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Introduction

Chapter 1. Green manufacturing and Regional innovation ecosystems in Europe

1.1. Green manufacturing

1.1.1. 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). Thus, the future of European economy strongly relies on its manufacturing sector.

In recent years green manufacturing and circular economy have 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 environmental impacts and to contribute creating a sustainable economy.

In 2015, The European Commission implemented an action plan to support the transition of Europe towards 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 program." [1] The Green Action Plan of the European Commission[2] aims to help SMEs to take advantage of the opportunities offered by the transition by supporting actions to raise SMEs' awareness of resource efficiency and to increase productivity, competitiveness and business opportunities through circular economy.
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 shape our economy and pave the way towards a climate-neutral and circular economy where pressure on natural, freshwater resources and ecosystems is minimized.[3]

[1] https://ec.europa.eu/commission/priorities/jobs-growth-and-investment/towards-circular-economy_en
[2] https://ec.europa.eu/growth/smes/business-friendly-environment/green-action-plan_en
[3] http://ec.europa.eu/environment/circular-economy/index_en.htm

1.1.2. Drivers and barriers for green manufacturing

There are several drivers for companies to embrace the circular economy paradigm and to uptake innovative green manufacturing technologies and 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**: top management commitment, perception of the increasing strategic relevance of green aspects in future competition, long-term strategic orientation and strong R&D capabilities around green technologies.
- **Regulation drivers**: environmental regulation and standards, together with penalty mechanisms for non-compliance.
- **Financial drivers**: provision of incentives and financial assistance to companies implementing green manufacturing practices, as well as cost savings due to reduced consumption of resources.
- **Technological and process drivers**: higher availability of high-performing green technologies that guarantee process resource optimization, support efficient remanufacturing, re-generation, recycling, reverse logistics process and new green products design.
- **Market and external partnership drivers**: new culture and green demand of customers on the one side, and increasing relevance assigned to cooperation and partnerships which are jointly engaged in green supply and manufacturing practices on the other.

However, the implementation of green manufacturing practices and technologies is very challenging for companies and in particular for SMEs. While Large enterprises have more capacities and resources for shifting towards circular economy, SMEs have to focus on their day-to-day business to ensure economic sustainability. Thus, they struggle to uptake the green manufacturing technologies, even though their customers and suppliers express a clear demand. The main barriers for SMEs are summarized below (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**: complexity of the new 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**: lack of skilled professionals to plan and implement eco-innovation and unavailability of specific training and coaching programs related to green innovation practices at the range of SMEs.
- **Organisational barriers**: lack of commitment of SMEs entrepreneurs, weak organizational structure to support green manufacturing innovation and management, limited corporate social responsibility.
- **Market barriers**: market risks and uncertainty concerning the acceptance of green products, which are produced re-manufacturing or recycling old products, price-based choices of customers .

- **Financial barriers**: high change over costs from traditional to green production systems, sunk costs which can cause losses, high cost of green certification/verification, which disproportionally penalizes small organizations, difficult access to financing sources for green innovation.
- **Cultural barriers**: lack of awareness, , insufficient knowledge sharing on the availability of specific service offerings and potential partners on green manufacturing, lack of platforms and forums for SMEs to discuss problems related to green innovation.
- **Policy barriers**: difficult communication between SMEs and policy makers, as well as weak participation of SMEs to the policy definition process.

1.2. 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 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 independently-managed assets, which enables SMEs to use such facilities overcoming the investment barrier for their realization. Thus, Pilot Plants are strategic innovation assets for SMEs.

The Pilot Plants will also integrate highly skilled and specialised personnel able to use embedded state-of-the-art technologies and to assist users to perform tests and experiments. Thus, they offer innovation services to industry and R&D players, being a center of multi-disciplinary knowledge aggregation (technology, business and innovation) which offers unique resources to connect and transform the value chains.

Unfortunately, these infrastructures are still not available on a large scale in Europe, especially in emerging manufacturing Regions. Thus, the gap for transforming R&D results into concrete industrial implementation, the so-called "Valley of Death" is not covered yet. Due to their role in supporting innovation processes, Pilot Plants are being recently conceived in alignment with the EU framework of Regional Innovation Specialization (*) and are included into initiatives such as the S3 Platform for Industrial Modernisation of the European Commission (*) and the Vanguard Initiative (*). Moreover, they can also be linked 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, being much more sustainable at the same time, the above described Pilot Plants are essential to test, validate and transfer disruptive solutions to the market.

1.3. Collaborative innovation ecosystem for green manufacturing

Nowadays the ability to generate knowledge and to transfer it to the users is quite essential for the competitiveness and growth of organizations, especially companies and industrial stakeholders. Individual entities cannot integrate all the resources and competencies needed to innovate constantly. This is why successful innovation takes more and more place inside "ecosystems of innovation".

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, European regional innovation ecosystems have been influenced in the last years by the definition of the regional Smart Specialization Strategy. This process has led to the reorganization and improvement of regional innovation ecosystems in European regions, for instance, grouping entities according to identified specializations and assigning new roles and responsibilities to intermediate organisations that aggregate different agents of new value chains, such as Clusters.

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. Among them the Vanguard Initiative (mentioned before) and the Smart Specialisation Platform for industrial modernisation (a cooperation platform which combines smart specialisation and interregional cooperation to boost industrial competitiveness and innovation). Such initiatives are based on two distinctive points:

(i) The exploitation 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 innovation processes and of the entire regional innovation ecosystem.

Pilot plants have emerged as regional "one stop shop" where companies, especially SMEs, can have access to the latest advanced manufacturing technologies to test them and increase technology competence prior uptaking, thus reducing innovation risks. Moreover, pilot plants can be considered as the infrastructure which facilitates the 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.
Being complex multi-disciplinary infrastructures embedding recent results of research, Pilot Plants need huge investments to be designed, built and regularly upgraded in order to follow fast modern innovation cycles. That is why it is essential that pilot plants are at the centre of regional Smart Specialisation Strategies in order that Regional Authorities support their existence through proper policies.

On the other hand, clusters, technology centres and intermediaries are playing an important role as animators and orchestrators of the regional innovation ecosystems in Europe. There is evidence that 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 innovation ecosystems. In this context, clusters have appeared as the ideal intermediaries which facilitate the constant convergence of knowledge and its exchange and transfer throughout the ecosystem on a continuous basis.
Not all the European regions can rely on clusters as innovation ecosystem facilitators. Also where clusters are established, sometimes they are not structurally prepared to lead these activities. In some case, other entities that are able to integrate 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.

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

Under the light of Smart Specialisation Strategy, many European regions are moving 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 an integrated European value chain perspective. In this regard, inter-regional collaboration among different regions would facilitate not only the transfer of knowledge and technologies among regions, but it would also generate

more opportunities to create a critical business mass allowing 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 designing a European network of pilot plants which can support the implementation of green manufacturing. Such a network of pilot plants will be a trans-regional infrastructure which links key stakeholders and capabilities across regions and creates critical mass by aggregating pieces of the innovation value chain that are currently fragmented in various countries. The "Efficient and Sustainable Manufacturing pilot" of the "Vanguard Initiative" follows such an objective.

The establishment of such a network requires a coordinated process animated by clusters and intermediaries of regional innovation ecosystems in order to mobilise a critical mass of industrial stakeholders around the strategic topics for green manufacturing aligned with S3. Such a regionally-consolidated critical mass, in the format of working groups, are the core engine of the regional ecosystem to design and implement pilot plants satisfying specific needs of the companies in the region in terms of green technologies.

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

Several instruments at European level are designed to promote the inter-regional collaboration in Europe. Interreg is one of the key programs 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 Program for the Mediterranean area which brings partners from 13 countries across MED regions together. The main objective of the Interreg MED Program 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[4].

GREENOMED project has been developed and funded as a modular project in the frame of interreg-MED program, under the theme of Green Growth. The main objective of the project is to foster green manufacturing in MED regions through the 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. Implementing such an inter-regional cooperation methodology, clusters can mobilise and coordinate actors of their regional innovation ecosystem to conceive technological infrastructure and innovation projects for the industrial uptake of green technologies, under the light of Smart Specialisation Strategy.

[4] https://interreg-med.eu/about-us/what-is-interreg-med/

Chapter 2. GREENOMED cooperative transnational methodology

The establishment of a structured and shared trans-national cooperation methodology will support companies and the other actors of the European ecosystems to overcome the challenges and the barriers of cooperation actions. Recently, also the European Commission recognized the benefit of defining a structured methodological process to guide and support the establishment of inter-regional investment projects by suggesting guidelines to the thematic partnerships established in the framework of S3Platform. However, while such guidelines aim at supporting the partnership journey toward investment, the GREENOMED methodology is specifically designed for Clusters and intermediaries and providing detailed guidelines for the creation and management of regional working groups that will be involved in interregional pilot plants projects.

2.1. Why GREENOMED methodology?

Inter-regional cooperation for innovation is a very complicated process which should be governed in order to be successful. In fact, it implies the involvement of different type of stakeholders in the cooperating Regions (companies, universities, research organisations and intermediaries), whose number can be significant and can generate huge coordination difficulty per se. Such regional stakeholders should be internally aligned, share a common goal as regional ecosystem and should define interfaces which are able to represent regional scopes and capabilities. In addition to that, European innovation ecosystems can greatly differ in terms of culture, innovation practices and processes. Thus, when they start cooperating, the interaction process can result difficult, slow and also very expensive for the concerned stakeholders.

To address such a complexity, the experience matured in the Vanguard Initiative (and in particular in the “ESM-Efficient and Sustainable Manufacturing Pilot”) demonstrated that a structured cooperation methodology, consisting in a set of standardized steps and tools, can of great help in facilitating the complex mechanisms of inter-regional cooperation mechanisms. Such a cooperation methodology can provide suggestions for organizing efficiently the internal ecosystem organization, support the convergence of stakeholders towards common goals, as well as for adopting the same processes and tools to accelerate cooperation processes and to make them more effective.

GREENOMED collected the experience made in the Vanguard Initiative, with the main goal of rationalizing, codifying and testing at large scale such an inter-regional cooperation methodology.

2.2. Users of methodology

The main target users of the GREENOMED methodology are:

1. **Clusters and other intermediary organisations**, that have the role of facilitating the innovation in the regional innovation eco-system (companies, RTOs, universities, technology providers, etc.). Being the direct users of the GREENOMED methodology, they are supposed to guide regional stakeholders

in the implementation of its various phases. Practically, they will offer a portfolio of services to regional actors that will support them in the participation to the various phases of the cooperation. Offered service and standard tools for service provision are part of the methodology, too.

2. **Companies, RTOs and universities**, that will be involved as actors of the ecosystem taking part to the inter-regional cooperation. They will be guided by clusters that, through the provision of specific services, will facilitate the successful engagement various organization in the inter-regional cooperation for innovation.

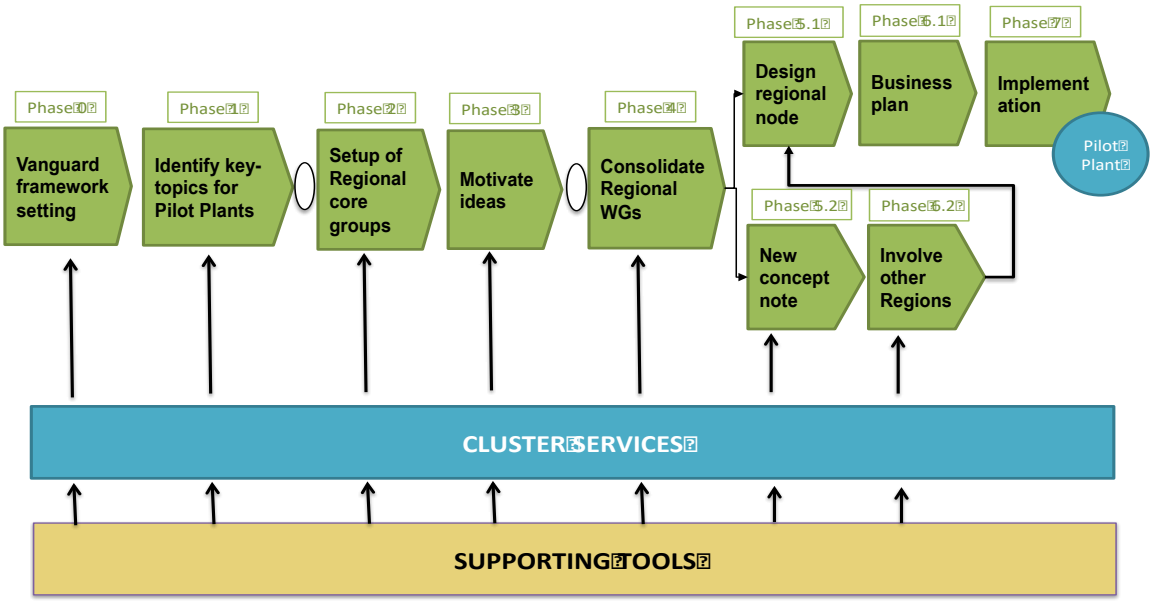
2.3. The GREENOMED methodology

The GREENOMED methodology consists in:

- a process, i.e. sequential steps that have to be implemented by actors of regional ecosystems to implement innovation;
- a set of services that Clusters are supposed to provide to regional ecosystem members to engage stakeholders in the cooperation and to coordinate their intra- and extra-regional activity finalized to innovation;
- a set of standard tools that support clusters service offering and that contribute to homogenize interfaces and the action of Clusters in different European Regions.

2.3.1. Main phases of the methodology

Phases of the GREENOMED methodology are represented below. Such phases are meant to be sequential, since each phase generates the conditions to progress in the methodology. There can be some overlap among sequential phases, in a logic of concurrent engineering.



Phase 0- Vanguard framework setting: Considering the final goal of GREENOMED to design and implement inter-regional pilot plants for green manufacturing in the framework of the Vanguard Initiative, awareness on this initiative and a clear understanding of its goals is a crucial pre-condition. Accordingly, as starting step, clusters and intermediaries will raise awareness about Vanguard and its potential benefits, 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 is provided in phase 0, stakeholders will proceed with the identification of key-topics for pilot plants, i.e. will define high-priority thematic and technological innovation areas that are relevant to their regional specialization. Either a bottom-up approach can be followed (i.e. topics are triggered by industrial stakeholders and RTOs), or a top-down approach (i.e. topics are motivated by the existing strategic and political initiatives in the region). The topics identified in this phase will pass through a preliminary check of network, that will check the coherence with the scope and the goals of the initiative. Indeed, Vanguard will provide a feedback on the proposed topics and priority areas in terms of: 1) general alignment with Vanguard vision and goals, and in particular with the already 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 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, 3 participating Regions will be the required minimum number of members, 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.

2.3.2. 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.

I. Communication and awareness raising on Vanguard/Pilot plants
II. Regional orchestration for identification of strategic topics in the Region
III. Setup and animation of Regional WGs
IV. Coaching of WG to Design Regional pilot plants
V. Service for Internationalisation of WGs
VI. Support for the identification of funding for pilot plant projects
VII. Support for the definition of new demo case and proposal to Vanguard pilot
VIII. Regional Mapping

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.

- **SI5- 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

Slovenia example of the first event to raise awareness about Vanguard

Since the beginning of the GREENOMED project, Technology park Ljubljana has actively communicated Vanguard Initiative with various Slovenian stakeholders. TPLJ has hosted numerous events and meetings with the purpose of raising awareness about the Vanguard initiative.

Throughout the project TPLJ has organized several meetings of different kinds: one-on-one meetings with Vanguard representatives, working-group meetings between companies, R&D and policy makers, conferences, networking events abroad (Barcelona, Lyon), invited stakeholders to Vanguard plenary meetings in Brussels, connected with SBRA (Slovenian business and research association) which is the Slovenian local point for Vanguard in Brussels, organized events for clusters and offered general Vanguard information to interested parties.

Slovenia is a member of the Vanguard initiative since 2017 and in 2019 Slovenia was also the member of the Vanguard board. Three Slovenian ministries and government offices are co-responsible for the Vanguard membership: Ministry of Education, Science and Sport, Ministry of Economic Development and Technology and Government Office for Development and European Cohesion Policy. Several policy meetings were also held with these national policymakers throughout the duration of the project and beyond.

Besides that, Technology park Ljubljana will remain the local national contact point for stakeholders interested in joining the Vanguard initiative. Our work with the regional SRIPs – Strategic research and innovation partnerships has resulted in the awareness that TPLJ has valuable information and access to possible contacts for the work to be continued in an international setting. Moreover, TPLJ has cultivated valuable connections between partners of the Greenomed project and will continue to nurture these relationships in the future also for Vanguard awareness raising.

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

Experience of Cluster Marche

In order to identify and to distinguish regional stakeholders by their activities, ACMM listed them using regional Mapping Tool of the project. This work was completed in parallel with identification key topics but was regularly updated after different actions such as communication events or regional workshops.
Industrial stakeholders were listed by:

- Company name
- Status of the contact
- Company data (company type, number of employees, yearly turnover and location
- Market (sector and target products/services)
- Emerged topic

Policy makers, Intermediaries and Support Organisations, research centres, universities were also listed by the name, domain of expertise, type of services offered and the topics in which they are interested to participate in.

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

ACMM experience

Once the Vanguard Initiative was explained and discussed within regional ecosystem, ACMM went through the identification of key topics within the regional territory, by adopting a bottom up approach. Thanks to the involvement on regional stakeholders 3 topics of interest emerged:

- De- and re manufacturing: with the goal to understand how to recycle and re-use the production waste from different manufacturing sector, including the waste of composite materials and convert them into revenues through the development of a Pilot Plant
- Waste treatment and recycling: with a particular focus on special and dangerous wastes.
- Energy efficiency.

Once ACMM identified the key topics for pilot plants, regional core groups were established and animated to better define the sub-topics to be developed according to the industrial needs and interests emerged. ACMM animated and orchestrated

these groups exploiting the tools offered by the GREENOMED methodology and its steps.

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

Plastipolis example

In order to set-up the core group, Plastipolis proceed to a mapping of current actors in the frame of Green Manufacturing in its network and also on regional ecosystem. Thanks to that, several key players were identified in addition of attendees for the Watify event.
Furthermore, thanks to de workgroup on smart plastics, we identify a core group for the pilot plan on this specific topic which was selected by Plastipolis.
This workgroup will be the basis of the regional core group.

During the Milano meeting in July 2017, we exchanged with CNR-ITIA about potential key topics to focus on, and after internal discussion, we decide to select the main key topic for Plastipolis and the highest potential one for the region: Smart Plastics.
Furthermore, this topic was already identified internally at Plastipolis with the set-up of workgroup on Smart Plastics and also the development of several projects supported by Plastipolis. In addition, at regional level, several actions are ongoing such as the development of a kind of technology park on Smart Plastics, the development of new platform between smart plastics and mechatronics.
This topic is totally associated to Greenomed topics. Indeed, Smart Plastipolis are able to provide new solution to manufacturing, allowing to reduce the use of PCB part and also to optimise the size and the weight of electronic applications. This topic also includes the fact that on smart plastics we will have to integrate the recyclability and the ageing of such devices.

Following the presentation of CNR-STIIMA in July 2018 during the S3 event (60 participants) and the one of Eurecat in September 2018 during the Smart Plastics Congress (70 participants), Plastipolis validated with the regional core group the Ampere Lab as the regional Greenomed pilot plant. The Ampere lab, as a member of the core group, started the Engineer Master2 program in September in collaboration with companies regarding students' projects. These companies are obviously part of the regional core group. Furthermore, letters of intent were sent to companies in order them to sign one, consolidating their participation in the project. The objectives of the letters of intent have been explained in the previous Smart Plastics club on November 19th.

Due to the alignment of smart plastics activities with the regional specialization strategy and ongoing projects in the region, companies participating in the core

group are aware of the strategic advantage which can benefit from structured pilot plant. As the companies in the core group collaborate with the living lab to make students work on dedicated projects, these companies are motivated to consolidate the pilot plant development. The Smart Plastics industrial club, organised 2 or 3 times a year, is the ideal meeting to motivate new ideas regarding the pilot plant and each meeting are relevant to discuss about potential improvement.

At the starting point, the regional Working Group was composed by:

- 7 end users
- 3 technology providers
- 2 external experts
- 1 local public authority

One of the objectives was to consolidate the regional WG by adding new comers, especially end users working in different economic sectors. This happened by organizing dedicated events in the Auvergne-Rhône-Alpes region. A second objective was to internationalise the WG by participating in some events abroad or to invite foreign experts in events which have been organized by Plastipolis.

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 it 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 topics 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

I-BEC Example

i-BEC proceeded to the linkage of the working groups with regional living labs in order to provide to the later further support during the preparation of their business plans for the development of pilot plant(s) in the near future. That is why i-BEC organized two living lab events during the duration of the project:

- The first one took place on 28th of June (2019) in the accredited testing laboratory of i-BEC

- The second one took place on 16th of October 2019 in the Laboratory of General and Inorganic Chemical Technology, School of Chemistry (AUTH).

The regional WGs worked together with i-BEC throughout the implementation of the project in order to establish a sustainable business plan of their common cooperation in the frame of green manufacturing, especially in agri-food activities.

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, these 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

Plastipolis example to set links with Catalonia

As Smart Plastics is a common strategic domain in Catalonia and Auvergne-Rhône-Alpes, some synergies appeared during the progress of Greenomed project:

- Plastipolis visited Eurecat in Barcelona on July 2018. Faiveley Plast, one member of the regional core group participated in this meeting to discuss about technical collaboration
- Plastipolis invited Eurecat to speak during the Smart Plastics Congress, which has been organized in Besançon in September 2018. As the same time, Eurecat visited some sites, for example S2P company in Oyonnax
- During the testing seminar organized by Plastipolis in Lyon on 29th of January 2019, Eurecat had the opportunity to visit the living lab
- During the transfer meeting in Barcelona in April 2019, Plastipolis invited the Ampere Lab, Plastipolis living lab and one regional company to visit Eurecat facility

Consequently to these meetings and visits, It appears obvious to develop New demo-case «Polymer-based functional products», an ESM Pilot of the Vanguard Initiative and in the EU S3 Platform coming from Greenomed project. The title of the demo-case is as follows: "**Seamless Integration of Electronics and Plastics. Production of high added-value plastics components and products with embedded electronics».**

Further meetings and visits are planned to continue the collaboration, for example the Smart Plastics Congress 2020 in Lyon and the Equiplast 2020 trade show in Barcelona.

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.

<u>Supporting tools:</u>

- 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

Defining an economic model of the demo case is the first step before searching for funding, in the regional level, but also in the national level and of course in the EU level. In the stage of the end of Greenomed project, for partners who have defined a

demo case, it appears the INNOSUP call is a suitable support for this kind of projects where clusters accelerate the development of such a case, in collaboration with SMEs.

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 ides of a new demo-case to Vanguard and upon receiving the approval from VI, it can go on with design and implement of a new pilot plant. In such a scenario, clusters should support the WG intensively to define of 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 a new Vanguard pilot plant.

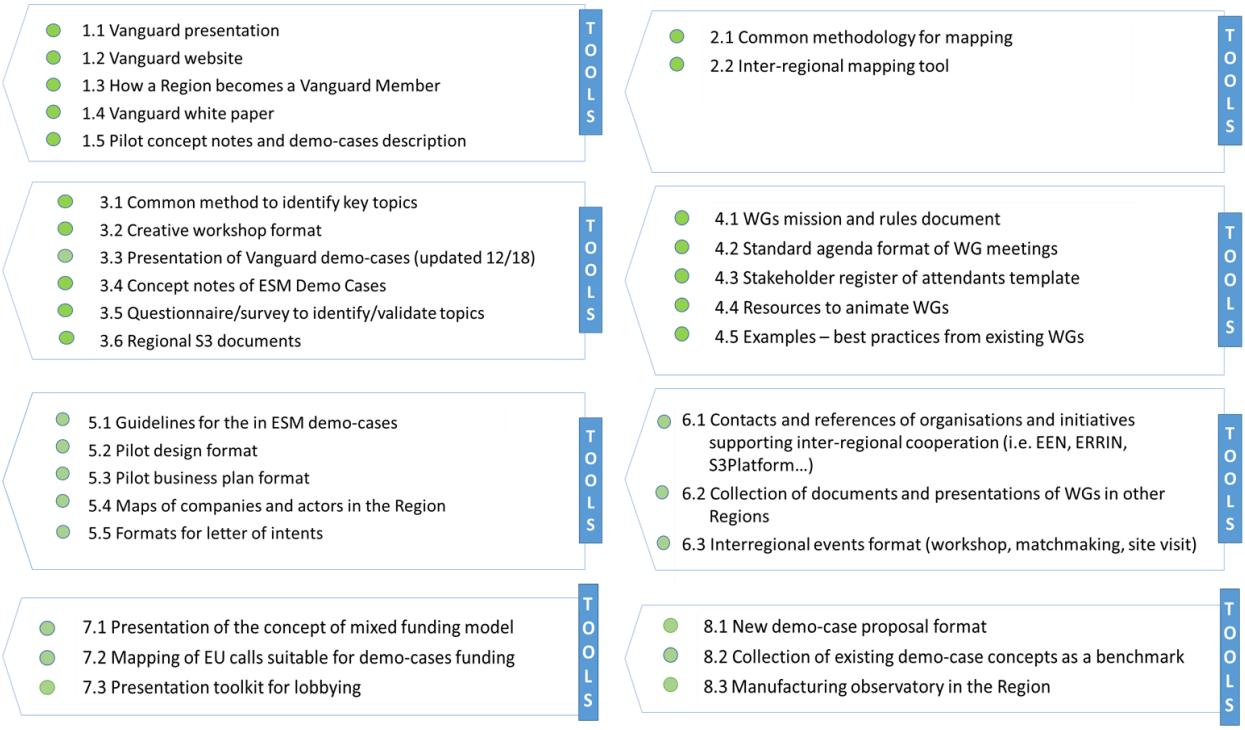
Supporting tools:

- 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

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



Chapter 3. Implementation stories by clusters in different MED regions

Here we explain the case of each cluster, how they implemented the methodology, what services they offered and how it brought benefit to the RIS as well as the challenges they faced.

3.1. Case 1: Marche Region

Characteristics of the region and situation prior to the implementation of GREENOMED

Marche is one of the most specialized and craft regions in Italy, one of the most industrialized in Europe and holds the national record of the production centers, hosting leading companies that are complemented by small companies in manufacturing output. The Region is ranked 16th for GDP among the total 272 regions of the European Union and, in 2014, it has been officially recognized as "Entrepreneurial Region of Europe" by the Committee of the Regions. To allow companies to be competitive in the European context, the Marche Region has

adopted the Regional S3, characterized by a widespread industrial manufacturing system, strongly oriented towards innovation. For this aim, four cross-sectoral fields have been identified:

- Home automation;
- Mechatronics;
- Sustainable Manufacturing;
- Health and well-being.

In the last few years, the circular economy topic has received considerable attention worldwide as an opportunity to optimise and promote sustainable production and consumption through new models.

Actions implemented through GREENOMED

Besides its manufacturing focus Marche Region was not aware of the Vanguard initiative, its objectives and dynamics. Accordingly, following the GREENOMED methodology, we started raising awareness on Vanguard Initiative focusing on the governance, the activities and the benefit for regional stakeholders and companies. We succeeded in overcoming this gap organising several events to present GREENOMED project to our stakeholders and to introduce them to the Vanguard Initiative. Once the Vanguard Initiative was properly spread, we went on with the identification of key topics for pilot plants within the regional territory, by adopting a bottom up approach. Thanks to the involvement on regional stakehoders 3 topics of interest emerged:

- De- and re manufacturing: with the goal to understand how to recycle and re-use the production waste from different manufacturing sector, including the waste of composite materials and convert them into revenues through the development of a Pilot Plant
- Waste treatment and recycling: with a particular focus on special and dangerous wastes.
- Energy efficiency.

Once we identified the key topics for pilot plants, regional core groups were established and animated to better define the sub-topics to be developed according to the industrial needs and interests emerged. We animated and orchestrated these groups exploiting the tools offered by the GREENOMED methodology and its steps. While the first two working groups were successful and collected the interest of a number of stakeholders, the energy efficiency topic was not easy to develop among the stakeholders identified since they did not find a common ground. The involvement of key stakeholders was a strategic activity started with an online call for expression of interest among our associated partners to check their level of interest. After this checking, we formalized their involvement through letters of intent and we are constantly working to collect the committment of other companies interested in the working group, through targeted follow-up phone calls and e-mails.

Alongside the establishment of the working groups, we worked hard to motivate ideas by organizing regional meetings during which we clarified the overall objective of the working groups. Accordingly, we promoted concrete actions to be realised within the working groups to start formalising some ideas and concepts based on the regional

competences and the industrial needs emerged. Thanks to a first mapping exercise we were able to gather a detailed overview of the topics targeted identifying related key technologies and possible developments as well as barriers and needs emerged when it comes to the industrial applications.

Main results through GREENOMED

Once we went through the Greenomed methodology, we consolidated an innovation regional ecosystem that was at the beginning disaggregated by involving several actors: universities, research centres and local stakeholders. By adopting a bottom up approach, we put a strong effort to engage, orchestrate and animate the working group on the de- and re-manufacturing for composite materials. First of all we tested the interest of our associated partners in taking part to the working group through targeted calls for expression of interest; secondly, we formalized their involvement by providing them the Project's letters of intent.

During the 2nd Greenomed Conference in Barcelona, we highlighted some common points between our working group on de and re-manufacturing and the one established in Milan by AFIL and coordinated by Prof. Marcello Colledani, which is dealing with the same topic. This represent a key aspect in order to set up links with other working group on the same topic and give a boost to future cooperation. It will be easier to work with the working group on de and remanufacturing established by AFIL, because we overcome the language and cultural barriers. To strength this cooperation, one of the coordinators of our regional working group, Eta Blades Srl, went to visit the living lab coordinated by Marcello Colledani in Milan. We also identified Living Labs to involve in the working group and, thanks to the support of the Lead Partner and AFIL, we figured out how to involve them in the Project. Concerning the involvement of regional Living Labs, the 10th of May we organized a regional Living Lab event at Università Politecnica delle Marche, to boost future synergies and collaboration among stakeholders.

From the political side, we are trying to obtain a strong commitment from the Regional administration authority in order to improve the knowledge about benefits of the circular economy. We took part to the First Political Meeting in Brussels, the 3rd and 4th of December 2018 with our regional representatives. This event was the occasion to understand challenges experienced by the stakeholders and possible support that could be provided by Regional authorities. We organized the regional event "Closing the Loop: Promoting Circular Economy in Marche Region" the 8th of March 2019, held 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. The target audience reached through the event has been represented by local companies, mainly SMEs of Marche Region, with the aim to encourage cross-fertilisation among different sectors. The Marche Region realized that the circular economy topic is fundamental to improve the development of the territory and for the first time the Region is going to open targeted regional calls on circular economy around June/July 2019.

We took part to the final Greenomed Conference, held in Milan the 5th December 2019. It has been the final event of the Greenomed project, targeting Regional Authorities and policy makers from MED and other European regions. We succeed in involving regional authorities of Marche Region to the event, by showing, explaining and transferring them the methodology designed and tested within the Greenomed framework. This effort has allowed Regions to cooperate efficiently for the collaborative design and implementation of pilot plants and innovation projects under the paradigm of Smart Specialization.

We were able to explain that the Project cooperation methodology is designed to facilitate Regional manufacturing ecosystems to access relevant innovation initiatives such as the "Vanguard Initiative" and the innovation Partnerships promoted by the S3 Platform of the European Commission.

Lessons learned that can be exported

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 topic, in order to engage companies and obtain a strong commitment from them.
- Find a coordinator to consolidate and lead the activity of the working group: without a strong coordination the working group could not have the chance to work properly. This happens to the energy efficiency group, where the leading company decided to leave the core group.
- Try to involve the regional authorities since the beginning of the Project to arise amore awareness on the topic across the territory.
- Cooperate with regional living labs to avoid overlapping of activities and at the same time keep on with the improvement of collaboration.

Main challenges

During the Project we faced some difficulties:

- Obtain trust from local stakeholders and involve them in the working group on de- and re- manufacturing. During the initial phases of testing activities, several Greenomed tools were exploited, in particular Power Point presentations provided by the Lead Partner to involve more companies.
- Involve Living Labs from the territory, due to the difficulty to let them understand benefits and opportunities coming from the participation in Greenomed Project. We overcame this challenge thanks to ad hoc meetings with the Living Labs. Through the meetings, it has been possible to formalize the partnership with 2 Living Labs: Meccano and Università Politecnica delle Marche.
- 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.

3.2. Case 2: Rhone-Alpes

Characteristics of the region and situation prior to the implementation of GREENOMED

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 Bade-Wurttemberg, 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 plastronics specialisation. In concrete, there is the "City of Plastronics" 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.

Actions implemented during GREENOMED
The GREENOMED pilot plant in Auvergne-Rhône-Alpes offers 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 may be the result of regional work, but also from extra-regional partners.

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 identification of the topic for GREENOMED project was very clear to Plastipolis. The main challenge for the region was to involve more critical mass, mainly companies, to the initiative and the working groups. That is why Plastipolis organised a dedicated event 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 meets 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.

Main results through GREENOMED

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

- Acknowledgement and lick with regional Smart Plastics ecosystem in the MED zone with identification of collaboration, for example with Catalonia. Now there is a regular contact with Catalonia working group. Other potential collaborations may be established with other MED regions, and even with other regions out of MED regions.
- Consolidation of the 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.
- GREENOMED pilot plant structuring regarding the business plan. Has now all the elements to write the business plan and potential expansion strategy thanks to the consolidation of the regional stakeholders mapping and the identification of potential interregional partners.

Lessons learned that can be exported

Although the topic identification appeared obvious in the Auvergne-Rhône-Alpes region, the process of Plastipolis
regarding the regional RIS3 and Plastipolis strategy and ongoing actions, it appeared obvious to Plastipolis that Smart Plastics is a main topic regarding green manufacturing (using less material, less components, lightening products) in the Auvergne-Rhône-Alpes region. As Greenomed project appeared after the Smart Plastics economic start in the region, the needs of motivation to participate came out:

- Need to increase communication of Greenomed objectives and potential results in short term for regional companies business
- 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
- Better adaptation to companies constraints (big companies already organised globally and small companies not enough advanced in the topic)

Main challenges

Some challenges appeared to Plastipolis during GREENOMED project progress:

- The involvment of the core group and companies, mainly because they already have technical monitoring, and for some of them ongoing projects regarding smart plastics. The Greenomed project does not contribute to speed up their current tasks so far
- The link of « la Cité de la Plastronique » in Oyonnax, forecast to be built in 2020, but now 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 strenghten regarding the project time frame

3.3. Case 3: Slovenia

Characteristics of the region and situation prior to the implementation of GREENOMED

Technology park Ljubljana describes in this handbook the situation of Western 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 commericalisation 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.

Slovenia and Circular Economy

The 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.

Slovenia and International focus

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.

Actions implemented during GREENOMED

TPLJ 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 trough 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.

TPLJ 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.

Main benefits through implementation of GREENOMED methodology

- 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.

Main challenges

- 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 TPLJs 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.

3.4. Case 4: Croatia

Characteristics of the region and situation prior to the implementation of GREENOMED

Croatia is a Central European country with 4.284.889 inhabitants (in 2011). It is surrounded by the northern border with Slovenia and Hungary, on the east with Serbia, Bosnia and Herzegovina and Montenegro in the south and east and across the sea border with Italy. 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. The most important economic sector is tourism, with about 10 million foreign visitors per year and 15% of GDP. 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 become more and more popular in the economist surrounding. Croatia recognizes need for going green but situation is not promising. 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 under performing 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 "Inteligentna energija" 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.

Actions implemented during GREENOMED
As region of Croatia was not aware of Vanguard initiative at both company and governance level we started the process with the Vanguard framework setting. Throughout the project GREENOMED, Cluster Intelligent Energy has undertaken various activities related to raising awareness of the Vanguard initiative. Cluster "Inteligentna energija" attended the Watify event on automation and robotics in green manufacturing to identify potential topics for pilot plants and mobilise stakeholders, in which discussed manufacturing processes software controling and the Vanguard Initiative, of which Mr. Perkov stated its actually and potentially emerging benefits.

Cluster Inteligent Energy co-organized the "Smart Industry for Green Future" event in Zagreb. Mr. Perkov held a presentation on the Vanguard Initiative and the GREENOMED project. It was concluded that industry in Croatia could and should be closer to green manufacturing. During the Q/A Mr. Perkov underlined the importance of projects like GREENOMED for green manufacturing further development in Croatia

Main results through GREENOMED

Mr. Mladen Perkov contacted all the companies he considered to be potential members of working group. In direct contact with potential companies, he presented the GREENOMED project and the benefits of joining it. During the 4th period, 4 companies (DELTA PROJEKT, CENTROMETAL, ENERGOVIZIJA and HELB), 1 University (FER LARES) and 1 NGO (Croatia green building council) were involved in testing activities. They are part of regional WG and they signed letters of intent.

CIE reinforced the concept of Living labs in the region with the participants of 1st Living lab event in Zagreb (Dec 21st 2018). They discussed the monitoring systems as the main theme for a living lab in Croatia.

During the events, we included the companies Veski, Helb and the Croatian Wood Cluster in activities within the GREENOMED project. The participation of our stakeholders at events in Brussels, Lyon and Barcelona encouraged the trans-regional cluster co-operation and exchange of knowledge and experiences.

Thanks to GREENOMED project and joint meetings with stakeholders, cluster "Inteligentna energija" 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. Cluster "Inteligentna energija" will continue to work on energy efficiency issues and search technologically innovative solutions along with cluster members and GREENOMED stakeholders.

Lessons learned that can be exported

Croatia has recognized the absolute need for moving towards circular economy and green manufacturing. One of the biggest challenges was in the fact that a lot of companies in Croatia weren't interested in long term investments and potential changes in their manufacturing process. One of the main reasons was the fact that new technologies and solutions seemed abstract. That problem was met by involvement of stakeholders at the very beginning through:

- bilateral meetings
- various events,
- presenting Vanguard initiative since pilot plant programs literally solve the issue of investment fear and technology leap.

Main challenges

Croatian stakeholders, especially SMEs are extremely oriented towards short term impact activities. Cluster "Inteligentna energija" attended various events with the purpose of presenting GREENOMED and Vanguard Initiative. These activities have produced several results; however, they were time and effort consuming, and clusters

has determined that additional efforts are needed. Also, due to the challenging economic situation, most companies are reluctant toward investments, mostly due to market's unclear future challenges. Cluster "Inteligentna Energija" has determined that these financial uncertainties are the main barriers to regional stakeholders' mobilization. In spite of this, Cluster "Inteligentna Energija" increased the number of workgroup members by increasing awareness of benefits gained through GREENOMED.

3.5. Case 5: Greece

Characteristics of the Region of Central Macedonia and its situation prior to the implementation of GREENOMED project

Basic characteristic of the Region of Central Macedonia
The region of Central Macedonia is one of the thirteen regions of 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.

Macroeconomics data
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).

Significant performance indicators
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)

Education and Research
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.

The situation of the Region of Central Macedonia prior to the implementation of GREENOMED
Prior to the implementation of the GREENOMED project, the region of Central Macedonia was focused 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.

Actions implemented during GREENOMED

Taking into account the fact that the Region of Central Macedonia was not aware about Vanguard initiative nether 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 created three local working groups upon the following subjects:

- Exploitation of wineries' biomass residuals to energy production (acronym: BIO2CHP)
- Exploitation of agro-energy industries' residuals and by-products to produce feed and food ingredients through microalgae cultivation (acronym: RETAIN)
- Exploitation of ginning and spinning mills' solid waste to energy production (acronym: EOGAS)

After the establishment of the regional working groups which in the beginning were consist of two or three members for each working group, several rounds of bilateral meetings took place in order to further invigorate them (quantitative and qualitative). Towards this direction, i-BEC organized a testing workshop on 17th of May 2019 as well as on 15th of October 2019. Furthermore, i-BEC participated in the 2nd GREENOMED Conference in Barcelona, during which representatives of the 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.

Moreover, i-BEC procced to the linkage of the working groups with regional living labs in order to provide to the later further support during the preparation of their business plans for the development of pilot plant(s) in the near future. To that end, i-BEC

organized two living lab events during the duration of the project. The first one took place on 28th of June (2019) in the accredited testing laboratory of i-BEC, while the second one took place on 16th of October 2019 in the Laboratory of General and Inorganic Chemical Technology, School of Chemistry (AUTH).

The abovementioned WGs worked together with i-BEC throughout the implementation of the project in order to establish a sustainable business plan of their common cooperation in the frame of green manufacturing. Each working group consist of relevant enterprises as well as knowledge providers (universities and/or private units), while one of the members of the working group RETAIN is a consulting company providing a broad spectrum of services in all fields related to agri-food sector throughout Greece.

Moreover, on 15th October 2019, i-BEC, with the support of CNR and AFIL, organized at its premises the first GREENOMED transfer event in the Region of Central Macedonia in order to spread the GREENOMED methodology in regional clusters and business associations. The event joined representatives of the Agri-food cluster of Central Macedonia (Ag-Cluster) as well as representatives from the Greek Exporter Association (SEVE). During the transferring event, a set of services and tools developed through the GREENOMED project were presented to the participants with the goal to further utilization them through their organizations.

At the political level, i-BEC was 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. Except of bilateral meeting with policymakers of the Region of Central Macedonia, i-BEC organized. Moreover, on 14th of October 2019, i-BEC organized at its premises an informative event about the exploitation of the GREENOMED results in Greece as well as the Vanguard Initiative and Pilot plants to regional policymakers coming from the Region of Central Macedonia and from the Region of Western Macedonia. Finally, i-BEC ensure the active participation of two representatives from the Region of Central Macedonia in the 3rd GREENOMED Conference (political meeting) during which, Mr Constantinos Michailides, the Director of the Independent Directorate of Innovation and Entrepreneurship Support of the Region of Central Macedonia stated that in the upcoming period the Region of Central Macedonia will launch the procedure to became a member of Vanguard Initiative.

Main results through GREENOMED

"Now that we went through the GREENOMED methodology we have consolidated an innovation ecosystem which was disaggregated and not cooperating too much. We have engaged a number of 13 companies in the 3 regional working groups and made links with the Lombardy region in the topics of exploitation of microalgae as a mechanism for regenerate food and feed ingredients from agro-energy industries. We have also the commitment of our regional administration that is on the way to see how to enter Vanguard Initiative. We have reinforced the concept of Living Labs in the region and will be the central space for interregional innovation regarding the

exploitation of wastes and by-products deriving from the operation of the agro-food and agro-energy industries in the Region of Central Macedonia"

Moreover, i-BEC reinforce the culture and knowledge of green manufacturing among the agents of the ecosystem in the Region of Central Macedonia, especially among SMEs, clusters, and RTOs. Finally, in the frame of GREENOMED project, i-BEC provide support to the Region of Central Macedonia in order to establish the Innovation and Entrepreneurship Ecosystem Support Facility in Central Macedonia « one-stop liaison office», which will be the local point for synergies between companies and other type of stakeholders in the frame of eco-innovation.

Lessons learned that can be exported

- 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.

Main challenges (this will be included in another section)

- 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.