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# Methodology for Regional Cooperation

# Synergic Circular Economy across European Regions SCREEN

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# 1. Preface

Circular Economy is an emerging paradigm aiming at establishing a new sustainable development path by decoupling economic growth and resource consumption. Circular Economy shows potentials to generate new business opportunities in worldwide economies and to significantly increase resource efficiency in industrial systems. The vision of the Circular Economy paradigm is to fundamentally change the current linear "take-make-dispose" economic approach, which is cause of massive waste flows. In contrast, Circular Economy is an industrial system that is restorative and regenerative by intention and design [1]. It aims to keep products, components, and materials at their highest utility and value along their life-cycle. It replaces the product 'end-of-life' concept with restoration and aims at the elimination of waste through the superior design of materials, products, systems, and, within this, business models. Recent studies show that a transition to Circular Economy may represent a new sustainable growth path as well as a business opportunity for the worldwide industry [2]. In a world of close to 9 billion people expected by 2030 - including 3 billion new middle-class consumers - the challenges of expanding resource supply to meet future demand are unprecedented. Without a rethinking of how society uses materials in the linear economy, resources that are vital for industry could be depleted within the next 5-50 years, reaching the planetary boundaries with irreversible effects [3]. A new industrial model that decouples revenues from material input, and production from resource consumption is needed for achieving a sustainable development path, both in early-industrialised countries and in emerging economies [4]. A sustainable transition to Circular Economy is expected to bring benefits in environmental, economic and social terms.

European Regions play a fundamental role in boosting the transition towards this new economic model. Circular Economy opportunities emerge from systemically connecting stakeholders within innovative value-chains that intersect the traditionally defined business sectors. Moreover, these opportunities require multi-disciplinary technical approaches that go beyond the competences on individual business actors. By exploring the existing synergies between the local smart specialization areas and core business sectors, European Regions can drive the identification and establishment of innovative circular value-chains in Europe, providing benefits to the local stakeholders and, in turn, to the socio-economical regional eco-system. However, in this process of identification of synergies and alignment of objectives, a new and shared methodology is needed that can be replicated and upscaled at European level for systematically boosting the implementation of virtuous circular economy practices.

The SCREEN project, Synergic Circular Economy Across European Regions, funded by the European Union's Horizon 2020 Research and Innovation program, under grant agreement number 730313, has focused on the development of such methodology. SCREEN involves 17 European Regions working together with the objective of defining a replicable and scalable approach, to support European Regions in the transition to new Circular Economy cross-regional value-chains. This has been done through the identification and implementation of operative synergies between R&I investments of H2020 program and EU structural funds. The main technical objectives and pillars of the SCREEN project are summarized in Figure 1. The



methodology developed within SCREEN will be replicable in all the European Regions, thus creating an interregional framework for implementing innovative circular value-chains.

This document presents the SCREEN approach and highlights the benefits of the developed methodology through examples derived by its application to the SCREEN Regions. Through this publication the SCREEN consortium intends to disseminate the developed approach to the European stakeholders, with the vision of extending the approach to other Regions and business actors in Europe, also beyond the project life-time. The intention is therefore to transfer the information on the main steps of the methodology through a clear and synthetic language. More detailed information on the referred public project deliverables and the SCREEN outcomes can be found in the SCREEN website http://www.screen-lab.eu.



Figure 1: Technical objectives and pillars of the SCREEN project.

# 2. The SCREEN Methodology for Regional Cooperation

The SCREEN methodology is a scientific approach based on four main phases namely *Data Collection, Analysis, Synthesis* and *Implementation*. These phases are emphasised in the box.

- Data Collection: A tool has been designed to collect data about existing capabilities in the Screen Regions, also considering the Smart Specialization Strategies and the key industry sectors.
- Analysis: A twofold data-driven and interaction-driven approach has been followed in order to analyse the existing capabilities and identify the existence of regional hotspots and crossregional opportunities and emerging ideas.
- 3. **Synthesis**: The existing cross-regional value-chains have been formalized and specific opportunities that can potentially result in actions to be implemented through cross-regional cooperation have been formalized.
- 4. **Implementation**: The identified cross-regional cooperation initiatives are mapped against existing funding and support instruments at Regional and European level to analyze gaps and formalize requirements towards new support instruments.



The *Data Collection* phase is needed to achieve a mutual understanding of existing multi-facet regional capabilities and smart specialization areas. Sharing a common knowledge basis is indeed the pre-condition for the identification of potential regional and cross-regional links were new circular opportunities can emerge. The output of this phase is the population of a structured database for each Region, namely the *SCREEN Mapping tool*, containing information about the existing capabilities in a coherent and homogeneous format.

The *Analysis* phase aims at exploiting the available information to identify emerging and currently unexploited local and cross-regional synergies, in view of the identification of cross-regional Circular value-chains. To this aim, a twofold approach is followed, encompassing a more rigorous data-driven approach and a soft skill oriented interaction-driven approach, through specific local workshops. The output of this phase consists in the preliminary identification of regional hotspots and cross- regional emerging ideas under a value-chain oriented approach.

The *Synthesis* phase aims at formalizing the potential cross-regional value-chains and the specific innovation actions and projects that could be supported for driving the establishment of these value-chains. In this phase, preliminary *Synergy Maps* are derived by exploiting the data analysis outcomes. Then, the specific cross-regional value-chains and the involved regions / stakeholders are mapped. Furthermore, at higher level of details, the specific emerging ideas and actions that can boost the establishment of such new value-chains are formalized. To support the prioritization among these actions through the prediction of the expected impacts, a new set of Circular Economy Key Performance Indicators (KPIs) and methods for their quantification have been elaborated, that can be used as strategic tools by Regions.

The *Implementation* phase looks at the identification of the most suitable support and financing tool to enable the activation of the synthetized innovation actions. The existing Regional instruments presenting suitable characteristics to support the identified cross-regional initiatives are classified, according to a framework common for all the regions. Specific best practices are highlighted to enabling a cross-regional learning process. Then, the existing gaps among the instruments and the features of the synthetized initiatives are highlighted, resulting in specific requirements and recommendations for the development of new support instruments in the future. Such recommendations are transferred to the Policy Lab, which is the SCREEN permanent committee of regional representatives, linking the SCREEN project to the European Commission and other European Institutions active in Circular Economy, for further discussions towards the implementation.

The detailed steps of the SCREEN methodology, aligned with the aforementioned four phases, are represented and summarized in Figure 2.



Figure 2: Specific steps of the SCREEN methodology. Data Collection (Green), Analysis (Light Green), Synthesis (Light Blue), Implementation (Deep Blue).

# 3. Data Collection

The Data Collection phase has been supported by a tool specifically designed within the SCREEN project and named *SCREEN Mapping tool*. More information about this tool can be found within the public deliverable D2.1 "Screen Mapping Tool: Scope and Guidelines". The availability of a structured and formalized knowledge basis concerning the existing capabilities and best practices being developed within the European Regions is of paramount importance to support the identification of promising local and cross-regional value-chains and to boost a transition to new circular economy business opportunities in Europe. Indeed, by analysing such information, missing links in the product and material loops as well as potential cross-sectorial best practice transferring mechanisms can be identified. However, a similar knowledge base is currently poorly deployed, thus bounding the opportunities for Regional cooperation in the identification of specific actions to unlock circular economy potentials. To overcome such limitation, the *SCREEN mapping tool* has been designed within the SCREEN project to collect data about existing capabilities in the Regions, also considering the Smart Specialization Strategies and the key industry sectors.

The SCREEN mapping tool consists in a pre-formatted excel file, containing the metadata structure for supporting the mapping of the Regional capabilities, under common criteria. The data collection framework is inspired by the approach adopted in the multi-regional Vanguard Pilot on "De-and Remanufacturing for Circular Economy" [5] and considers general inputs from the "Policymakers Toolkit" proposed by the Ellen Mc Arthur foundation [6]. However, these data structures are adapted to the scope of the SCREEN project. In the following, after a general



overview of the mapping tool, each area is discussed. The reference framework to which the SCREEN tool is referred is discussed in the next section.

The SCREEN mapping tool has been presented to the consortium, compiled by the participating Regions and validated through several Question and Answers (Q&A) web-meetings, where the major aspects of improvement and the major barriers to the compilation were gathered and used for improvement. Moreover, a quality feedback questionnaire was produced to support continuous improvement of the tool and better alignment with available information at the Regional institutions.

# 3.1 The SCREEN Mapping Tool

The main objective of the *SCREEN mapping tool* is to map within a comprehensive framework the current baseline situation in the Screen Regions in terms of existing technological, industrial, research and innovation, and education capabilities, as well as emerging Circular Economy initiatives, in line with the RIS3 strategy of the Region. The metadata contained in the excel file were organized in six steps corresponding to six different areas of interest for the Regions, according to the framework reported in Figure 3.





Figure 3: The SCREEN Mapping tool framework.

Each area is classified as *Mandatory*, *Strongly Recommended*, or *Optional*. Mandatory data is referred to data required for the subsequent analysis of local and cross-regional value-chains that will be carried out in phase two of the SCREEN methodology. Strongly Recommended data refer to already existing and identified emerging ideas proposed by regional stakeholders that could represent future areas of development of Circular Economy initiatives within the Region. Such emerging activities may be latent, implicit and not yet well-formalized nor implemented innovation ideas that, if efficiently boosted, could result in new circular businesses with high impact for the Regional stakeholders. Proposers can be different stakeholders, including industrial, research and education organizations or associations and clusters. These emerging



ideas shall bring significant expected impacts, considering economic, social and environmental impacts.

While areas from 1 to 4 are focused on technological and strategic perspectives, Optional data refers to the analysis of non-technological barriers. This analysis can help defining existing conditions, which can slow or foster the implementation of new circular value chains. The first area is related to existing legal frameworks at both national and regional level. The second area relates to the initial identification of existing support instruments that could foster the implementation and development of the most innovative circular economy initiatives. The analysis of the existing funding instruments will, in any case, be further developed in phase 4 of the overall SCREEN methodology. For each entry line, the data source can be reported. This option has been included in order to improve data traceability and reporting capabilities.

The introduction of different levels of importance of the SCREEN Mapping Tool areas is due to need of dealing with different degrees of maturity of European Regions with respect to sectorial and business data collection, statistical analysis and monitoring. The idea is that while regional institutions where specific units focused on data collection and analysis are already established would complete all the areas of the tool, those regional authorities which are less structured with respect to data collection and analysis would only focus on mandatory data. However, a learning process is expected in the medium-long term.

In the following paragraphs the metadata structure will be briefly presented. The sheets of the complete Excel Tool, along with some examples for its compilation, are found in the SCREEN project website. An overview of the SCREEN Mapping tool areas and sub-areas is provided in Figure 4 and the specific objectives and outputs of each area are commented in Table 1.



Figure 4: the SCREEN Mapping tool areas and sub-areas.

SCREEN Mapping tool area	Objective	Expected Output
1. RIS 3, strategic areas, SWOT analysis	Highlight the most strategic innovation areas in the Region in view of supporting the transition to Circular Economy.	SWOT analysis of the Regional capabilities, understanding of the RIS3 areas related to Circular Economy.



2. Focus sectors and companies	Identify the role of sectors in the regional economy and highlight the maturity level of sectors towards Circular Economy.	A broad understanding of the industrial eco- system of the Region.
3. Research, Development and Innovation Capabilities	Create a Circular Economy oriented overview of research, innovation, development and education capabilities	Map of existing expertise in the Region, able to drive innovation in Circular Economy.
4. Emerging Ideas	Map the emerging innovation ides in the region	List of emerging ideas to be considered in each Region.
5. Existing Circular Economy Legislation	Map sector-specific legislation and policies	List of implemented regulations and policies
6. Existing Funding Instruments	Review of the existing portfolio of funding instruments for supporting Circular Economy innovations	List of funding instruments at regional level

Table 1: the objectives and expected outcomes of the SCREEN Mapping tool areas.

The specific metadata for each area and sub-area are available in the public deliverable D2.1, together with the guidelines and instructions for completion. In this document, the main of data fields are reported in compact form within Table 2.

	SCREEN Mapping tool							
Area	Sub-area	Data Fields						
1. RIS 3, strategic areas, SWOT	RIS3	Brief Description						
analysis	SWOT Analysis	Environmental, Economic, Social, Regulatory, or Other						
2. Focus sectors and companies	Focus Sectors	Employees in the region; Turnover; Gross Value Added; Number of companies in the region; Volume of waste generated by the sector, Share of waste recycled, landfilled and incinerated						
	Companies	Name; Position in the circular value chain; Application Domain of Circular Economy activities; Technological Capabilities; Input materials; Output materials.						
3. Research, Development and Innovation Capabilities	General Overview	Gross Domestic Expenditure on R&D EU funding for research and innovation; Number of total patent applications; People employed in R&D in the Region. Project Name; Funding Source; Abstract; Total budget; Requested funding; Consortium of the project; Regional partners; Target sectors.						
	R&D Capability	Department or Institutes: Number of researchers; Application domains; Enabling technologies; Number of spin-off and Start-up						
	Innovation Capability	Name; Application domains; Enabling technologies; Facility owner(s); Types of access; Services and activities.						
	Education Capability	Institute name; Provided course name; Area/sector; Type of course; Number of students;						
4. Emerging Ideas		Abstract; Potential partnership; Target sectors; Position in the value chain; Target product/material/service; Expected impact.						
5. Existing Circular Economy	Regulatory Framework	Regional vs national; Existing vs under development						



Legislation	Policy Implementation Mechanism	Education, information and awareness actions; Collaboration platforms; Business support schemes; Incentive mechanisms for circular economy
6. Existing Funding Instruments	Financial instruments stemming from European Regional Development Funds (ERDF)	ERDF funds.
	Other financial instruments	Regional R&D Support Programmes; Regional Innovation Support Programs; Vouchers for Industry; Start-Up Programs

Table 2: Specific data fields for areas and sub-areas within the SCREEN Mapping tool.

# 3.2 The SCREEN value-chain oriented taxonomy

The overall viewpoint taken within the SCREEN Mapping tool is focused on the identification of new circular value-chains. Therefore, a taxonomy of circular value chains and a shared definition of its core transformation phases was developed in SCREEN to provide a common ground to map the regional stakeholders and define circular economy opportunity. These definitions are compliant to those reported in [2]. The objective of this framework is to provide a common representation of circular value-chains, providing the capability to map the position of a specific stakeholder in the respective phase of the circular value chain. In the following, the main features of the circular value-chain taxonomy is reported. The framework is presented by following and incremental approach, starting from a traditional linear value-chain (make-take-dispose). The phases of a typical linear value chain are presented in Figure 5. An explanation of the different phases follows.



Figure 5. Transformation phases in linear value chains.

- **Gathering of Core Resources**: this encompasses all the activities referred to the gathering of raw materials.
- **Primary Material Processing**: this encompasses all the activities that pre-process the "core" material, before production in the narrow sense.
- **Production**: this encompasses all the production activities, i.e. the activities and processes which act on the pre-processed input material and transform it to generate the core value-added product within the value chain.
- **Packaging & Distribution**: this encompasses all the operations dealing with the packaging of the value-added final product, and its distribution to the users.
- **Use/Service**: this encompasses the use of the product and the related services.
- **Collection**: this encompasses all the reverse logistics operations of collection of post-use products or materials.
- **Disposal**: This encompasses all the activities concurrent to the non-circular disposal of the product or its materials in landfills.



Within the framework, each linear value chain is related to a particular **product flow** (core resources transformation), which will be referred to as the "**Primary Flow**". For each position in the linear value chain, it is possible to identify "**Secondary Flows**". They could be input flows (e.g. materials, water and energy) or output flows (e.g. by-products, such as solid waste and wastewater) of a specific position in the value chain. These latter can result in "Primary Flows" of other value chain as well. Please note that the property of a product/material flow of being "Primary" or "Secondary" depends on the value chain under analysis. Examples of "Secondary Flows" are showed in Figure 6.



Figure 6. Primary and Secondary Flows in the Value Chain.

The transition from a linear to a circular value chain requires the introduction of reverse flows that close the loop at different levels of the value chain according to the waste management hierarchy, by exploiting appropriate technologies and capabilities. The proposed framework aims at capturing the "circular" perspective, leveraging both on Primary and Secondary Flows. At technical levels, different business options for circular economy and different levels to close the loop have been proposed to generate benefits by exploiting different value-creation mechanisms. The representation of the circular value-chain is reported in Figure 7.







Each Circular Economy option is further detailed:

- a) **Maintenance**: it is referred to operations performed on a product, in order to extend its useful life-time. It is usually delivered as a service.
- b) **Reuse**: It refers to all operations where a return product is put back into service, essentially in the same form, with or without repair or remediation [7].
- c) **Repair**: includes the correction of specified faults in a product. Repair refers to actions performed in order to return a product or component purely to a functioning condition after a failure has been detected [8]. Repair can take place either in service or after discard.
- d) Remanufacturing: it is defined as a standardized industrial process aiming at restoring or upgrading the functions of a product, in line with technical specifications. The remanufacturing process usually involves disassembly, inspection, cleaning and remachining or replacing of components. A main distinction can be made between remanufacturing for function restore and remanufacturing for function upgrade. In the first case, remanufacturing aims to return a used product to at least its original performance with a warranty that is equivalent or better than that of the newly manufactured product. A remanufactured product fulfills a similar function to the original [9]. Remanufacturing with upgrade is the process of providing new functionalities to products through remanufacturing. Remanufacturing with upgrade aims to extend products' value life enabling the introduction of technological innovation into remanufactured products in order to satisfy evolving customers' preferences and, at the same time, preserving as much as possible the physical resources employed in the process [10].
- e) **Closed Loop Recycling**: is defined as "a resource recovery method involving the collection and treatment of waste products for use as raw material in the manufacture of the same or a similar product" [11]. In closed-loop recycling, the inherent properties of



the recycled material are not considerably different from those of the virgin material, thus substitution is possible. Resources recycled in this way are used as input materials for the same value chain they are collected from. Closed-loop recycling, in particular, is a more sustainable concept than Open Loop Recycling, because recycling of a material can be done indefinitely without degradation of properties.

- f) Open Loop Recycling: the conversion of material from one or more products into a new product, involving a change in the inherent properties of the material itself (often a degradation in quality). In open-loop recycling, the inherent properties of the recycled material differ from those of the virgin material in a way that it is only usable for other product applications, mostly substituting other materials [12]. In open-loop recycling a material is not recycled indefinitely, and is eventually excluded from the utilization loop, becoming waste.
- g) **Biochemical Feedstock Recovery**: "recovery" is an activity applicable to materials, energy and waste. It is a process of restoring materials found in the waste stream to a beneficial use which may be for purposes other than the original use" [12], e.g. conversion of the organic fraction of a waste stream into natural gas or heat.

# **3.3 Outcomes of the Data Collection phase**

The SCREEN Mapping tool has been compiled, at different levels of detail, by the 17 SCREEN Regions. Throughout the life-time of the project, the compiled tools have been uploaded in a common repository, in order to make the contained information visible to all the partners, at all stages of project development. For sake of clarity, the contained information is not reported in this document, but it is made available in the SCREEN web-site, excluding confidential information related to stakeholders emerging ideas. In summary, the following figures, reported in Table 3, give an idea of the great potentials of the tool in terms of amount of structured information contained, also in view of the application of specific data analytics instruments (outside of the scope of SCREEN).

SCREEN Mapping tool KPIs						
Indicator	Value					
Number of Regions compiling the tool	17					
Total Number of records	30,000					
Number of companies mapped	300					
Number of projects mapped	120					
Number of R&D&I stakeholders mapped	50					
Number of Emerging Ideas	150					
Industrial Value-chains analyzed	13					

Table 3. Summary of outcomes of the SCREEN Mapping tool.

Moreover, in order to gather feedback on the usability of the tool, several tutorial sessions have been activated where partners had the possibility to address questions and suggest improvements. After these web-meetings, the Screen mapping tool was considered as accepted and understood by the Screen Regions. In particular, the following general comments on the effectiveness of the Screen Mapping tool were gathered:



- Useful tool for systematic value-chains identification that can be integrated with other EC initiatives.
- Useful as a continuous review process.
- It triggers practical examples, learning from best practices.
- Promotes strong interaction with stakeholders during the completion.
- It supports avoiding replication of initiatives.
- There is need for new CE KPIs for rating emerging ideas.
- There is need for close interaction with data analytics regional offices.

These feedback has been elaborated and addressed in the next phases of the SCREEN methodology.

# 4. Analysis

As mentioned in section 2, the Analysis phase of the SCREEN methodology is carried out with a twofold approach. On the one hand, a data-driven analysis approach is followed, were the information contained in the SCREEN mapping tool is exploited to highlight missing links in the value-chain and potential cross-regional collaboration areas with a systematic approach. On the other hand, and based on the knowledge of the capabilities highlighted in the SCREEN mapping tools, workshops have been organized both at local and cross-regional level, to drive a discussion towards the identification of cooperation areas and innovation needs in the core sectors highlighted in the Smart Specialization strategies of the Regions. Both approaches are discussed in the section and examples of outcomes generated during the SCREEN project are reported. More details of both approaches can be found in the public SCREEN deliverable D3.1 "A roadmap for Building Circular Value-chains".

# 4.1 Data-driven analysis

The data-driven analysis aims at exploiting the availability of information contained in the SCREEN mapping tools compiled by the Regions to identify potential local and cross-regional synergies and initiatives targeted to new circular economy business cases.

Regional capabilities and best practices are not transferable between regions as such, but a post-processing of the information contained within the different Screen mapping tools compiled by the Regions needs to be carried out in order to understand collaboration potentials. This objective can be achieved through the application of different synergy identification mechanisms:

- **Mechanism 1:** *value-chain analysis.* By analysing the information contained in the "Company" sub-area, complete value-chain representations can be obtained, both at regional level and at cross-regional level. This will make it possible to have a compact overview of the value-chain coverage in the geographical area of interest and to identify missing nodes in the value-chain that prevent from a transition from a linear to a circular value-chain. If stakeholders from more than one region are involved, this representation provides a clear identification of a potential cross-regional synergy to be exploited to close the loop in the region.
- **Mechanism 2:** *material-driven analysis*. By analysing the information contained in the "Company" sub-area, input and output material types for each stakeholder can be gathered and possible upstream-downstream material links can be identified through



proper material flow-charts. For example, if a region has a stakeholder in a specific step of the value-chain that generates waste that is potentially acceptable as input by another stakeholder of a different region positioned in another value-chain, there is an option for a circular economy synergy resulting in a cross-sectorial and cross-regional innovation.

- **Mechanism 3:** *Matching capabilities with emerging ideas.* By analysing the information in the area 3 related to "Capabilities" and in the area 4 related to "Emerging Ideas" it is possible to identify existing capabilities that, if exploited, could support the implementation of the emerging idea. This provides potential for best practice/capability transfer among sectors (local) and Regions (cross-regional). For example, if a region expressed an emerging idea that has been already addressed within another region as a best practice (or capability) there is an option for transferring the best practice.
- **Mechanism 4:** *Transferring of boundary non-technical preconditions.* By analysing the strategic vision of the Region (area 1) and the non-technical areas 5 and 6, the need for possible cross-regional or cross-sectorial transferring of legislation and funding instruments can be identified, in order to drive the alignment of innovation activity with the regional development strategies.

The mechanism 1 is supported by cross-regional value-chain diagrams. These diagrams are obtained by mapping on the value-chain representation of Figure 6 the companies framed in the SCREEN Mapping tool belonging to a specific sectorial value-chain, in different phases of the transformation process. The input data are contained in the SCREEN Mapping tool sub-area "Company", within the "Position in the value-chain" field. Example can be found in Figure 7 and Figure 8, where the automotive and food sectors are considered, respectively.



Figure 7. Transport and mobility value-chain.





Figure 8. Food and beverage value-chain.

The mechanism 2 is supported by material-flow maps. By considering the fields of the SCREEN Mapping tool under the "Company" sub-area named "Input Material" and "Output Material" specific maps, showing the existing and potential material links can be developed, at local and cross-regional level. An example of material-flow map using a Sankey diagram developed by the Province of Fryslan is reported in Figure 9.



Figure 9. Material flow map elaborated by Fryslan using the Sankey diagram.

All in all, 13 value-chains have been identified in SCREEN, with the explained approach, namely:

- **Business driven sectorial value-chains:** Electrical and Electronic Equipment; Energy Paper and forest-based industries; Textile; Transport and mobility; Food and beverage.
- **Material-driven value-chains:** Agriculture; (Smart) Packaging; Water and wastewater; Biobased materials & biotechnology; Manufacturing & de-manufacturing ; (Bio)waste management; Construction/Build Environment.

Mechanisms 3 and 4 are supported by specific *Synergy Grids*. A synergy grid is a table elaborated from the SCREEN Mapping tool reporting in a unique synthetic view the main



hotspots of the Region. A hotspot is defined, in broad sense, as a core competence area of the Region, in which the Region shows specific competitive advantage or skills. Hotspots can be related to capabilities, infrastructures or legislation and policy instruments. An example of sectorial hotspots map is represented in Figure 10, obtained by linking the information contained in the area "Focus Sector" of the Screen Mapping tool. An example of thematic synergy, focused on the emerging idea named "Nutrient recovery from wastewater" is reported in Figure 11.

Focus Sectors									
NACE - Sectors	Lazio	Lombardia	Fryslan	Crete	Tampere	Scotland	Navarra	Centro	La Reunion
A1 - Crop and animal production, hunting and related service activities									
E36 - Water collection, treatment and supply									
C32 - Other manufacturing									
J61 - Telecommunications									
C20 - Manufacture of chemicals and chemical products									
B8 - Other mining and quarrying									
C26 - Manufacture of computer, electronic and optical products									
E38 - Waste collection, treatment and disposal activities; materials recovery									
M74 - Other professional, scientific and technical activities									
C23 - Manufacture of other non-metallic mineral products									
A2 - Forestry and logging									
C30 - Manufacture of other transport equipment									
C29 - Manufacture of motor vehicles, trailers and semi-trailers									
H52 - Warehousing and support activities for transportation									
F42 - Civil engineering									
E38 - Waste collection, treatment and disposal activities; materials recovery									
A3 - Fishing and aquaculture									

# Figure 10. Synergy grid for Focus Sectors.

Emerging Idea	Nutrient recovery from wastewater							
Synergy potential exists with regard to	Fryslân	Navarra	Lazio	Crete	Tampere	Scotland	Centro	Lombardia
1.R&D-Capabilities	2	2	2	1	3	2	3	2
2.Companies	3	1	2	1	3	2	2	2
3.Education Capabilities	2	2	1	1	2	3	1	2

Figure 11. Synergy grid for the emerging idea "Nutrient recovery from wastewater".

The outputs of this preliminary data-driven analysis have been shared with the SCREEN partners and used as a basis for further discussion in the inter-regional and local workshops.

# 4.2 Inter-regional workshops

Inter-regional workshops have been organized within the partner Regions of the SCREEN project during the project meetings. The main goals were to:

- Create a common understanding of the result of the data-driven analysis among the SCREEN Regions;
- Support a discussion on the identified synergies and sectors;
- Raise awareness and seek synergies with the local stakeholders invited to the meetings.

The workshops have been carried out in separate groups, each one focusing on a specific valuechain of reference. A moderator was assigned to each discussion table, in order to drive the interaction towards the workshop objectives. Banners, post-its, pre-printed value-chain schema and printed synergy grids were used, as support material, to animate the discussion. The outcome of each workshop were discussed during a plenary session following the workshops. All the workshops have been documented and the outcome registered, and further elaborated, along the project steps. An example of organization of the parallel discussion for each thematic area, i.e. target value chain, is reported in Table 4.



Top six sectorial value chains	Partner(s)
Agriculture & food	Lombardy, Navarra, Limburg, Crete, Scotland Centro Portugal, Fryslân, Lazio, Łódzkie
(Smart) Packaging	Limburg, Crete, Centro Portugal, Fryslân, Navarra, Ile de France
(Resources from) water and wastewater	Fryslân, Navarra, Tampere, Lombardy, Crete Flanders, Łódzkie, Scotland
Biobased materials & biotechnology	Crete, Lombardy, Fryslân, Scotland, Tampere, Navarra, Flanders, Lazio,Łódzkie
Manufacturing and de-manufacturing	Navarra, Lombardy, Tampere
(Bio)Waste management	Navarra, Tampere, Lombardy, Crete, Łódzkie
Table 4. Parallel discussion tables organize	ed during the meeting in Rome, 16-3-2017.

# 4.3 Local Workshops

Local workshops are focused on specific sectorial value-chain of relevance for each Region, as emerging from the SCREEN mapping tool, and were carried out asynchronously by the SCREEN Regions along the project life-time. A common approach and a common agenda have been adopted to drive the discussion during these workshops to the project goals.

The procedure to conduct the local workshops is inspired by the Backcasting method [13] but has been modified to fit the purpose of SCREEN. It consists of four main steps, summarized in Figure 12.



Figure 12. Shared framework for conducting local workshops.

Specific guidelines to conduct these workshops are summarized in the following boxes.

### 1. Common ground (45 minutes plenary)

In this first part, the results of the data-driven analysis are presented to set the scene. This first stage of the workshop has two elements:

1. Presentation of the results from the analysis of the value chains;

2. Discussions about the Regional hotspots.

With the presentation of the results as a starting point, the workshop group can move on discussing the most important weights and fulcrums in the system. It is valuable to also discuss how the stakeholders at the workshop assess the importance of the different hotspots - i.e. their weight. The fulcrums are the processes that govern a certain hotspot. It can be a manufacturing process, a waste treatment system, or something else. It is likely that some of the stakeholders at the workshop are directly responsible for one or more of the relevant processes. Remember: the purpose is not to point fingers at individual actors in the value chain, but instead to develop a common understanding of the value chain as a system. At the end of this section, everyone present at the workshop should have a comprehensive overview of:

- The value chain (or the part of it that has been analyzed).
- The material and energy flows in the value chain and its stakeholders.
- The hotspot analysis, indicating where in the value chain intervention is most valuable or necessary.
- The importance of the different hotspots and the processes that are connected to the hotspots.

### 2. Visioning (45 minutes - plenary)

In the second part, a general shared understanding of the circular economy should be developed and a common vision should be formulated for what a circular value chain in your region should look like.

Developing a shared understanding of circular economy can be best achieved by getting everyone up to the same minimum level of understanding with a quick presentation (no longer than 10 minutes).

For creating a shared vision, it is always helpful to envision what the value chain would look like when it is completely circular in, for example 2030.

In what regards is it different? Which features distinctly make the value chain circular? It is important to prepare and coordinate this part very well as it can easily become a long discussion.

### 3. Defining interventions (1 hour - break out session)

With everyone sharing the same understanding of the current state of the value chain, identified weights and fulcrums in the system, as well as the shared vision, it is time to define the interventions that can transform the value chain from its current state to the envisioned circular state. In other words, it is time to find the levers of the system to change the relevant processes.

To do this, a brainstorm should be held in small groups to think about

which interventions are needed that bring you closer to a sustainable value chain. Interventions can take many forms and could be: policies, innovation, technologies and joint ventures. Support materials can be provided here to inspire and trigger creative thinking in the desired direction, examples include: principles of circular business models, focus areas for the circular economy, and successful business cases of circular initiatives.

It is up to the individual workshop hosts to facilitate this process in a suitable way. Ensure that all creative solutions are documented, even the ideas that may seem unrealistic.



# 4. Road mapping (1 hour - break out session)

In this last step, the roadmap will be developed. The identified interventions towards a circular value chain can be assessed through the process of asking the following questions:

- Does this intervention address the right process in the system?
- Is the intervention in the stage of an idea, a plan, a pilot, a demonstration, or is it mature proposition?
- Does this action bring an acceptable financial, ecological, or social return on investment?
- Is this intervention scalable throughout the value chain and to other SCREEN regions?

After the prioritization, gather the best interventions and sort them according to their time horizon - i.e. how soon can they be implemented. In this way

you will form the roadmap towards your vision. Appropriate stakeholders should then be identified to take responsibility for the implementation of the individual intervention (funding, coordination, and communication). Others interventions may result as promising but may require certain capabilities that are not in the region itself. These are the interventions that are suited for the cross-regional synergies. These are some of the ideas that can be taken forward in the SCREEN partnership to establish synergies. Update the SCREEN Mapping tool with these emerging ideas for synergies, for an enriched view of the potential actions and projects.

# The suggested agenda and the support material are reported in the following box.



The main outcomes expected from the local workshops are three:

• Vision: A shared vision for a circular value chain in the specific regional context.



- *Roadmap*: A list of clearly defined regional interventions structured on a timeline with responsible stakeholders assigned to each intervention.
- *Catalogue*: A collection of the hotspots and initiatives that need the extra capacity of cross-regional synergies to be effective.

For example, in Lombardy one of the two organized workshops was focused on "Circular valuechain in the automotive sector". Several companies in the local value-chain were invited including car-sharing service provides, Original Equipment Suppliers (OES), technology providers, material suppliers, recyclers, RTOs. The logos of the participating companies are reported in Figure 13.



Figure 13. Companies participating to the Lombardy Region workshop on automotive.

The roadmap and the strategic actions elaborated within the workshop are reported in Table 4.

Strategic Line #	Action	Type of action (P=Policy, I=Innovatio n, C=Commun ic.)	Involved Stakeholders	Need of a cross- regional synergy
1 Technologies	Development of high throughput size-reduction, separation and reuse technologies, for highly mixed materials. High interests for case studies emerging during the workshop, i.e. Batteries, tyres, steel mill dross.	I	Research Institutes, Recyclers, Primary Materials Processers	Yes
	Development of a norm to implement product co-design, in order to take into account the technical difficulties of de-and remanufacturing during the product design process.	Ρ	Normative entities, producers, recyclers	Yes



2 Waste life cycle data management	Facilitate the information flow from the producer to the recycler. The norm should point out which subset of data, already owned by producers, could support de-and remanufacturer in the efficient treatment. To do so, the group agrees that is necessary to develop and implement a research project to identify the nature, quantity and quality of such necessary data for the automotive sector.	P+I	Recyclers, producer of components, producers of systems	Yes
	Create strategic partnerships between producers and de- and remanufacturers (e.g. in the form of joint ventures, consortia, associations,), to increase the efficiency of processes by sharing technological knowledge and best practices.	P+I	Recyclers, producer of components, producers of systems, clusters.	Yes
3 New	Create different sub-texts within the norm for industrial waste management, starting from the current normative text and declining it into specific cases (e.g. use of steel mill dross for civil applications, use of tyres fine powder,).	Ρ	Normative entities, primary materials producers, recyclers	Yes
normative processes for the circular economy	Creation of a normative process, similar to the one applied to new pharmaceuticals (with different stage of trials) to understand if each application would be environmentally safe or not, by using quantitative and objective data.	P+I	Normative entities, primary materials producers, recyclers	Yes
4 New university courses	Increase the number of university courses focused on Circular Economy, with particular emphasis on "design for de-and remanufacturing", "advanced de-and remanufacturing processes", and "new circular business models".	I	Universities	Yes
5	Create fiscal and/or financial incentives for more durable products developed with a eco-design approach.	Ρ	Financial entities (public and/or private)	No
Incentives	Create fiscal and/or financial incentives for suppliers and users of car sharing services, lowering the costs to the final customers.	Р	Financial entities (public and/or private)	No
6 Normative enforcement	Make compulsory the conformity norms for all types of products.	Ρ	Normative entities	Yes
7 Awareness	Communication and awareness campaigns targeted to citizens and companies, aiming at the spread of the concept of sustainable mobility (e.g. car sharing).	С	Public entities (municipality, regional government)	No
	Conversion of car dismantling businesses into "Smart Dismantlers".	I+P	Certified car demolition businesses	Yes
8 Evolution of	Training courses for car demolition businesses created within professional institutes and/or Universities, with the participation of car makers and recyclers.	I+P	Certified car demolition businesses, Universities	No



car dismantling businesses	Execution of a research project focalized on the economical evaluation of recovery and recycling of all automotive components, to define decision support systems that identify the optimal level of disassembly, recovery and recycling of car components and materials, including emerging green vehicle technologies.	I	Universities, Research Institutes, producers of components, Certified car demolition businesses	Yes
7 and 8	Communication and awareness campaigns for citizens and companies, focused on the advantages and the quality of recycled and reconditioned products.	С	Public entities, producers of components and systems	No
4 and 8	Increase the number of courses in universities on circular business models.	I	Universities	No

Table 5. Roadmap and strategic actions elaborated within the Lombardy automotive workshop.

In total, within the SCREEN project, 27 local workshops have been conducted involving more than 500 stakeholders, of which 200 industrial members. See Table 5 for a summary of the conducted workshops. This activity has generated a considerable amount of outcomes, reported in the public deliverable D6.4, that have been exploited, together with the output of the inter-regional workshops and the data-driven analysis, to identify cross-regional synergies, actions and initiatives.

Country	Date	Local Workshop	N of stakeholder	Public Body	Regional government	Local government	General public	R&D Institution	Category Association	No-Profit	SM E/Industry	NGO	Universities Education
HR	20/6/18	Primorje-Gorski Kotar	26	2	7	2	2	12			1		0
NL	20/7/18	Fryslan	21			3		2			9		7
PL	14/6/17	Lodzkie Region	4		2	1							1
PL	18/12/17	Lodzkie Region	13		1	2		1			4	1	4
PL	12/9/18	Lodzkie Region	12				12						
PL	26/10/18	Lodzkie Region	14								10		4
IT	19/10/17	Lombardia	49		10		1		5		30		3
IT	13/11/17	Lombardia	29								21		8
SP	21/11/17	Navarra	9		1				2		6		
SP	24/11/71	Navarra	6		1				4		1		
Р	15/11/17	Azores	37										
Р	30/1/18	Centro	14		4					3	7		
Р	14/2/18	Centro	24		5					5	14		
Р	2/3/18	Centro	13		3					4	6		
EN	5/7/18	Extremadura	14		3						11		
FI	23/5/17	Tampere	6		2		1				1		2
FI	9/6/17	Tampere	11		2		5						4
FI	9/6/17	Tampere	11		2		4						5
FI	29/8/17	Tampere	17		1			5		1	10		
EL	29/6/18	Crete s1	13		2		2	2		3	1		3
EL	29/6/18	Crete s2	21		6		2	9		2			2
EL	29/6/18	Crete s3	44		16		7	13		8			
NL	3/7/18	Limburg	17		1						15		1
IT	9/10/18	Lazio	7		1				2		3		1
BE	18/6/18	Flanders	13		2			2	1				8
BE	28/6/18	Flanders	18		4			5			9		
UK	22/11/17	KTN	35		5					2	18		10
UK	23/10/18	KTN	29		3	3					20		3
RO	16/10/18	North East Romania	ι <b>47</b>	3	2	23	11				3	4	1
Total			574	5	86	34	47	51	14	28	200	5	67

Table 6. Summary of the SCREEN Local Workshops and the related stakeholders.



# 5. Synthesis

By elaborating the outputs of the data-driven analysis, inter-regional and local workshops, crossregional synergies can be systematically synthetized, at different level of details. First, the macrotopics of collaboration with specific areas of interest for multiple regions can be formalized, grounding on the elaborated synergy grids and value-chain maps. Second, by exploiting the different mechanisms for cross-regional cooperation the specific actions and projects emerging from the workshops can be framed, also indicating the degree of maturity and Technology Readiness Level (TRL). These activities are explained in the next two sections.

# 5.1 Synthesis of cross-regional synergies

The macro-areas of collaboration are derived by geographically mapping those Regions featuring specific capabilities in the topic areas of interest, made explicit within the synergy grids obtained at the previous phase of the methodology. An example is shown in Figure 14, where the "Manufacturing an De-manufacturing" value-chain is represented. The Figure on the left shows the complementarity among Regional capabilities in the interested Regions, in terms of R&I, industrial, and education capabilities. The Figure on the right shows the so-called "*Blind Spots*". These are gaps in capabilities that should be fulfilled in order to enable a circular development of the considered value-chain, through local investments or cross-regional synergy building. The maps also report all the emerging ideas that are connected to the specific value-chain. These maps are derived for all the target value-chains emerging from the "Analysis" phase and provide the first synthetic overview of areas where synergies can be further developed and specified.



Figure 14. Synergy maps derived from the Synergy Grids.



# 5.2 Definition of specific actions and projects

By complementing the previous maps with the outputs of the workshop, more detailed and specific descriptions of potential cross-regional synergies can be defined, achieving the formalization of concrete collaborative actions and projects. Depending on the level of maturity of the actions, different type of synergies can be created to boost the further development of the action towards the implementation. In order to capture the different levels of maturity, for technical developments usually called Technology Readiness Levels (TRL), and to connect them to specific potential types of synergies, the scale reported in Figure 15 is adopted.



Figure 15. Maturity level of the action and project, and link to specific synergy types.

The characteristics of the different synergy types and the underlying forms of collaboration are commented in Table 7.



The sector analysis takes a more analytical approach than the working group and aims to analyze a specific sector across several regions to gain a deeper understanding of it and work towards the identification of challenges and possibly towards an early formulation of innovations needed to solve these.



# **RESEARCH CONSORTIUM**

The research consortium is a cross-regional research collaboration that aims to study important challenges that have already been identified to develop and validate potential innovations that could address the specific challenges. The research consortium is different from the sector analysis in that from the beginning it is focused on a specific challenge rather than a whole sector or value chain and aims to provide much more specific understanding of possible solutions.



The strategic investment synergy is a collaboration of parties across regions that aim to promote a specific emerging idea through a strategic use of investment. This can be achieved by investing in different innovations that together can form a complete solution or by supporting the development a similar innovation in different regions to allow for more market players and a better chance of a successful outcome. The investment can also be directed to the development of a network of innovation pilot plants or platforms, hosted in different regions, that can act as *Innovation Hubs for Circular Economy*, being a network of competence and technology centers and supporting future producer-driven replication at industrial scale (TRL 9). This synergy is inspired by the one promoted within the Vanguard Initiative pilot and SSP inter-regional partnership on "De-and Remanufacturing for Circular Economy" [5].

# BUSINESS MODELING

Emerging ideas sometimes unlock value that is challenging to monetize commercially. It is not always easy to get more money for a product just because it can be disassembled and recycled easily, although this is clearly beneficial for the society as a whole. Therefore, it can be necessary to innovate on the business model side to properly capture this value. Moreover, the collection of the product after its use may be facilitated through specific non-ownership oriented business models. Business modelling functions as a cross-regional collaboration of regions that share interest in a promising innovation that is under development but struggle to arrive at a profitable business model.

# MARKET UNLOCKING

Sometimes, though, it is not the business model that is missing but some outdated regulation that is bounding a valuable innovation from providing its expected benefits. This is a common barrier in circular economy where existing regulation restricts the options for material closed loop recycling, or upcycling, of different waste categories. This synergy is therefore similar to the one above in that it aims to unlock the potential of an existing innovation. However, in this case instead of experimenting new business models, new policy frameworks or temporary dispensations to operate under monitoring are designed and experimented, usually at limited geographical or business scale.





When an innovation is fully mature and ready to scale-up, other regions can often benefit from adopting it instead of developing a new solution themselves, thus "reinventing the wheel". Therefore, in this synergy type, a group of regions that are potentially interested in importing a technology, and one region, that acts as the technology-exporter, form a team to favor the cross-regional technology transfer. Collaborating closely around this process can be extremely valuable, as technologies often need to be adapted to the regional context to offer their full potentials.



# **KNOWLEDGE TRANSFER**

This type of synergy is used when an innovation is under development or fully mature. It does not involve an actual export of a technology but is instead a process of sharing experience and know-how that can be relevant for other regions to further develop their own solutions. This can take the form of a mentoring or coaching program among regions, if one region is clearly leading technologically, or a more mutual exchange of knowledge, if regions possess different relevant capabilities.

# Table 7. Synergy types and underlying collaboration mechanisms.

Each identified synergy, resulting in an action or innovation project, has been mapped with respect to its maturity level and synergy type. Furthermore, a common *Synergy Description Model* has been developed, which represents, in a unique compact view, the following information:

- Title of the synergy resulting in an action or innovation project;
- Main problem of reference, involved Regions, hotspots, and existing barriers;
- Emerging ideas from one or more regions;
- Type of synergy involved and suggestion for actions.

Examples are shown in Figures 16, 17 and 18. In total a number of about 40 synergies, resulting in an action or innovation project, have been formalized under this model within the SCREEN project.



# Sludge recovery and utilization



# Figure 15. Synergy Description Model for the *Sludge Recovery and Utilization* action.

### Valorization of grass



Figure 17. Synergy Description Model for the Valorization of Grass action.



# Making bioplastic competitive



Figure 18. Synergy Description Model for the Making Bioplastic Competitive action.

# 5.3 Circular Economy measures to prioritize actions

With the objective to measure the expected impacts of these actions and projects in terms of environmental, social and economic benefits, and to support Regions in finding priorities of intervention among the selected actions, a new set of Key Performance Indicators (KPIs), also called measures, to measure the multi-facet effects of these actions has been proposed. The methodology to achieve a wide agreement on these measures has been as follows. In an initial stage, a first set of measures and quantification methods has been produced by the consortium partners, based on the experience gathered during the completion of the SCREEN Mapping tool. This initial set of indicators and measurement methods has been transferred in a questionnaire to be further validated at large scale. The questionnaire has been published on the SCREEN web-site and more than 170 replies have been attracted during the project. Moreover, the set of indicators have been discussed with different DGs of the European Commission as well as within multiple technical meetings organized by various institutional stakeholders in Europe. The feedback have been collected and fused into the shared set of indicators and quantification methods reported in Table 8.



		A	В	c	D	E	F		
	N.	CRITERION	Explanation	Metrics	Additional parameters	Assessment indicator	Weight		
PRODUCTION	1	ECO- Design	Re-shaping the first stage of an industrial process (Product design) in order to reduce the waste generated AND/OR increase the life of the final product	Kg/year of virgin material avoided through the new process AND/OR by the prolongation of the product's life	Economic value of the virgin material (€/Kg)	Metrics x additional parameter (€/year)	10		
	2	New production process accepting "secondary raw material"	Replacement , total or partial, of virgin material with "secondary raw material"	Kg/year of virgin material avoided through the new process	Economic value of the virgin material (€/Kg)	Metrics x additional parameter (€/year)	8		
CONSUMPTION	3	RE-Use, Re-Manufacturing, Refurbishment,	Prolongation of the life of a certain product that otherwise will be disposed	Kg/year of virgin material avoided by the prolongation of the product's life	Economic value of the virgin material (€/Kg)	Metrics x additional parameter (€/year)	8		
DISPOSAL	5	Mass of waste resources recovered and re-introduced in a production cycle as secondary raw material	The new process generates waste that can be re-used in the same process or in another production process	Kg/year	Economic value of the secondary raw material(€/Kg) minus Cost of its transport to the production site (€/Kg) (*)	Metrics x additional parameter (€/year)	8		
	6	Project promoting waste recycling	Promotional campaign with a specific target producing a specific waste	Waste produced by the target Kg/year	Cost of disposal (€/Kg)	Metrics x additional parameter (€/year)	6		
	7	"Net Energy balance respect to the previous system" or "Amount of energy recovered"	Energy (KWh) used in the old process <u>per unit of product</u> divided by energy used in the new process for the same unit of product	Number that can be lower or higher than 1		Metrics (the number in column C)	1.000		
CRITERIA	8	Reduction of emissions	Emissions of CO2 (**) generated by the old process <u>per unit of product</u> divided by emissions used in the new process for the same unit of product	Number that can be lower or higher than 1		Metrics (the number in column C)	assessment Indicator is "per se" a weight)		
SOCIAL CRITERION	9	Net balance of jobs	Number of new jobs created by the circular economy project, minus the number of jobs lost in the previous linear process	N = Number of full time working units (can be positive or negative)	P = Number of full time woking units in the old process	1+ ( <i>N</i> )/P	in Light p		
Applicants may select		Implementation of "CIRCULAR PROCURE	MENT" in the project (tick the box if relevant)	The weight of the related project is increased by 50%					
only one of these two boxes		Educational projects targeted to relevant	stakeholders (tick the box if relevant)	The weight of the related project is increased by 20%					
	(*) In case the secondary raw material does not have a final destination but is just "put on the market", the weight is reduced from 8 to 7 (*') In case of other pollutans, a table of equivalence should be used to convert them into CO2 equivalent emissions - https://climatechangeconnection.org/emissions/co2-equivalents/								

Table 8. SCREEN Measures to evaluate the impact of Circular Economy actions and projects.

The idea is that with this framework of measures the Regions and, more in general, the authorities evaluating specific innovation actions in Circular Economy will be able to assess the impact and rate the priority among the actions in order to select those to be supported, according to the available budget. In practice, SCREEN has proposed a set of standardized indicators that can be selected on a project call basis and used to evaluate proposal and rank them according to the expected impacts. It is worth highlighting that, in parallel to the project life-time, the new Monitoring Framework – COM (2018) 29 Final has been released by the Commission, with a set of indicators applicable to Circular Economy initiatives. A good agreement between the SCREEN measures list and the Monitoring Framework emerges.

# 6. Implementation: matching cross-regional value chain initiatives with financial instruments

In the *Implementation* phase existing measures and instruments to be applied in a synergic way to fill the gaps and the needs expressed within the cross-regional synergies identified in the previous project phases, covering a broad range of TRL levels, are analyzed. The ultimate goal is to understand if and how existing and new regional instruments can support the implementation of the identified Circular Economy initiatives.

Specific investment instruments that have been taken into consideration by the participating regions include:

(i) Cross-regional vouchers for industrial partners to access inter-regional research and innovation services;

(ii) Funding measures to encourage entrepreneurial initiatives based on H2020 projects' results;

- (iii) Funding of industrial take-ups of running H2020 project results, for industrial exploitation and replication;
- (iv) Infrastructural investments, in synergy with European Structural and Investment Funds (ESIF) and the European Investment Bank (EIB);
- (v) Other eventual instruments to be included based on Regions experience and interests.



In general, particular importance has been given to instruments addressing cross-regional cooperation and instruments exploiting funding synergies to support industrial uptake and replication of the funded initiative.

The construction of the portfolio was, therefore, carried out by following the following steps:

- Request to the partners of the financial instruments belonging to the 5 categories mentioned above and managed by their own Authority;
- Selection, among the identified tools, of some "best practices" that have been considered most suitable to achieve the project's goals;
- Collection of some "success stories" related to the effective application of the tools identified as "best practices";
- Association of financial instruments to the "actions" necessary to fill the gaps and to satisfy the emerging needs for the development of the circular economy in the identified value chains.
- Identification of existing gaps among funding instruments and actions and definition of a set of recommendations towards new funding instruments fulfilling such gaps.

These steps are synthetically reported in the next section. More detailed about this SCREEN project phase can be found in the public deliverable D3.4.

# 6.1 Mapping existing funding instruments at regional level

Although a preliminary screening of the existing funding instruments was already carried out through the "Data Collection" of area 6 of the Screen Mapping Tool, namely "Existing funding instruments", since that area was labelled as "optional" a new data collection process has been carried out, specifically targeted to the goal of the "Implementation" phase. In particular, with the objective to collect the information related to the funding instruments, a pre-set excel sheet was provided to the partners in which the following information was included:

- Investment instrument name: the name of the regional investment instrument;
- Scope of the instrument: the target area of application of the investment instrument (selected among European; National; Regional; Municipal; Other);
- Destination area(s) of funds (if any): the related area of specialization (if available) or the related sector of application of the investment instrument;
- *Type of financing*: the type of financing established by the investment instrument (selected among Loan; Subsidy requiring co-financing; Subsidy without co-financing; Other);
- *Rate of financing (%)*: the rate of financing of the investment instrument or, whether the financing percentage is not applicable, the specification of this case;
- *Eligible costs*: description of the eligible costs covered by the investment instrument (e.g. personnel, equipment, consumables, travel, overheads, external services, sub-contracting, other);
- Source of funding: the funding source of the investment instrument (e.g. regional funds, ERDF, other);
- *Supported TRL level*: the Technology Readiness Level (TRL) of the project needed to be financed with the considered investment instrument;
- *Mechanism for the funding mix building*: the mechanism and the internal procedures adopted during the financial engineering process and the development of the fund. This can be interesting for other regions willing to investigate the proposal of similar



instruments. If possible, the indication of a website or similar sources where further information on the funding mechanisms could be gathered.

The financial instruments to be taken into consideration are those with the following characteristics, in accordance with the objectives of the SCREEN project:

- Tools dedicated to the financing or supporting of Circular Economy initiatives;
- Tools dedicated to the financing or supporting of initiatives in areas that are within the smart specialization strategy of the region, not specifically targeted to circular economy, but that can be used to finance Circular Economy projects (e.g. manufacturing, environment, ICT areas);
- Tools financing or supporting initiatives in more traditional areas different from Circular Economy (e.g. smart cities, energy, etc.) that can be converted to propose new financing tools also for circular economy.

Moreover, particular emphasis has been given to instruments addressing cross-regional cooperation and instruments exploiting funding synergies to support industrial uptake and replication of the funded initiative.

Once the contributions were obtained from the partners, a first "screening" of the records was made by eliminating the instruments that didn't feature the aforementioned characteristics. The remaining instruments of each region were then classified according to the following categories:

- Instruments potentially supporting cross-regional cooperation [art. 70 Regulation (EU) No 1303/2013];
- Instruments targeting also CE;
- Instruments dedicated to CE;
- Classes of TRL; in detail the following four classes were identified: TRL = 2-3; TRL = 4-5; TRL = 6-7; TRL = 8-9.

Table 9 summarizes the gathered data. As it can be noticed, more than 100 instruments have been analysed, of which 64 showed capability to support cross-regional cooperation. Moreover, 87 instruments showed capability to support circular economy initiatives, which provides a significant ground for association between the identified action and the funding instruments. Furthermore, all TRL areas are covered by the existing tools.

Region	Total n° of instruments	Processed Data	Instruments potentially supporting cross- regional cooperation [art. 70]	Instruments targeting also CE	Instruments dedicated to CE	TRL 2-3	TRL 4-5	TRL 6-7	TRL 8-9
CCDRC	33	32	25	31	13	0	7	16	9
Extremadura	3	3	3	3	0	0	1	1	0
Fryslan	5	5	2	5	1	1	1	2	1
KTN - Scotland	9	8	5	7	2	1	3	5	2
La Reunion	4	4	4	4	0	0	1	2	4
Lombardia	4	4	4	4	_	1	1	3	1



Lazio	4	3	3	1	2	-	-	2	3
PGKC	2	2	-	2	-	2	-	-	-
Limburg	11	10	3	9	1	3	1	6	-
Flanders	8	8	4	8	-	-	-	5	3
Tampere	1	1	1	1	-	-	-	1	-
Navarra	4	4	4	4	-	-	1	2	1
NE Romania	3	3	3	1	-	-	1	-	2
Lodzkie	10	7	3	7	_	3	3	6	3
TOTAL	101	94	64	87	19	11	20	51	29

Table 9. Total number of classified funding instruments.

From the analysis of the financial instruments communicated by the partners, it was decided to select some "best practices", i.e. some instruments that due to their intrinsic characteristics are suitable (or could be suitable if adequately re-routed) to support actions, also cross-regional, which could support the development of the selected value chains in a circular sense. The criteria that led to the selection of best practices are the following:

- The financial instrument (which may or may not be referred to the CE) provides for a mix of funds from different sources (European, national, regional);
- The instrument (which may or may not be addressed to the CE) is financed by one of the European Structural and Investment Funds (ESIF) and, therefore, makes it possible to activate the art. 70 of the EU Regulation 1303/2013;
- The instrument, while not presenting any of the two previous characteristics, is distinguished by being dedicated to the development of the circular economy or to support specific funding areas, e.g. investments in infrastructure.

The purpose of this selection is to provide an overview of the financial instruments impacting directly on the circular economy, but also those that, although not specifically dedicated to it, have particular characteristics and operating mechanisms such as the simultaneous activation of different sources of financing or the potential activation of art. 70 of the EU Reg. 1303/2013.

The instruments selected as best practices are summarized in the Table 10, divided by proposing partner. Few best practice examples are reported in Figures 19, 20, 21, and 22.

Partner's region	Funding instrument
CCDRC	Fundo Ambiental: Repensar os Plásticos na Economia: Desenhar, Usar, Regenerar (DURe)
CCDRC	Vale Economia Circular (Circular economy voucher)
CCDRC	SI Qualificação das PME - Projeto individual
CCDRC	SI Investigação e Desenvolvimento Tecnológico (SI I&DT)
CCDRC	Valorização de Resíduos



Extremadura	"Ayudas para financiación de contratos predoctorales para formación de Doctores en los centros públicos (D 45/2016) V Plan Regional de I+D+i (2014-2017) "
Fryslan	Open Innovation Call
KTN - Scotland	Circular Economy Investment Fund -
KTN - Scotland	Food and Drink Collaborative Innovation Fund
KTN - Scotland	Circular Economy Business Support Service
La Reunion	Fund of Funds: Financiere Region Reunion
Lazio	APEA
Lazio	Circular Economy and Energy
Limburg	Limburg Energy fund
Lodzkie	Regional Operational Programme for Lodzkie Region 2014-2020.
Lombardia	ManuNet
Lombardia	InnoDriver S3
Lombardia	Fund of Funds - AlpGIP
Lombardia	Linea R&S per aggregazioni
NE Romania	SME Initiative Operation Programme
Navarra	Orizont Accelerator - SODENA
Tampere	The Sustainable Growth and Jobs 2014-2020 Structural Funds Programme of Finland

Table 10. Funding instruments: best practices.

£18 million Circular Economy Investment Fund, administered by Zero Waste Scotland, for SMEs based in Scotland that will deliver circular economy growth. It is supported by the European Regional Development Fund through the £73million Resource Efficiency Circular Economy Accelerator Program

- 1. Funding applications of £50,000 to £99,999.
- 2. Higher value applications from £100,000 to £1,000,000.

<u>R&I infrastructure (investment costs) are eligible.</u>

TRL 6-7 Subsidy requiring co-financing The Fund has been established by Zero Waste Scotland (ZWS), funded in part with European Regional Development Fund (ERDF).

http://www.zerowastescotland.org.uk/circular-economy/investment-fund



Figure 19. Best practice: Scotland "Circular Economy Investment Fund".

Successful example of Vouchers for Industry: *Bando Innodriver – S3 – edizione* 2017 - 11MEuro to finance the following technological innovation measures:

- Measure A vouchers in support of cooperation among SMEs and RTOs;
- *Measure B* vouchers for the Lombardy companies that have obtained the "Seal of Excellence" in the "SME Instruments" phase 1 of Horizon 2020, but they are not financed by the EU due to limited resources;
- Measure C vouchers in support of patenting for industrial uptake.

The vouchers of the Lombardy Region come from the ESIF-ERDF Funds and they are already compliant with the Art. 70 of the ESIF Regulation



TRL 6-7

Subsidy requiring co-

financing

http://www.fesr.regione.lombardia.it/wps/portal/PROUE/ FESR/Bandi/DettaglioBando/Agevolazioni/bandoinnodriver-2017

Figure 20. Best practice: Lombardy "Innodriver SME Vouchers".



Figure 21. Best practice: La Reunion "Fund of Funds".



REGIONE LAZIO

# Destination Area: Instrument targeted to SMEs innovating in the area<br/>of circular economy and energy fund - was created to support the<br/>development of new value-chains and boost the competitiveness of the local<br/>eco-system, in line with the Smart Specialization Strategy of Regione Lazio<br/>through the support to thematic projects in the area of circular economy and<br/>energy.Mttp://www.lazioinnova.it/bandi-<br/>post/circular-economy-ed-energiaROP ERDF- 2014-2020-(50% EU<br/>35% national 15% regional)<br/>TRL 6-7<br/>Subsidy Requiring co-financing<br/>Rate of financing: 10%-80%

Figure 22. Best practice: Lazio "Circular Economy and Energy Fund".

For each of the tools chosen as "best practice", the partners were then asked to produce summary sheets describing successful cases of application of the instrument. The scope was to highlight, through concrete examples, the features of the funding instrument and the supported types of activity. Few examples are reported in Figure 23 and 24.



Lombardia

Regione









### Success Story Title: "SuperEcoPlast"

Funding instrument: Research&Development line for aggregations Region: Lombardy

Starting Date - End Date: 6 December 2016 - 6 December 2018

Involved Stakeholders: enterprises and university

Description of the action: The technological innovations of Superecoplast are devoted to the metallization (chrome plating) of plastic materials, and then to the final applications related to the components for cars, furniture and devices, consumer goods. Surface metallization gives the molded piece high aesthetic and functional properties, such as scratch resistance and cleanability. Project's goal:

· integrate technologies with low environmental impact such as solventless UV coating and physical vapor coating deposition (PVD) of metal chromium (therefore free of Cr6 + ions);

• develop cycles of metallic finishing of highly innovative, high performance and low environmental impact plastics materials, as they are free from Cr6 + and from the release of organic solvents.

Achieved results.

- setting of the metallization of the plastic substrates (UV curing cycle of the varnish, cycle of deposition of metal chromium by PVD);
- diversification and expansion of classes of treatable plastic materials (extending to materials not commonly treated such as polypropylene);
- performance improvement of metallized products, with particular reference to their mechanical surface behavior (hardness, scratch resistance, wear resistance, adhesion).

The company obtained the additional 5% funding thanks to the participation in the project "FiberEUse" funded by Horizon 2020. This project concerns a large scale demonstration of new circular economy value-chains based on the reuse of end-of-life fiber reinforced composites. The project involves the participation of subjects (companies, universities, research centers) belonging to 7 european countries

Support material: http://www.greencoat.it/?page\_id=237, http://fibereuse.eu/

Success Story Title: Ferguson's PI-Polymer Recycling Funding instrument: Circular Economy Investment Fund

Figure 23. Success story: Lombardy "Greencoat".





Development Funding) has just awarded funding of £1.7million in Perthshire. By locating state-of-the-art recycling technologies together, significantly more plastic is kept in the economy and diverted from landfill and incineration, contributing towards Scotland's ambitious recycling targets.

The system being developed at Project Beacon combines the latest material separation combined with a chemical feedstock recycling process.

The key element is said to be a patented process based on thermal cracking which has been developed to cope with difficult to recycle end-of-life plastic waste such as mixed, laminated, black, film, hard and contaminated streams.

The process produces a range of chemical constituents that can be used to create new virgin plastics, or other chemical products.

Achieved results:

The facility will process between 15,000 and 25,000 tonnes of plastics per annum and create over 70 new jobs.

Support material.

https://www.zerowastescotland.org.uk/case-study/project-beacon

Figure 24. Success story: Scotland "Ferguson's Polymer Recycling".





# 6.2 Identification of funding opportunities and existing gaps

Given the availability of detailed and exhaustive information about the existing funding instruments, a methodology to identify potential matches among the funding instruments and the local emerging ideas and cross-regional synergies has been designed, which should lead to the development, in a circular sense, of the value chains selected in the previous phases of the project. The scope of this activity is twofold. On the one hand, potential routes to support the implementation of the synergies identified to unlock new circular economy business opportunities are drawn. On the other hand, the existing gaps among funding instruments and cross-regional synergies that could lead to the development of new cross-regional support instruments targeted to circular economy are identified. Such gaps and the related recommendations for new funding instruments are discussed in the next section.

It should be noted that some instruments, in the current formulation, may not be dedicated specifically to the circular economy; however, the operating mechanism as well as the ability to activate multiple sources of financing make them particularly interesting for possible adaptations to support the circular economy. Therefore, they have been considered in the analysis.

The adopted matching method has been primarily based on the following matching criteria:

- Target TRL of the considered initiative or cross-regional synergy matched with supported TRL of the funding instruments;
- Type of investment and funding item required by the initiative or cross-regional synergy matched with the eligible costs of the instrument;
- Type of proposer matched with type of beneficiary of the instrument;
- Objective of the initiative matched with the scope of the instrument.

These four matching criteria have been applied to all the initiatives and funding instruments of the Regions where stakeholders of the initiative are involved. The resulting mapping process is conceptually summarized in Figure 25. In this way, a map of feasible associations and areas with limited associations are highlighted thus indicating, at the same, time finding opportunities and gaps.

	Investment Instrument type 1	Investment Instrument type 2	
CE Initiative 1	X		
CE Initiative 2		Х	
CE Initiative 3	X	Х	] GAF
CE Initiative 4			

Figure 25. Methodology to match Circular Economy actions and projects with funding instruments.

Examples of feasible matching cases are provided in Figures 26 and 27.





Lazio - Circular Economy and Energy fund: Instrument targeted to SMEs providing subsidies requiring co-financing, with a funding rate between 10%-80%, at TRL 6-7, on the ROP ERDF-2014-2020 fund, with a funding mix 50% EU, 35% national, 15% regional.



*Fryslan- Circulair Economy Call Fryslân*: instrument targeted to SMEs providing subsidies requiring co-financing, with a funding rate of maximum 40%, at TRL 6-7, on regional funds.

Figure 26. Example of feasible matching between action and funding instruments.



*Limburg- Energy fund*: Instrument targeted to industry providing loans and subsidies requiring cofinancing, at TRL 6-7, using a mix or Regional and EIB funds, focused on nergy savings and circular economy.



*Fryslan- Circulair Economy Call Fryslân*: instrument targeted to SMEs providing subsidies requiring co-financing, with a funding rate of maximum 40%, at TRL 6-7, on regional funds.

Figure 27. Example of feasible matching between action and funding instruments.

# 6.3 Definition of requirements and needs for new instruments

According to the analysis carried out, few existing gaps that, if not removed, could prevent the development and future implementation of cross-regional circular economy initiatives have been identified, giving origin to specific recommendations for the future. The preliminary recommendations are listed below:

- Although "Existing financial Instruments" at regional level are usually applied in isolation, even if they could be partially used to support cross-regional initiatives, there exist recently developed instruments favoring a cross-regional cooperation (e.g. Fund of funds).
- In general, cross-regional cooperation is not reflected in the evaluation of projects.
- The transfer of technologies and solutions from one region to another, among sectors, is usually not supported by specific instruments.



- The "Seal of Excellence" approach is currently only applied only to the SME Instrument and is not exploited to support cross-regional cooperation within project consortia.
- Only few instruments support the development of innovation infrastructures through ERDF to de-risk by demonstration future industrial investments in circular economy.
- The establishment of an ERA-NET like fund for circular economy would support the development of focused projects originated by the identified SCREEN synergies.
- A cross-regional open innovation initiative may be useful to promote the systematic identification of inter-regional actions, extending the SCREEN methodology beyond the project life.

These recommendations, together with more other inputs concerning the entire methodology, for example related to the challenges concerning data collection, have been provided to the SCREEN Policy Lab for further elaboration and discussion with relevant stakeholders at European institutional level.

# 7. The SCREEN Policy Lab

The SCREEN Policy Lab is the organizational body of the SCREEN project dedicated to the (i) collection of the main results derived from the methodology developed in the project and (ii) to the transferring and alignment of these results to the European institutions targeting Circular Economy related topics. All the Regional representatives of the SCREEN project, as well as specific invited technical experts involved in SCREEN, are part of the Policy Lab. The Policy Lab has been continuously supporting the development of the SCREEN methodology through a series of live and remote meetings listed in the following:

- First Meeting 04 May 2017 Lazio Region Office in Brussels;
- Second Meeting 11 October 2017 Lazio Region Office in Brussels;
- Third Meeting 22 February 2018 Portuguese Permanent Representation to the European Union Brussels;
- Fourth Meeting 30 May 2018 European Economic and Social Committee Brussels;
- Continuous meetings online through the Policy Lab Linkedin Group at https://www.linkedin.com/groups/13531065/.

Although several other outcomes can be mentioned, the most relevant and visible result of the SCREEN Policy Lab has been the proposal and discussion of a new support instrument targeted to the effective use of European Regional Development Funds – ERDF – to support the implementation of proposals targeting Circular Economy submitted to the H2020 research funding programme that have passed the quality thresholds during the evaluation but have not been granted with funding. A Memorandum of Understanding was developed, shared, and signed by several SCREEN Regions to express their intention to establish this new instrument, which extends the concept of Regional vouchers, traditionally applied only to proposals for the SME Instrument. This proposal has been presented by the SCREEN Policy lab in different events on funding synergies and has been discussed within different DGs of the European Commission.

# 8. Concluding Remarks

The SCREEN project has developed a methodology for cross-regional cooperation that is replicable throughput Regions in Europe. The methodology has been validated within the



network of SCREEN Regions and can be easily extended to a large set of Regions currently not involved in the project. Concrete outcomes have been achieved that are summarized below:

# SCREEN project outcomes in synthesis:

Data Collection:

- SCREEN Mapping tool compiled by all the 17 Regions.
- More than 30,000 records included.
- More than 300 companies mapped.
- More than 100 Circular Economy projects and more than 150 emerging ideas mapped.

# Analysis:

- 13 Sectorial and cross-sectorial innovative value chains identified.
- 27 local workshops organized, including about 500 stakeholders, of which 2000 from industry.

# Synthesis:

• About 40 synergies identified.

Implementation:



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