMED opened the opportunity in the creation of value chains even outside of the field of ESM, for example health industries.
- Developing a potential to raise regional economy's' competitiveness through sustainable, innovative technologies; prospects of additional support and funding being developed and tackled.
- Stimulating more linkages between research and economy, contributing to improving the countries innovation and commercialization potential.
- Connecting regional policy level for common bottom-up initiatives reaching goals of S3/4
- Creating concrete and regionally connected instruments of support and sources on EU level ensuring impact. Based on creation of working groups and business cases in Greenomed new need were brought to the forefront, thus recommendations for policymakers developed.
- Both Slovene partners as Greenomed partners got ability to learn and obtain some tools and methodology for internationalization, by which both developed new services for their tenant companies and members and attract new ones to join.
- Significant effort was put into bringing together various stakeholder groups: policymakers, institutes, companies with the objective of facilitation dialogue on what support does Vanguard, S3 and similar transnational platforms offer, what should be/is the role of each of the stakeholder groups and furthermore facilitating collaboration and building trust of these groups that can also be competitors on the market.
- The notion of value chain creation even though very promoted in theory is not that present in the practice of the real sector. Thus, through GREENOMED methodology stakeholders were able to see their role, and the added value of such a linkage.

Meanwhile we also faced the following challenges during implementation of GREENOMED methodology:

- Companies find it hard to understand the long-term effects and impact on companies and stakeholders. Awareness raising and communication activities still need to be intensified in order to connect the right dots. Another thing is also the „trust“ issue or issues with IPR in case of cooperation, but also fragmented supply-individual approaches, lack of critical mass for EU R&D and industry absorption power.
- The companies are also lacking immediate funding opportunities/benefits for Open innovation / vouchers or sum of funds available due to specifics of Slovenia.
- A traditional economic mentality in Slovenia is also seen through the fragmentation of cluster environment. Thus, Slovenia is ranked 29th on the general Business sophistication indicator and 72nd on the State of cluster development.

- Even though GREENOMED has presented an obvious value to the Slovenian ecosystem from TPLs point of view, the fact is that with the completion of the project the continuance of such activities in jeopardized puts the credibility of partners, and GREENOMED to the test.
- Additionally, more efforts in the project itself should be put on development of real cases, not necessarily just methodology testing. In such a case the benefits would be even more evident and measurable.

4.3.2. East Slovenia

Pomurje Technology Park is located and thus represents the Eastern cohesion region of Slovenia which is more industry oriented and advanced, still there is slight gap in comparison to western region where more hi-tech companies are located. In last 10 year's Slovenia invested a lot in development of the Eastern part of the country, which aside of lower GDP per capita (Eastern Slovenia is equivalent to 70% of GDP per capita level in Western Slovenia in 2016) faces brain drain either to Western cohesion region and even more towards neighbouring Austria. A lot of qualified workers find better paid jobs there, so very small number of these skilled workers returns to Slovenia. Upon more flexible education system that adapts to industry needs and in recent years introduces modern studies University of Maribor aside of traditional programmes offers companies in region more skilled workforce. Unfortunately effects are lower than expected due to emigration to Austria.

Trade and economy: the most important sectors of Slovenia's economy in 2016 were industry (27.6 %), wholesale and retail trade, transport, accommodation and food services (20.7 %) and public administration, defence, education, human health and social work activities (16.9 %).

The **technological and innovation profile** of Slovenia is relatively high, especially when compared with other Balkan regions. Slovenia's innovation environment is regarded as generally friendly, with strong human resources and private sector investments. What Slovenia is lacking is additional public funding support and a stronger international market presence. Both, the European Innovation Scoreboard and Global Innovation Index confirm that. In the latter, Slovenia is ranked among top 50 economies in the world, with one of the highest numbers of scientific papers published, but there is room for improvement in efforts to commercialize the knowledge. By GII 2018 research Slovenia thus ranks 3rd in the world by the Scientific and technical articles per researcher but is ranked 91st when measured to the computer software spending as % of GDP. When market capitalization as percentage of GDP is concerned Slovenia ranks as 75th.

As above already stated SRIP Food (SRIP Hrana in Slovene language) its vision and mission are in line with national S3/4 pillar Sustainable Food (Trajnostna pridelava hrane in Slovene). The aim is to foster growth of companies/members, whole agri-food sector and by that national economy.

Currently Slovenian agro-food is powered by innovations that emerge outside companies, **DRI (Development, Research, Innovation) activity** in enterprises is still too weak, and thus does not take full advantage of the potential that it offers to increase productivity and create added value. Analyses show that Slovenian agriculture and food industry do not implement enough innovations in order to preserve the past growth rate of productivity, which is why productivity growth in the

agri-food sector has fallen over the past decade. This downturn is growing interest in the DRI, and for the most part, it reveals, in particular, to food companies **the opportunities for boosting growth and development** and raising competitiveness.

The innovative ability of companies, e.g. ability to innovate successfully for greater company performance, depends on the characteristics of the owner, the company itself and the wider work environment. These characteristics influence the acceptance of innovations and results in the field of **competitiveness**. Definitely this processing industry has potential to improve in processes (enabling technologies provided by mechatronics), services and products, and considering average customer being more and more ecologically aware, also to comply with **Efficient Sustainable Manufacturing** measures, which bring them in first stage additional costs / investments, but after greater efficiency and thus savings. SRIP Food activities are directed towards achievements of these goals of their member companies.

To understand the FOOD SECTOR importance one must have insight also agriculture sector and its characteristics: small fragmented production, lower critical mass, but with transition, concentration takes pace and so does efficiency. Size: as per indicators Slovene farming companies (A; 2015): Number of companies: 454 / Number of employed people in agriculture: 3.104 / Revenues from sales (mio €) 380 / Incomes from export (mio €) 122,3 / Export orientation (%) 32,2 / Value added per employee (€) 35.856

Next also clustering of these actors in cooperatives: Indicators (Activity code A, C10, C11; in 2015): Number of cooperatives: 92 / Number of employed people: 606 / Revenues from sales (mio €) 103.123 / Incomes from export (mio €) 24.007 / Export orientation (%) 22,8 / Value added per employee (€) 28.022

The Slovenian food and beverage industry is an important member of the chain of economic activities, with **704 enterprises** engaged in the food processing industry in 2015. The industry has **12,658 employees**. The **export orientation** indicator, which measures the share of export revenues in total sales revenues, thus **exceeded 24.3%** in 2015, amounting to **€ 501 million**, the highest measured value. **Added value per employee** amounts to **€ 36,742**, while sales **revenues** in 2015 amounted to **€ 2,01 billion**.

Production volume has increased by 4% in food production in 2015 and was among the highest since 2008, while the production of **beverages fell by 9%**, indicating a continuation of the long-term downward trend in production in this industry. The producer's food prices in 2015 were lower by 1.5% in comparison with the previous year (1% in real terms), while the **prices of beverages increased by 1.3%** (1.8% in real terms).

The business results in addition to the remarkable improvement in the business result in brewing were also influenced by higher profits in milk processing and the production of other food products, positive operations in wine production and feed production.

In 2015, the food processing industry reported a **net profit of € 85.5 million** and a net loss of € 15.3 million and ended the financial year with a net net profit of € 70.2 million (€ 34.4 million in

2014). In the year 2015, the negative net financial result was shown only in oil and bakery. In other activities of the food processing industry, net profit was recorded in 2015.

Slovenia remains a net importer in value at most customs tariffs for agri-food products. The surplus in trade in goods was also achieved in 2015 only in meat and live products. Most of the commodity trade in agri-food products was similar to that of the previous years with the EU countries, with the accession of Croatia to the EU further increasing the share of these groups of countries (76% of exports and 85% of imports in 2015) and the external trade deficit slightly decreased.

For Slovenia agri-food and **food-processing sector represents important, stable** industry sector, which assures improved self-sufficiency/sustainability; with available modern technologies it is more than ready for **digital transformation** and competitiveness. What is the challenge of transformation is needed adequate and competent HR offer in order to be able to support this process.

4.3.2.1. Implementation of GREENOMED methodology

PTP went to check current ESM stories within Vanguard and looked for potential in Slovenia, but due to quite short time, the issue/preconditions for TRL of innovative solutions, some of earlier identified cases were dropped (Olive culture institute and waste resumes), next we explored cold plasma use in (smart) packaging - there was a formed consortium of international partners, even some patents were made, IRP issues and short term orientation didn't result in further cooperation, although we stay in communication if they change their mind.

Next, via SRIP Circular economy we came and met people from university of Maribor, Faculty of Mechanical engineering & chemistry lab, who cooperated with private institute IOS on de-manufacturing. Again international project and consortium, however here things seem to be formed in more concrete way so mandate for talks was found. Their contribution to Greenomed/Vanguard could be at least a Use case, but prior to that we need to sign LoI, and quickly we can follow the methodology approach. Last developments are excellent and we are looking forward to complete the project Greenomed with one good story.

From other activities (even outside this project) we established common interest for FOOD MANUFACTURING INDUSTRY sector and challenges there – partly IOS with food waste de-manufacturing (reuse of raw materials) as well as SRP Food, association with agri-food enterprises and working groups established and already working on some specific topics like omega 3/6 in meat and eggs,...but talks for details need to be made first.

We managed to have 3 events from which we got these concrete contacts and even more, we were invited to some events outside Greenomed for networking, which gives concrete inputs for implementation of Testing and already identifying clusters for transfer phase.

Upon activities performed PTP becomes more and more recognized Greenomed project that offers tools/services to promote regional actors on international scene (Vanguard initiative and Greenomed partnership), that is known as intermediate looking for Efficient and sustainable manufacturing cases or lately food industry related green-tech (currently more in waste de-re-

/manufacturing (industry components). We are looking forward to offer regional actors potential to internationalize their business potentials, offering them also services of partnership in order to become members of international supply/value chains and to be in R&D transregional initiatives. PTP as only Technology Park in Slovenia focuses in manufacturing industry, already now offering services like LEAN, search of financing opportunities (even web tools developed, where aside of matchmaking also search for funding can be made, alone or with regional facilitators <http://www.p-tech.si/sfh-mapping/>). For PTP a success will be bringing Resyntex demo case to be Vanguard use case (currently main effort), considering the size of whole Slovenia potential in comparison to some other Greenomed partners' countries larger cities. Through this link we feel there are even more cases that could be identified as potential cases.

PTP, due to Greenomed approach already managed to get trust (from), to connect (with) business actors, as well as with policy level and RTOs. For PTP main references are successful stories of companies (internationalization is just one among many), while we play the role of integrator among companies and research organizations and bring their stories to attention of other interested stakeholders (investors). It took us a while to understand the logic of methodology, and now we are harvesting results of invested efforts so far; partnerships with Chambers of commerce, clusters and minimum 3 SRIPs (Circular Economy, SRP Food and SRIP Factories of the Future are just confirming the positive impacts of being involved in Greenomed.

4.3.2.2. Main benefits and challenges

The main benefits gained through implementation of GREENOMED methodology have been:

- Identification of competent actors in Slovenia (mapping);
- Communication and dissemination of Vanguard and Greenomed tools and services;
- Establishing links with clusters and within with SMEs, RTO's and intermediates;
- Exploring possibilities of cooperation / linking R&D facilities internationally (with other regions' ecosystems) – testing the trans-national collaboration model (issue of addressing appropriate/interested candidates takes time unless trust is already established with other intermediates).
- Internationalization of regional ecosystem – specific actors' offer of identified service providers (search of business cooperation, either in KTT or in business - value chains with value added – successful in ESM – textile disintegration and synthesis
- New field of potential cooperation: food processing industry - optional food plastics/packaging = cold plasma and even food waste recycling in e.g. olive waste reuse...
- Improvement of regional economy's' competitiveness through innovative green technologies (more and more important issue to tackle about).
- Testing the commercialization potentials of regions' based on innovative green tech solutions in industry/manufacturing.
- Presenting current achievements in green tech made by SMEs and Labs to policy level (bottom-up) and verification of current S3 (space for improvement?)
- Providing support (services and tools) to regional actors in order to internationalize them more successfully (ensuring impact). Project partners developed new services for their tenant companies and members and attract new ones to join.

- Huge challenges are still attracting & connecting together various stakeholder groups, where trust remains the most decisive factor no matter we talk about target group of policymakers, institutes, companies
- We learned about gap between policy level thinking (mid-to long term) versus SME's/RTOs short period orientation (to commercialize work/performance ASAP)
- Mappings via transnational platforms offer opportunities and threats to these groups

Slowly GREENOMED methodology is accepted by stakeholders (long time to see their benefits in being involved).

Meanwhile we also faced the following challenges during implementation of GREENOMED methodology:

- Lack of time and inner resources to handle the process (capacity issues)
- Perception of long-term e.g. mid vs. short term impact for companies
- Reach issue: awareness and communication on Greenomed/Vanguard remain important challenge (looking for synergies with other actors/events)
- „trust“ issues
- IPR issues / sharing the knowledge
- Presenting internal weaknesses in-front of competitors/co-operators
- lack of critical mass for EU R&D and industry absorption power.
- SMEs face HR issues / brain drain of experts who could introduce new tech to production
- SMEs have difficulties at applying for funding (hard for them aside regular work to study calls/tenders and problem of confidentiality with intermediates on their inner challenges)
- Lack of funding opportunities/benefits (or difficult administrative work at applying for funding) – some good cases are vouchers for technical solutions available in Slovenia.

In general, for PTP it was a concrete challenge to establish understanding between actors of ecosystem, and just recently cooperation is becoming more open, sincere and dynamics is improving. With the prolongation of the project PTP gets the opportunity to provide good cases and most of all upon methodology set (for targeted groups) this scientific approach seems to be too complicated, too time consuming and with long-term over short term promised benefits that they daily strive for.

4.4 Croatia

4.4.1. County of Zagreb

Croatia is a Central European country with 4.284.889 inhabitants (in 2011). Service activities account for about two-thirds of GDP. The largest industrial production is realized in the field of processing industry, mining and electricity supply. Croatia carries out almost two-thirds of its foreign trade with the countries of the European Union, primarily with Italy, Germany, Slovenia and Austria. The global economic crisis has significantly influenced the development of the economy and the increased emigration of the young working-age population.

Recently, sustainable development and green technologies have become more and more popular in the economist surrounding. Although Croatia recognizes need for going green but the situation is challenging. In Croatia mostly companies that are a part of the Croatian business council for sustainable development

promote the concept of sustainable development, through corporate responsibility but it is a small minority among Croatian businesses.

Green technologies are considered to be the future of the country, also under the light of smart specialization strategy. According to Smart Specialization Strategy (S3), one of the major obstacles that the country and accordingly Region of Continental Croatia is facing relates to innovation performance. The innovation system is underperforming compared to its potential, whether measured by the system's inputs, outputs or by the contribution of innovation to economic growth.

In the light of mentioned situation and obstacles and opportunities in Croatia it is the belief of Cluster Intelligent Energy that Vanguard initiative and GREENOMED project could be a real opportunity to raise and continue the green awareness and progress of the green manufacturing in Croatia.

4.4.1.1.Implementation of GREENOMED methodology

Upon starting to implement the GREENOMED methodology, the situation was quite challenging. As region of Croatia, as well as the County of Zagreb, was not aware of Vanguard initiative, neither at industrial level nor at political level. Therefore, at both company and governance level, the main initial activities carried out in the project were related to creating awareness about Vanguard initiative, pilot plants and GREENOMED and to identify the topic of interest for the county.

As the representative of the County of Zagreb Cluster Intelligent Energy started the process of Vanguard framework setting. The most relevant actions which created awareness and impact on Vanguard within the entities of the Zagreb County innovation ecosystem, were two concrete events. On one side, Cluster Intelligent Energy co-organized the "Smart Industry for Green Future" event in Zagreb, where it was concluded that industry in Croatia could and should be closer to green manufacturing and the importance of projects like GREENOMED for green manufacturing further development in Croatia. On the other side, a Watify event on automation and robotics in green manufacturing was held in Zagreb, in which Vanguard Initiative was introduced and a workshop was set to identify potential topics for the pilot plants and to mobilise stakeholders.

From these events, a main topic emerged and was agreed among participants using a (bottom-up approach): the monitoring systems for energy efficiency in industry. This topic was definitely validated by cluster members of Cluster Intelligent Energy.

In parallel and also from the events and contacts of Cluster Intelligent Energy a set of relevant companies were identified and contacted as potential members of working group. As the topic was very related to their interest, they were invited to take part of a Working Group related to monitoring systems for Energy Efficiency in Industry.

4.4.1.2.Main results and benefits

After the implementation of the activities mentioned, now there is a working group composed of 4 companies, 1 university and y NGO aligned to start working on the definition of a Living Lab in monitoring systems for Energy Efficiency for Industry.

Thanks to GREENOMED project and joint meetings with stakeholders, Cluster Intelligent Energy is working on several projects with the help of stakeholders. The projects are aligned with S3 strategy and are dedicated to energy efficiency. One project is related to Modular power supplies for micro-networks and the other one is based on Loss Optimization System in Advanced Networks.

Besides, the concept of Living Lab and Vanguard initiative has been widespread throughout the region and the ecosystem is now aware of the opportunities of collaborating to these kind of initiatives to be more competitive in Europe. In this regard, the Croatian Wood Cluster has been interested in learning the

GREENOMED procedures to use them within their cluster and to engage with other Working Groups dealing with Circular Economy and Bio-Economy.

Other benefits that GREENOMED project brought to the region was the encouragement of the trans-regional cluster and company co-operation and exchange of knowledge and experiences through the multiple events in which the Zagreb ecosystem participated together with other partners' ecosystems.

4.4.1.3. Lessons learnt

From the activities implemented through GREENOMED, several lessons and recommendations can be exported:

- **The importance of a good communication strategy:** As it is really difficult to engage companies and entities in the process of identifying the topic and participating in the working groups, it is really relevant to generate interesting content to transmit to entities to engage them into GREENOMED methodology.
- **The importance of involvement of regional administration:** Another way to push entities to be involved in long term benefits initiatives are the involvement of regional administrations to enhance the importance of such initiatives in the region and attract therefore these companies.

4.4.1.4. Main challenges

The main challenges that Cluster Intelligent Energy faced are summarised below:

- **SMEs extremely oriented towards short term impact activities:** Difficulties in engaging companies when results are not visible in short term. For the companies it implies participating in events and meetings that are time and effort consuming without seeing the benefits of doing so.
- **Low interest in big investments at long term:** due to the challenging economic situation, most companies are reluctant toward investments, mostly due to market's unclear future challenges.

4.4.2. County of Varazdin

Industrial production accounts for about 21% of the Croatian GDP. The fastest growing sectors within the processing industry are also the largest: food and beverage (24% of the processing industry), pharmaceutical and chemical products manufacturing (11%), electrical machinery and equipment manufacturers (9%), and rubber, plastic, leather and paper products (9%). The processing industry generates 15.5% of the Gross Added Value, a little below the EU average. Over 21,000 enterprises in Croatia are registered in the manufacturing industry and they employ almost 300,000 people.

Despite the generally low level of robots and digital technology use in industrial production, there are a number of export oriented companies that are fully digitized and use top technologies. In 2015, Croatian companies had 13 robots per 10,000 employees. 18% of all companies in Croatia used industrial robots for heavy industry, while 17% used robots for handling processes.

Considering the local economy, the Varaždin County has strong industrial base, well-developed entrepreneurship, a large number of foreign investments and a pronounced orientation towards exports. Although the Croatian research and development system is very strong (there are 184 legal entities in the

Croatian research and development registry, among them research institutes, higher education institutions and business entities and technology and development centres performing R&D), there is a lack of a concrete and well-structured Innovation ecosystem (organisation, coordination and implementation) that disables effective cooperation of innovation organizations with business sector entities in order to provide high-quality environment for competitiveness of Croatian economy. Enterprises must be at the heart of innovations since they detect market opportunities and develop ideas for innovative solutions in order to seize these opportunities. However, Croatia's entrepreneurs face multiple obstacles like difficult access to external funding sources, lack of knowledge and possibilities about different networks, such as Vanguard Initiative to upgrade added value of the products and services.

4.4.2.1. Implementation of GREENOMED methodology

Following the GREENOMED methodology with support of the experienced mentors, the Varaždin County, through the CCE Varaždin entity, focused their activities on three levels: policy makers, R&D institution and business level.

At the beginning it was difficult for them to understand the concept and benefits of pilot plants with respect to their national/regional situation. During the course of project, they spent considerable time and effort to set the Vanguard Initiative framework on decision makers to support the establishment of the Pilot Plant and to create commitment to the idea of entering the Vanguard Initiative by the responsible for the Croatian Smart specialization strategy at policy level. The representatives of the Ministry of Economy, Entrepreneurship and Crafts participated in the events set with success and the highest level of policy makers were informed about Vanguard Initiative.

The CCE Varaždin maintained the contacts with companies/stakeholders through the bilateral core group meetings in order to define a set of technologies for industrial applications which could make basics for the Living Lab activities and new innovative entrepreneurial projects. At the beginning, automation and robotics was the main topic, but it appeared that it's very difficult to focus on a specific sub-topic and to create a critical mass within this area. Since there was no critical response from the businesses community where each company has its own set of technologies and very particular interests, it was decided to use top-down approach and move toward circular economy in order to deliver new business opportunities to regional industry and ecosystem.

At the same time, some R&D teams were reached to be involved in the process, mainly from universities. Since R&D system in Croatia is defragmented, we expected further problems but it turned out that academic community is very active and that there are capacities and demand in suggested topic – circular economy.

Focusing on the new topic identified, a seminar "Boosting the circular economy" organized in the CCE Varaždin was an additional trigger to participants to join the stakeholders working group Circular economy. Based on this feedback the CCE Varaždin contacted the Department of the Environmental technologies of the Geotechnical Faculty in Varaždin as the regional key player in this field in order to organize Living Lab in Varaždin. The Living Lab was formally opened and presented to general public during the Open Day and the Cooperation agreement between the Croatian Chamber of Economy- Varaždin County Chamber and the University of Zagreb, the Geotechnical Faculty in Varaždin was signed.

Focusing on entrepreneurs' identified needs we organized the conference Smart solution for Growth and Jobs and advised entrepreneurs about possibilities of using national incentives and EU grants, as well as the way of involving companies in the global value chains through Greenomed project.

4.4.2.2. Main results and benefits

It was set the possibility of dealing with the challenge of circular economy in cooperation with the Faculty

of Geotechnical Engineering, one of the leading research institution in environmental engineering, by establishing Living Lab. This would be a place where theoretical knowledge, scientific research and practical experience in the field of interdisciplinary technical sciences could be provided by staff of the Faculty that would help the economy, especially the economic subjects in Varaždin County. Stakeholders who would work in the Living Lab are researchers within the faculty, undergraduate and graduate students in scientific work through their thesis, PhD students through their scientific work on gaining the PhD diploma.

In frame of the Living Lab, the Department of Environmental Engineering offers new postgraduate study programme and the most relevant challenges related to circular economy raised by the industry could be additional researched through the doctoral thesis. On the other hand, the Greenomed Living Lab on Circular Economy has project ideas which could for sure boost the entrepreneurial activity and regional innovation system in respective field.

Living lab is open to interested regional business companies, non-governmental organizations and researches from other institutions. The set of technologies that would be addressed in the Living Lab are: (1) "closing the loop" in the recycling process of waste to contribute to the circular economy and environmental protection, where waste from one industry becomes raw material in the other industry; (2) eco-innovations; (3) environmental product declarations; (4) testing and application of new and alternative methods of water and air purification in the semi-industrial scale, including photo catalytic engineering, recognized as the alternative best available technique; (5) research and development of chemical sensors and biosensors for use in the environment, industry and biomedicine, particularly fast and cheap point-of-care for agriculture and agronomy, food industry, etc.

Joining the new concept "closing the loop", it will enable systematic transition in coming years from linear to circular economy and take over responsibility on time for potential opportunities and challenges for regional ecosystem.

On the other side, the focus of the working group is set on tailor-made internationalization programs for companies and other stakeholders as well as help for obtaining the favorable financial sources for entrepreneurial projects which increase the level of green innovation and new products by implementing the concept of the circular economy and connect it with the current European innovation chains.

4.4.2.3.Lessons learnt

From the activities implemented through GREENOMED, several lessons and recommendations can be exported:

- Innovation always requires new ideas and creative thoughts. Networking on all levels as an ongoing process of persistence, attention and organisation will for sure gain further opportunities and build long term relationships with wide base of stakeholders.
- Networking to increase awareness of news and trends in topic, find out about new business opportunities and constantly widen circles of potential partners is the key element of success, especially in Greenomed, as a project of testing of the new methodology.

4.4.2.4.Main challenges

The main challenges and difficulties were related to mobilizing regional stakeholders and creation of critical mass of companies interested to cooperate in selected topic and also lack of well-structured innovation eco-system in Croatia as well as lack of linkage between research institutions and business sector. The conference "Automation and robotics for green manufacturing" organized in Varaždin showed that

cooperation between the public and private sector in the development of joint initiatives and partnerships or joint demonstration projects is highly recommended and necessary since the conference was attended by entrepreneurs, industry representatives, representatives of universities, research and technological organizations. CCE Varaždin will continue to build these ties within ecosystem in frame of this project and its goal is to establish appropriate institutional framework using best practices of GREENOMED mentors, experienced partners from other regions.

At the company level in general it was detected organizational problems, lack of technological expertise and lack of skilled workers as well as shortage of financial means. One of the main detected barrier is also difficult access to external funding sources for SMEs. Since the Vanguard methodology is bottom-up process, CCE Varaždin is primary focused to help the business sector within working group to overcome this problems regarding the implementation of entrepreneurial innovation projects in circular economy.

4.5. Region of central Macedonia, Greece

The Region of Central Macedonia is the largest and second most populous region in Greece after Attica. The region is based at its capital city of Thessaloniki. According to the Hellenic Statistical Authority the GDP for 2015 was 23.716 million € and the GDP per capita was 12.557 €. The unemployed rate for the region is significantly high (26 % for 2015 and 24.5% for 2016).

The five most important sectors for the Region of Central Macedonia are the following: Public administration, education, health and social work activities (24.1 % in the total GVA of the region), Trade, transportation and storage, accommodation and food services activities (23.6% in the total GVA of the region), Real Estate activities (14.3% in the total GVA of the region), Manufacturing (12.4% in the total GVA of the region) and Agriculture, Forestry and Fishing (6.1% in the total GVA of the region)

The Region of Central Macedonia hosts some of the most important Universities and Research Institutions of the Country, such as: Aristotle University of Thessaloniki (A.U.TH.), Technological Educational Institute of Central Macedonia, Alexander Technological Educational Institute of Thessaloniki, University of Macedonia, International Hellenic University and the Centre for Research & Technology Hellas.

Prior to the implementation of the GREENOMED methodology, the region of Central Macedonia was focussed on an eco-innovation strategy relevant across both manufacturing, agricultural and service (green ICT) sectors. Despite the fact that RCM shows off a delay in the adoption of a concrete policy for green manufacturing, primarily due to the economic crisis, certain internal and external drivers were present to boost the transition of the region to a greener industrial model. Among the drivers, the socio-cultural factors, the legislation (national and European) as well as the economic factors (mainly referring to the long-term cost advantages) consisted the major catalytic forces towards the implementation of green and circular-economy practices in the industrial sector of the region. On the other side, certain barriers to fully integrate the bio-economy principles were also present. These barriers lie on: i) lack of information and understanding of the principles of circular economy, in particular among SMEs, ii) inconsistent legislation and regulations between national and European level and iii) lack of finance. The Regional Smart Specialisation Strategy (RIS3) for Central Macedonia consists an instrument of a great value for the local stakeholders in order to be guided and further supported (technically, scientifically and financially) during their transition to a «greener» manufacturing efficiency. In the context of RIS3, the sectors of agro-food, construction materials, textile & clothing and tourism have been identified as the Sectors of High Regional Interest, while pillars of the horizontal support sectors are the environmental and energy technologies.

4.5.1. Implementation of GREENOMED methodology

Taking into account the fact that the Region of Central Macedonia was not aware about Vanguard initiative neither at governance nor at company level, i-BEC launched an awareness campaign upon the topics of green manufacturing and Vanguard Initiatives, in line with the GREENOMED methodology. i-BEC conducted mapping activities in order to identify possible stakeholders coming from industry, academia and regional policymakers and proceed in the creation of a regional database of possible stakeholders, which were used later on, in order to organized several telecoms and bilateral meetings with them as well as to invite them in the 1st stakeholders meeting for the promotion of green manufacturing.

On 20th of February (2018), i-BEC organized the 1st stakeholders meeting. The main subject of the meeting was the exploration of a common ground in understanding the potential of pilot plants as facilitators in introducing and further supporting innovative technologies in the manufacturing sector, aiming to strengthen and promote green manufacturing in particular. It was attended by representatives and executives from the industry and manufacturing sector in the Region of Central Macedonia, research institutions and Academia, policy makers, as well as representatives from innovation clusters at local and regional level. In order to identify relevant topics for the pilot plants in the Region of Central Macedonia, a bottom-up approach was used initiating by the needs of the stakeholders in the context of green manufacturing while also taking into account the smart specialisation strategy of the region. Based on the outcomes of 1st stakeholders meeting as well as the bilateral meetings with regional stakeholders organized by i-BEC, the following key-topics for the Region of Central Macedonia were identified:

- Green manufacturing for agro-food industry
- Green manufacturing for agro-energy industry
- Energy efficiency for agro-based industry

After the establishment of the most important domains of green manufacturing in the region, i-BEC launched several activities in order to setup the regional core groups, such as: conducting mapping studies of individual stakeholders and existing clusters (quantitative and qualitative) as well as the utilization of facilitators and other brokers to identify firms that could work together. Moreover, during the 1st GREENOMED Conference (7th March), which was organized and hosted by i-BEC, a significant network of industries and research institutions were created in the frame of the Conference. The publicity that the abovementioned Conference had through the local press, facilitate the discussion with the enterprises of the region. Additional activities focusing on providing further support for the on-going procedure of the creation of the regional core group(s) were:

- Host awareness raising events (stakeholder meetings, conference, and cluster education)
- Organisation firm networking activities
- Increase links between researchers and SMEs of RCM
- Partner searches
- Benchmark performance
- Map cluster relationships

A linkage between industries and research institutions was performed towards the creation of the local working groups. Among the proffered activities linked with the enrolment of stakeholders to the creation of regional working groups, the most efficient method in the case of the Region of Central Macedonia was the organization of bilateral meeting with stakeholders from the industry in order to identify their needs regarding the greening of their industrial performance as well as their willingness to participate in the regional GREENOMED working groups.

I-BEC has already created three local working groups upon the following subjects:

- Exploitation of wineries' biomass residuals to energy production

- Exploitation of agro-energy industries' residuals and by-products to produce feed and food ingredients through microalgae cultivation
- Exploitation of ginning and spinning mills' solid waste to energy production

At the political level, i-BEC is in close contact with the Region of Central Macedonia in order the later to become a member of the Vanguard community. To that end, it must be mentioned that i-BEC orchestrated the discussion with representatives of RCM about the participation of RCM in the Vanguard Initiative.

Finally, i-BEC participated in the 2nd GREENOMED Conference in Barcelona, during which representatives of our region came in contact with other SMEs, clusters and Research institutions of the Mediterranean launching the discussion of potential cooperation in the frame of green manufacturing. To that end, possibilities of synergies between the Region of Central Macedonia and Lombardy Region have been detected in the frame of exploitation of microalgae as a mechanism for regenerate food and feed ingredients from agro-energy industries.

4.5.2.Lessons learnt

- The importance of raising awareness about the strategic relevance of pilot plants in the region among the stakeholders
- A concrete and standards methodology is needed, especially for the SMEs willing to invest in the bio-economy sectors at a regional level. Greenomed project, through its testing methodology, could act as a tool of great importance for the SMEs of the Mediterranean region willing to greener their activities as well as to establish inter-regional collaborations with other regions.
- Greenomed Living labs could be used for the study and analysis of enablers and bottlenecks and provide voluntary guidance to the optimization of bio-based innovation technologies applied to the industries.
- There is a need for concrete policies at regional and national level in order to overcome the economic, ecological and legislation boundaries linked with the deployment of the bio-economy sector in the Mediterranean region.
- The establishment of a strong collaboration between SMEs and R&D institutions is a solution towards the overcoming of technological barriers.
- A concrete business plan for each potential industrial symbiotic network is needed in order to be very clear from the beginning, the role of each stakeholder, what he receives as inputs from the other stakeholders and what produces as outputs.
- The establishment of synergies between SMEs, clusters, living labs and Research Institutions boosts the creation of industrial symbiotic networks in the region of Mediterranean.

4.5.3.Main challenges

- The concept of an industrial symbiotic network is extremely new in the Region of Central Macedonia, thus SMEs of the region have a lot of questions and doubts on how this symbiosis could come feasible and are hesitant to participate in this type of cooperation.
- Stakeholders, especially companies set down to the table confidentiality issues and mistrust, which is a fragile subject for any cooperation, especially for inter-regional collaboration focusing on green manufacturing innovation
- Unbalances concerning the level of commitment between different stakeholders
- Low technical readiness level of some technologies needed for the transition of the local industries to a «greener manufacturing footprint»
- Lack of access to financial support
- Absence of internal culture of the SMEs in our region to commit in activities that have long-term benefits.

- Reinforcing the culture and knowledge of green manufacturing among the agents of the ecosystem in RCM especially SMEs, clusters, and RTOs.