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Synergic Circular Economy across European Regions

SCREEN

Deliverable D3.1

Report on Synergies

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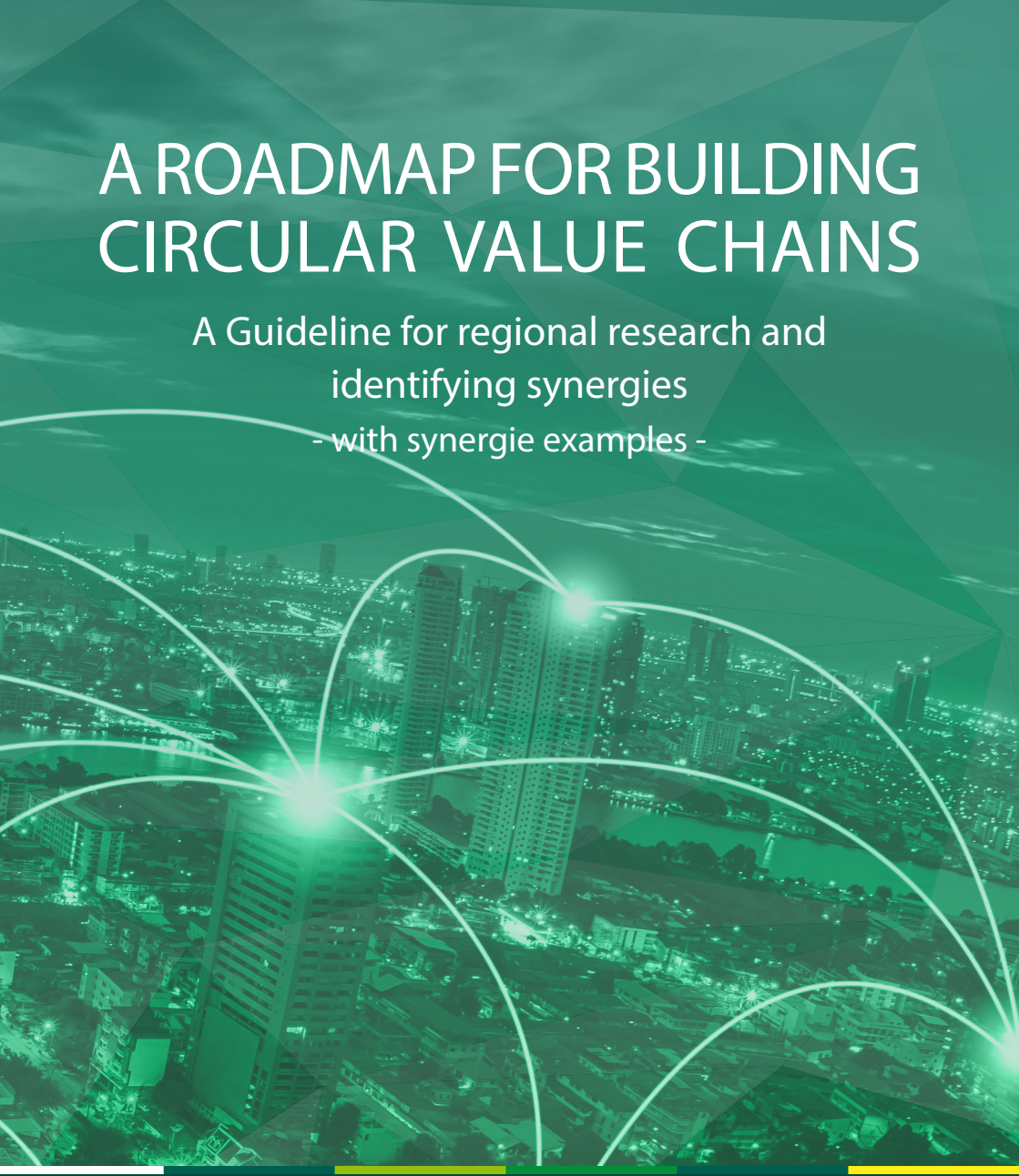
A ROADMAP FOR BUILDING CIRCULAR VALUE CHAINS

A Guideline for regional research and identifying synergies

- with synergie examples -



SCREEN

Synergic CircularR Economy across European regioNs

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INTRODUCTION

Synergic Circular Economy across European Regions (SCREEN) recognizes the need for finding innovative solutions in a fundamentally new manner and gathers regions in a collaborative project to do just that. The deliverables in workpackage 1 were focussing on identifying local circular economy potential Value chains and cross-regional synergies. This document guides regions further in order to identify synergies between regions. Once a potential synergy is identified, regions need look further into their regional context before they can work on a crossregional synergy. This guideline introduces leverage points to influence value chains, and stakeholder and material flow analysis as a tool for investigating the regional context. It offers a step-by-step approach regions can follow to search for synergies based on the regional context.

The search for synergies between regions is based on a process of pairing critical hotspots in the regional value chains with emerging ideas throughout the SCREEN partnership. Based on quantitative and qualitative criteria for both hotspots and emerging ideas, the best potential synergies can be extracted and analyzed further to develop powerful cross-regional synergies. This guideline therefore helps to:

WORK PACKAGE 2.3	• Build on your existing regional opportunity scan from the SCREEN tool and get a deeper and more analytical understanding of the regional value chain through a systemic lens. • Discover opportunities and intervention points where you can realize circular benefits.
WORK PACKAGE 3.1	• Identify the opportunities that can best be unleashed through cross-regional synergies and structure them according to sector, material flows, and viability. • Begin to filter and assess the possible cross-regional synergies based on criteria that score its potential value and impact.

READER'S GUIDE

Developing interventions that facilitate a transition to circular economy requires a new way of thinking and looking at things. The SCREEN partnership has therefore put together a package that not only shows what to do but, just as importantly, also why it is essential to do it and how it is best done. This document contains three main elements:

1. Concepts: An exploration into the principles and concepts
   This first part tours through the concepts used for this guideline.

2. Guideline: A step-by-step protocol to the full process
   In two main sections it will show you how to carry out the entire process leading to the identification of interventions and cross-regional synergies that ignite circular economy benefits.

3. Appendix: An appendix with all the elements needed
   The appendix is your toolbox. Here is what the project team will need to maneuver through the process in a systematic and comprehensive way. Some of these tool are attached as separate spreadsheets.

The first chapter, Concepts, forms the foundation for the rest of the document and for your work with circular economy in general. Reading this chapter is therefore strongly recommended.

Your use of the second chapter, Guideline, will depend on how thoroughly you wish to analyze your regional value chains and how far you are in this process. The majority of the Guideline covers how to analyze a regional value chain and develop interventions based on identified potential synergies (WP 2.3) and the remaining part focuses on the identification and assessment of hotspots and emerging ideas that will eventually form synergies (WP 3.1). If you wish to use this protocol only for Work Package 3.1, you can skip the first four steps of the Guideline and go directly to step IV. Following the full process of the Guideline is however strongly recommended as it ensures the best end-result in terms of cross-regional synergies and additionally establishes a firm foundation of knowledge and insights for the further development of circular economy within the region.

If more than one value chain is to be analyzed with the protocol, it is recommendable to carry out the respective analyses as separate processes to avoid unnecessary complexity. After the analytical results have been attained through separate processes, they can be compared and solutions that create synergies between the two value chains can be explored.

To accommodate different timelines and levels of capacity, we have structured the research process into two different research programs: A light version that is faster and easier to finish and a full version that is more comprehensive and will yield more data-driven and analytical results. These two versions will be further explained in the Guideline.

Before embarking on your own project, it can be valuable for you to have a look at Appendix 9 that explains the process of developing this protocol and presents the feedback it has gotten. This can help you get a sense of what others have found challenging or missing.

CONCEPTS

This first part will take you through some practical concepts that are used throughout the guidelinne to facilitate the process of working with circular economy and systems thinking. It si about:
- Finding and using leverage points
- Using material flow and stakeholder analysis in value chains

Finding and using leverage points

Leverage points are places within a value chain where a small intervention can produce big changes (D. Meadows, 1999). Leverage can thus be defined in this case as an opportunity to change the functioning of the value chain to transition it to a more sustainable and prosperous state. What we are looking for is both effective leverage points, the place where change needs to occur, and an understanding of what it is we are trying to change and how we are going to change it.

We use the analogy of a lever as a starting point for explaining leverage (Figure 2). The idea is that you are trying to shift the outcome of the system or, in this case the value chain, away from the negative impacts that are occurring. In the leverage analogy, the impacts or targeted outcomes are like the weights you are trying to move. Some examples of weights include unnecessary waste, CO_2 emissions, consumption of scarce resources, and stifling innovation. The leverage points can be described as the contributing elements or processes which need to be shifted to create change. This could include soil management practices, production methods of various kinds, consumer perceptions or the way in which we produce and extract resources. Finally, the levers are the mechanisms or strategies for change, which are made up of different interventions that can be implemented. Examples of levers are policies, technologies, partnerships, improved information flows, or transparency.

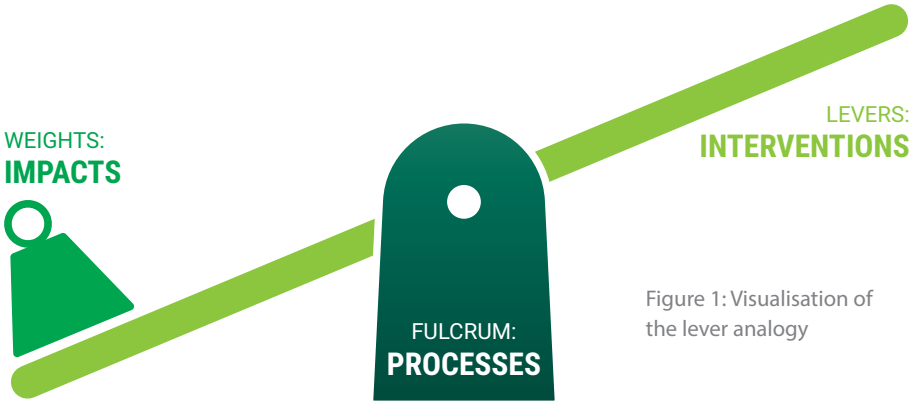


Figure 1: Visualisation of the lever analogy

How to find leverage

Defining what high leverage is, makes it clear that we are not only searching for one thing in the value chain, but for a combination of three things that together generate high leverage. We ask three key questions to find the right leverage and we follow a three-step process to answer those questions. The three questions and the steps are shown in matching pairs in the Table 1 below.

01 WEIGHTS:	02 FULCRUMS:	03 LEVERS:
What targeted outcomes or impacts of the system need to be changed most urgently?	Where in the system are processes which need to be shifted or interrupted to make these changes happen?	How do you shift or interrupt the processes effectively without leading to negative consequences in other parts of the system?
Step 1: Identify the largest problems or impacts, which are most relevant within the context of the situation.	Step 2: Map out the system and identify key processes based on their contribution to the problems	Step 3: Design interventions and evaluate the feasibility and desirability of these interventions within the context of the entire system.

Table 1: The three steps and questions to find leverage

This three-step approach to identifying and utilizing leverage will shape the framework around the workshop at the intersection between Work Package 2.3 and 3.1. Before the workshop can fruitfully be carried out, the time-consuming analytical process of mapping the value chain must be carried out so the results can be made available for the participants of the workshop and that is the focus of the three first steps of the Guideline section.

Using material flow analysis and stakeholder analysis in value chains

Value chains can be mapped and analyzed in a myriad of ways, many of which focus on the business aspects of value chains. For the purpose of investigating a value chain in the context of circular economy we will use two specific analytical frameworks:

1. Material flow analysis: An analytical method to quantitatively and qualitatively assess stocks and flows of energy, materials, and other resources.
2. Stakeholder analysis: A process of identifying actors or groups of actors that are involved in or have an interest in the value chain under consideration and that can influence or be influenced by changes in the value chain.

In the following section, the different procedures for these measures are carefully explained.

It may be tempting to treat these analyses as separate processes. But it is precisely the interconnections between the physical and socio-economic context that determine what solutions are most effective and the two analyses should therefore rather be considered two layers of the same analytical process. Consequently, it is valuable to let the two analyses run in parallel, so that they can inform each other along the way.

To ease the reading of the protocol, the main concepts are listed in Table 2 along with a short description of each.

Circular Economy	The circular economy is a new economic model for addressing human needs and fairly distributing resources without undermining the functioning of the biosphere or crossing any planetary boundaries.
Systems Thinking	The approach to look and think in systems and to understand how they interact with each other in a process.
Value Chain	The serial connection of all the people and organizations involved in producing a certain valuable and commercialized product or service.
Material Flow Analysis	An analytical method to quantitative and qualitative assess energy, material flows, and stocks.
Stakeholder Analysis	A process of identifying actors or groups of actors that are involved in or have an interest in the value chain under consideration and that can influence or be influenced by changes in the value chain.
Primary Stakeholders	Actors or groups of actors that constitute a part of the value chain.
Secondary Stakeholders	Actors or groups of actors who are not directly embedded in the value chain but stand to be indirectly affected by changes in the value chain.
Leverage points	Places within a value chain where a small intervention can produce big changes.
Emerging idea	Knowledge, initiative, or technology that can unleash circular economy benefits, for example by mitigating negative impacts or valorizing wasted resources.
Hotspot	Flow or process in the value chain that has a high negative impact.
Synergy	Collaboration that supports the further development of emerging ideas to tackle significant challenges.

Table 2: Overview over the concepts used and their definitions

GUIDELINE

In this second section, the principles of systems thinking are applied to the analysis of value chains to generate a comprehensive overview and an integrated analysis of the relevant value chain. The guideline consists of six steps that systematically take you through the whole process from initial mapping of the value chain, to development of a roadmap with interventions and further to the identification and evaluation of respectively hotspots and emerging ideas that will eventually synthesise into cross-regional synergies. These six steps are explained on page 20 and visualized in Figure 3 below. Note that Step VI should not be carried out by all regions but only by one region that takes the responsibility for this task.

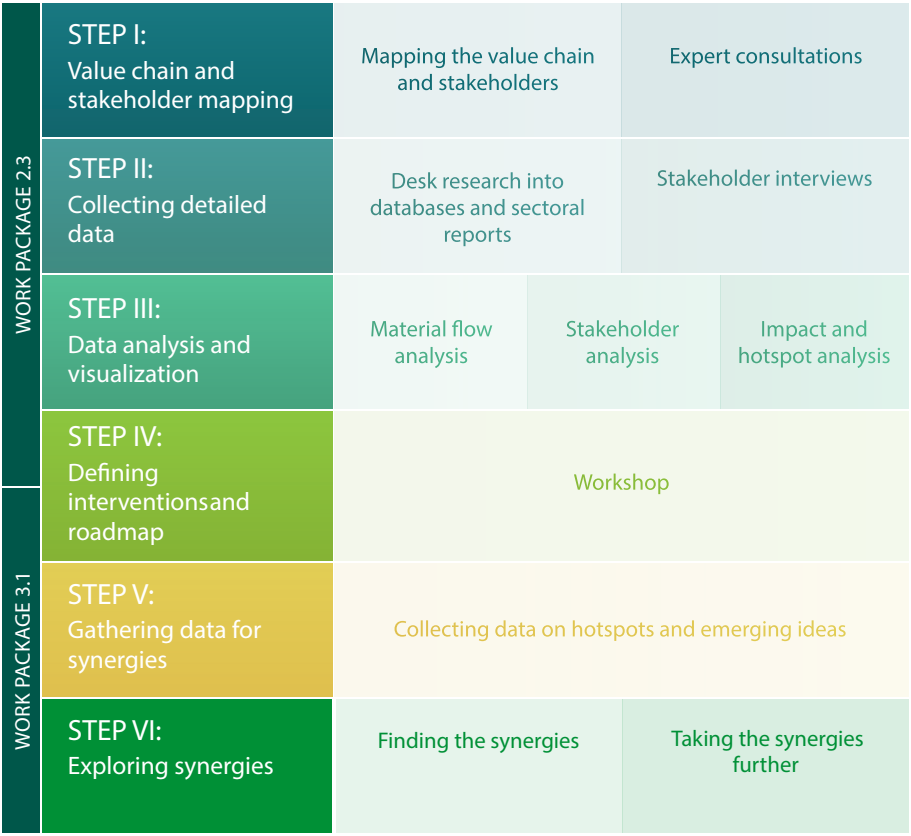


Figure 2: Flowchart of full research program

Performing all these steps can be an overwhelming task - both because it can take a significant amount of time and because some of the steps require some technical expertise. A light and a full version of the research process are therefore provided to accommodate different timelines and levels of expertise.

Full version

The full version includes all the steps in the Guideline and will provide more data and analytical insights when carried out well. It is however a more challenging process and a big part of the time is spent gathering and analyzing data which is not suited for everyone.

Light version

The light version consists of a subset of the steps in the Guideline. As displayed in figure 4 below, this version includes the mapping procedure in Step I, the stakeholder interviews in Step II and then Step IV and V. The light version mostly interview-driven, aiming to gather emerging ideas and hotspots solely from the stakeholders and work to unite and engage these as part of the process. This means that you should not be concerned about gathering quantitative data and filling in Appendix 2. You can still use the interview guide in Appendix 1 for the interviews but note that you can omit the part called Material flow analysis, which is marked with '(full version only)'. If you go for the light version, your main focus should be to talk to stakeholders in your value chain to get them interested in circular economy and harvest ideas and knowledge about barriers from them.

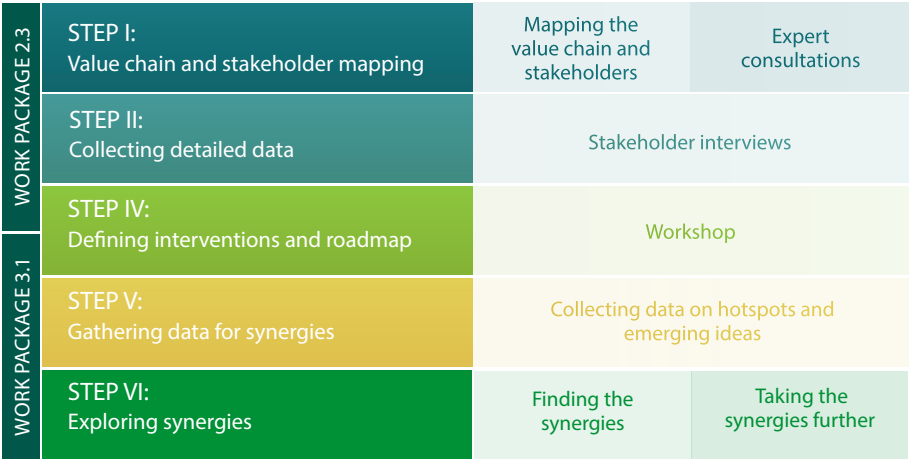


Figure 3: Flowchart of light research program

STEP I: Mapping the value chain and stakeholders

The selected value chain and the involved stakeholders are mapped by first scoping the value chain and its boundaries and by identifying important stakeholders. Expert consultations are subsequently used to validate and improve these initial findings.

STEP II: Collecting detailed data

Data on material flows throughout the value chain and the positions of stakeholders is gathered via desk research into databases and reports and by conducting interviews with stakeholders.

STEP III: Analyzing and visualizing the data

The gathered data is analyzed and visualized and an impact analysis is conducted to identify potential hotspots in the value chain. These hotspots pinpoint the specific areas in the value chain that are most harmful and, therefore, critically require interventions. These analytical insights will form the basis for the stakeholder workshop in the following step.

STEP IV: Defining interventions and road mapping

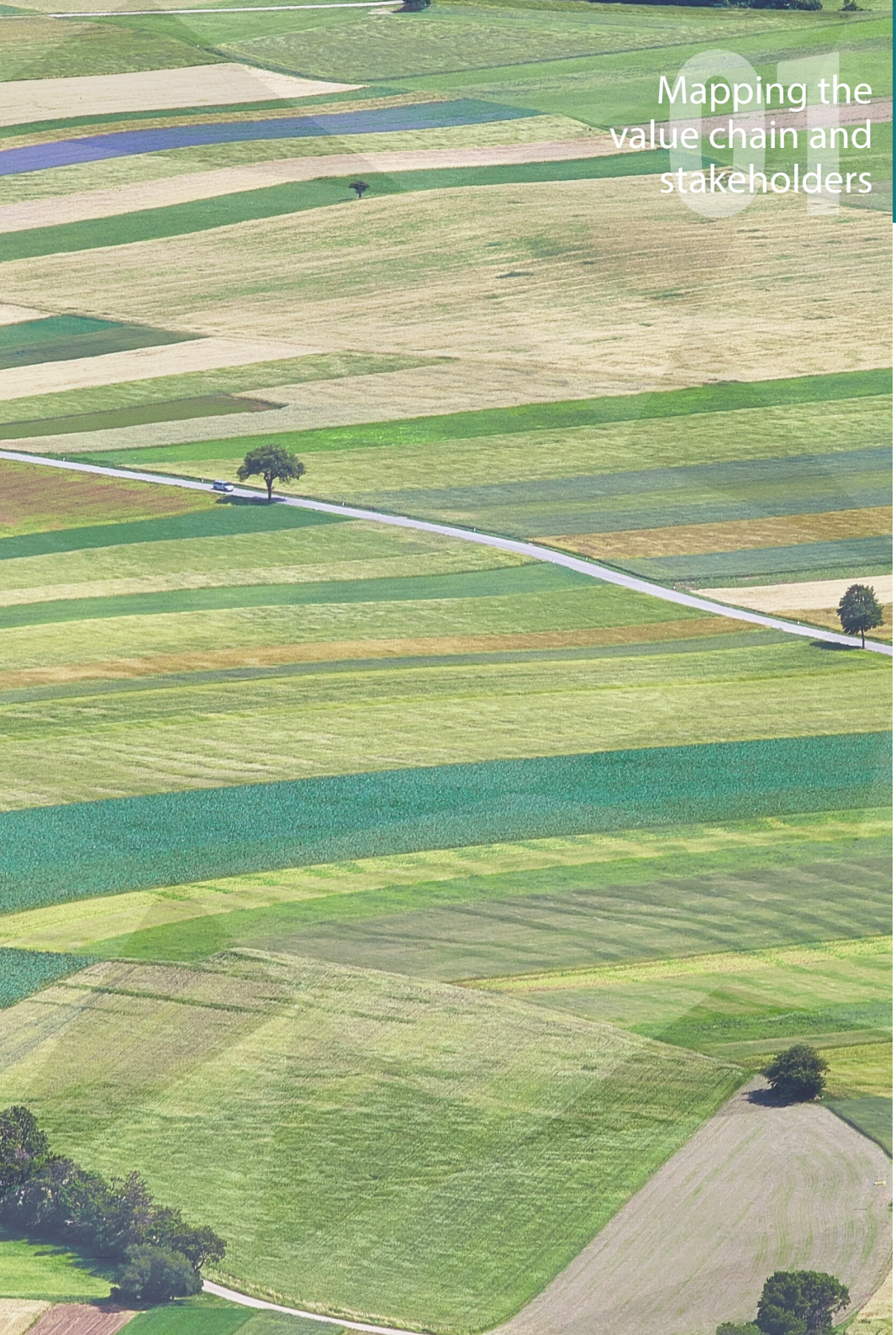
The workshop facilitates the process of defining a regional vision for a circular value chain and a roadmap with the interventions that have the most potential to realize the envisioned circular value chain. The workshop also helps to identify the hotspots and emerging ideas that require the added capacity of cross-regional synergies to be turned into circular economy benefits. This workshop thereby also forms the bridge between Work Package 2.3 and 3.1.

STEP V: Gathering data for synergies

In this step of the protocol, data on the hotspots and emerging ideas are systematically collected. This will form the groundwork for the further assessment and development of the cross-regional synergies in step VI.

STEP VI: Exploring synergies

In the last, different kinds of synergies are presented and a method for identifying the potential cross-regional synergies is presented along with some concrete examples.



01 Mapping the value chain and stakeholders

STEP 1: MAPPING VALUE CHAIN AND STAKEHOLDERS

The purpose of this step is to get an initial overview of the value chain that can serve as a starting point for exploring it more in depth. The step consists of two parts: step 1.1 involves making a preliminary map of the value chain and its stakeholders based on desk research and step 1.2 shows how to improve this map via expert consultations. Although the steps are presented as sequential in this guideline, in practice the two processes are likely to be happening in parallel or as an iterative process going back and forth between the two steps until a complete map of the value chain and stakeholders has been formed. At the end of this step, you should have:

- A visual map that depicts the different links in the regional value chain, the expected flows and the exchanges with actors outside of the regional value chain (see Figure 4).
- A first list of stakeholders including your preliminary assessment for each stakeholder.
- Two to four interviews with experts that provide insights about the value chain as well as contacts within the value chain.

STEP 1.1: GETTING AN INITIAL OVERVIEW OF VALUE CHAIN AND STAKEHOLDERS

A value chain is a sequence of processes or chain links that one after another contribute to the production of a final product or service, which is then consumed. For this project, it is recommended that you focus on the links of the value chain that reside within the geographical boundaries of the region itself and that you only collect data from one specific year. Figure 4 below illustrates a rudimentary example of a value chain for the dairy industry. In the first link, dairy farmers breed dairy cows and collect milk. The milk is sent to the processing company that makes dairy products and sells them wholesale to retailers, who then sell them to individual consumers. The processes along the chain are enabled by utility companies. All of this happens within the regional boundaries (depicted with the dotted white line) but the value chain also has several connections that go beyond the regional boundaries. Different supplies are delivered to both the farmers (e.g. cow feed, fertilizer, and diesel) and the dairy company (e.g. sugar, berries, and packaging) and some of the products also leave the region. The example shown in Figure 4 is quite simple and it is likely that the value chain you are going to map is more complex.

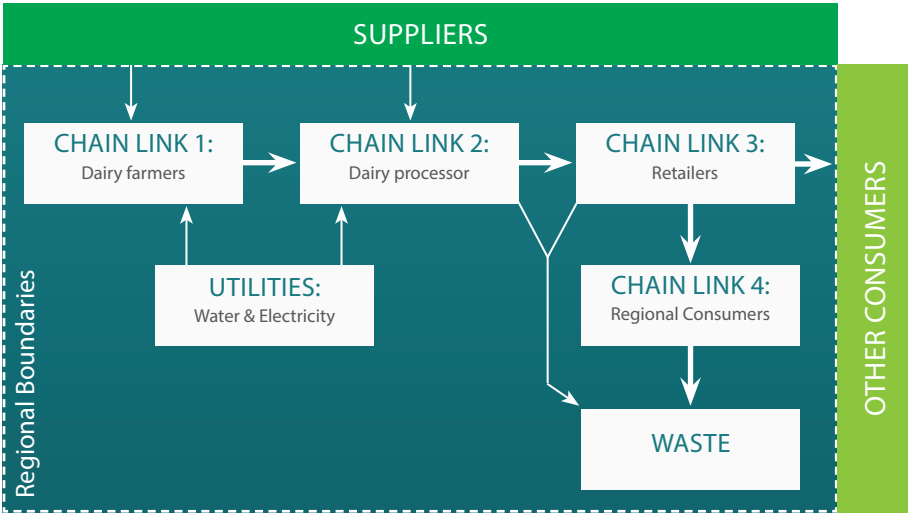


Figure 4: Example of a value chain map

Drawing up the value chain

To draw an initial map of the relevant value chain, you can follow the procedure described below and use desk research to carry out the procedure. It is important to include as many of the relevant companies and flows as possible.

1. Start mapping the value chain by noting down the link in the chain that is responsible for producing the final products or services of the value chain. In the example above, it would be the dairy company that produces dairy products.
2. Map the main companies that deliver supplies to produce the final product or service and judge whether these companies fit within the regional boundaries and the focus of the project.
    a. If so, then this industry can be added as a new link in the value chain.
    b. If not, then the product from this supplier should be added as an external flow.
3. Perform process 2 again for each of the new links that have been added to the regional value chain. The process of mapping the supplying companies can be continued for these new links until you think that the map represents the value chain sufficiently and that an additional iteration will add unnecessary complexity or go beyond the geographical boundaries of the region.

4. Map the main companies or actors that bring the final products or services to the customers and then map what happens after consumption.
5. Have a last thorough look at the map and consider whether you have included all relevant actors and all relevant flows. Ideally, there should be indications of or placeholders for all flows of energy, water, materials, and waste streams.

Initial mapping of stakeholders

Deciding on which stakeholders to include and which not to include can be challenging and will differ depending on the specific focus of the analysis. The inclusion of stakeholders should follow the boundaries of the value chain in question as defined in the mapping process described above. Companies or organizations that are part of the value chain, called primary stakeholders, are the most obvious stakeholders to include and should have already been identified through the mapping above.

Actors who are not directly embedded in the value chain, but who are able to affect the value chain indirectly or are themselves indirectly affected by the value chain, are called secondary stakeholders. Table 3 below outlines some generic categories of both primary and secondary stakeholders. They might not all be relevant but it can help to get an exhaustive overview of the stakeholders. To map the stakeholders, you should follow this procedure:

1. Start from the beginning of the value chain and list all the specific stakeholders related to each link. Here you can also use the 'focus sector companies' in your SCREEN tool assessment as a starting point.
2. When all the primary stakeholders have been recorded, you can turn your focus to the secondary stakeholders. Use the rough categories for secondary stakeholders on the next page to guide the thought process and write down specific actors that are relevant for the value chain.
3. When you have a full list of stakeholders, you should attribute two preliminary scores from 0 to 3 based for each stakeholder based on your current knowledge with zero indicating 'not at all' and three being 'very much'. The two scores for each stakeholder are:
    a. Affected: How much will changes in the value chain affect the stakeholder?
    b. Affecting: How much is the stakeholder able to change the value chain?

Primary stakeholders

Categories	Examples
Extractors	Mining companies, fishermen
Cultivators	Farmers, breeders, gardeners
Distributors	Logistics companies
Providers of secondary inputs	Utility companies
Manufacturers	Car companies
Processors	Dairy companies
Retailers	Supermarkets
Consumers	Companies, private individuals
Waste collectors	Private waste companies

Secondary stakeholders

Categories	Examples
Governments	Municipal governments, EU
Media	Newspapers, opinion makers
NGOs	Social or political organizations
Local citizens	Citizen groups or organizations
Financial institutions	Banks, pension funds
Scientific institutions & experts	Universities, research institutes

Table 3: Overview of generic categories of primary and secondary stakeholders

If there are more than 25 stakeholders on your list at this point, it is a good idea to sort out those that are least important by using the preliminary scores for affected and affecting. If the list is shorter than 10 stakeholders, you should consider whether you have overlooked some important stakeholders and use the expert consultation in next step to find out whether more stakeholders should be included in the analysis. These data can be stored as a list or as a table format, as long as different characteristics can be clearly linked to the different stakeholders.

When you have a complete list, it is time to do a bit of desk research to fill in the gaps and make sure to get concrete details for all stakeholders on the list. For larger homogeneous groups of actors, like farmers or grocery stores, think about whether a single organisation can meaningfully represent the group and its interests.

STEP 1.2: EXPERT CONSULTATIONS

After having developed an initial map of the value chain and its stakeholders, it is time to validate and enhance the map. This is done by consulting two to four experts that have intricate knowledge about the value chain. Examples include public officials that are involved in regulating, inspecting and supporting the value chain or researchers and experts that have detailed knowledge about the value chain in the specific regional context. Performing these initial interviews serves four main purposes:

1. Get expert insights about the value chain
2. Get feedback on your own research
3. Get references for contacting primary stakeholders that can be harder to involve
4. Get insights on key trends and opportunities in the sector

There are no strict tools for this stakeholder consultation step but it is a good idea to walk them through the goals of the protocol, the guideline steps, and preliminary results of step 1.1 to give them an opportunity for providing feedback and additional insights. Make sure to also use these stakeholders as gatekeepers by asking them to provide references to relevant primary stakeholders or by asking for access to useful databases or sectoral reports for the desk research and interviews the next step.

02 Collecting detailed data

STEP 2: COLLECTING DETAILED DATA

Building upon the overview of the stakeholders and main material flows through the value chain from the previous step, this step aims to obtain the quantitative data on energy and materials and the qualitative data on the stakeholders. Two steps with different methods are used to obtain this data:

1. Desk research into macroeconomic databases and sectoral reports.
2. Primary stakeholder interviews.

The desk research will yield quantitative material flow data and the stakeholder interviews provide more fine-grained quantitative data on company-specific material flows as well as data on the position of these stakeholders. The following two sections will explain how to conduct the methods of these steps. At the end of this step you should have:

- General numbers for the sector showing its size, energy, and water consumption, waste streams, and raw material consumption.
- One spreadsheet with data for each chain link in the value chain (explained below).
- Detailed notes from interviews with the primary stakeholders on your list.

The material flow data (materials, water, energy and waste) of the mapped value chain from one year should be gathered for each chosen value chain link and should be stored in the data input sheet in Appendix 2. To use the example from step 1.1 (Figure 4), you should fill out one sheet with data for all regional dairy farmers, another sheet for all the dairy processing facilities in the region and yet another sheet for the retail side.

Although this sheet requests detailed categories and descriptions of the flows of the different value chain links, a level of detail and quantification should be chosen that suits the data availability and potential time and resource limitations on the side of the project team.

The stakeholder data that is gathered in this step should reflect the position of the primary stakeholders in more detail than the first mapping exercise in step I, which encompasses the extent of being affected by or being able to affect

the value chain. Additionally, you should gather contextual data on the views of these primary stakeholders regarding circular economy, potential initiatives they have pursued in this field, and their perceived barriers towards sustainability.

STEP 2.1: DESK RESEARCH INTO MACROECONOMIC DATABASES AND SECTORAL REPORTS

In this step, you should aim to find data for the main flows in the whole value chain: consumption of energy, water and materials, waste streams, and size of the sector. If possible, you should also break down the data so it describes the separate parts of the value chain, but if this more fine-grained data is difficult to obtain through desk research, it can be obtained in the following step.

There are two main sources from which we advise to obtain data in this step: Macroeconomic databases (Global, European or national statistics offices, relevant government agencies, policy analysts and researchers) and reports on regional value chains (by sectoral, academic, or consulting organisations).

When these databases provide material flows data on for energy use, waste production and production quantity for the relevant value chain and within the regional scope, they can be readily used in the data input sheet. In cases where data is available on a national level, it might still be usable by downscaling it to the regional level (using the relative regional employment in the identified sector for example).

Different databases will be available for every region, but three examples of such databases are:

- Eurostat database on regional and sectoral statistics (link here).
- Prodcom database on the production of manufactured goods (link here).
- National statistics databases, for example CBS in the Netherlands (link here).

Reports on regional value chains by sectoral, academic or consulting organizations are a second useful data source to obtain quantitative data on material flows. These can be obtained via desk research or might be available from the secondary stakeholders that were consulted in step I. A requirement, again, is that the data should be on a regional level and connected to the relevant value chain.

Examples of such research and reports are:

- Inventory of available biomass from agriculture, or landscape maintenance.
- State of the market reports from specific sectors such as car manufacturing, consumer electronics, and petrochemical industries.
- Databases and knowledge banks managed by sector-specific organisations (e.g. PlasticsEurope for plastics, BREEAM for building practices).
- Scientific research (such as Life Cycle Analysis) on specific value chains.

The different databases and reports should complement each other in obtaining the required quantification for the material flow analysis. After the desk research and structuring the data in the input sheet in Appendix 2, potential data gaps should be indicated so that the interviews with primary stakeholders in the next step can effectively be used to fill these gaps.

STEP 2.2: PRIMARY STAKEHOLDER INTERVIEWS

Through interviews, this step provides qualitative data on primary stakeholders for the stakeholder analysis, a list of emerging circular ideas and initiatives by the primary stakeholders, and more fine-grained quantitative data to fill the remaining data gaps from the previous step. It is advisable to interview different primary stakeholders that represent each value chain link to obtain a complete representation. The stakeholders that scored the highest for being able to affect the value chain in Step I should gain preference. Conducting a maximum of ten interviews should be sufficient to obtain the described data. The question sheet for the interviews is available in Appendix 2. Because the available time for a single interview is limited and some detailed material flow data might not be readily available, it is advisable to send the question sheet to the interviewee beforehand to give him or her the opportunity to prepare the answers and collect data when needed.

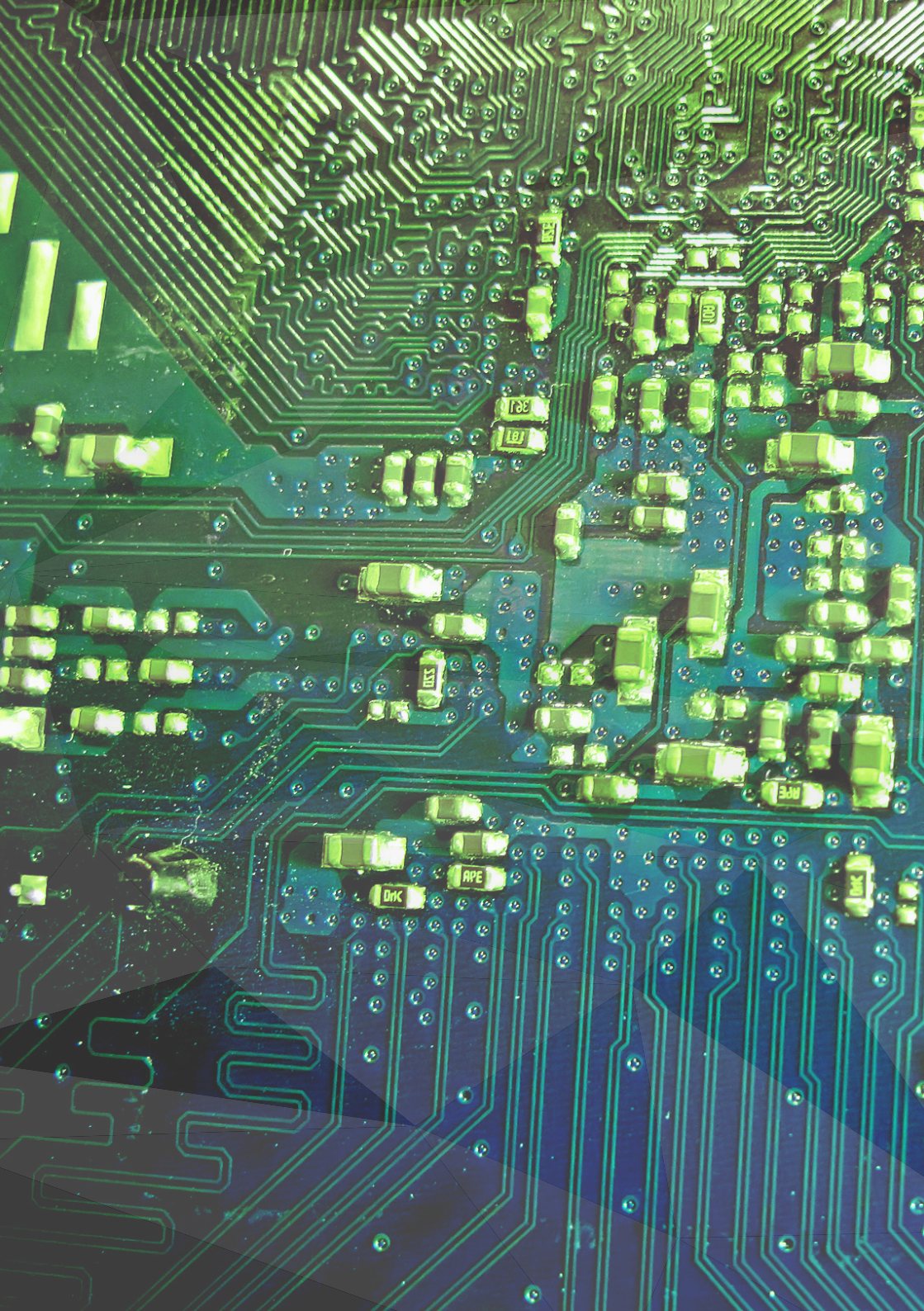
The initial desk research should have provided some general data on the regional value chain but inevitably, some data will be missing or imprecise and most of the data will not be as fine-grained as you would ideally want it. The quantitative gaps in the data input sheet of Appendix 1 can be filled by asking about this data (material, water or energy flows of a value chain link) at large regional companies in the specific value chain link where the gap occurs. An approximation of the total amount of energy or materials that flows in or out this value chain link (which represents the data gap) can then be gained by

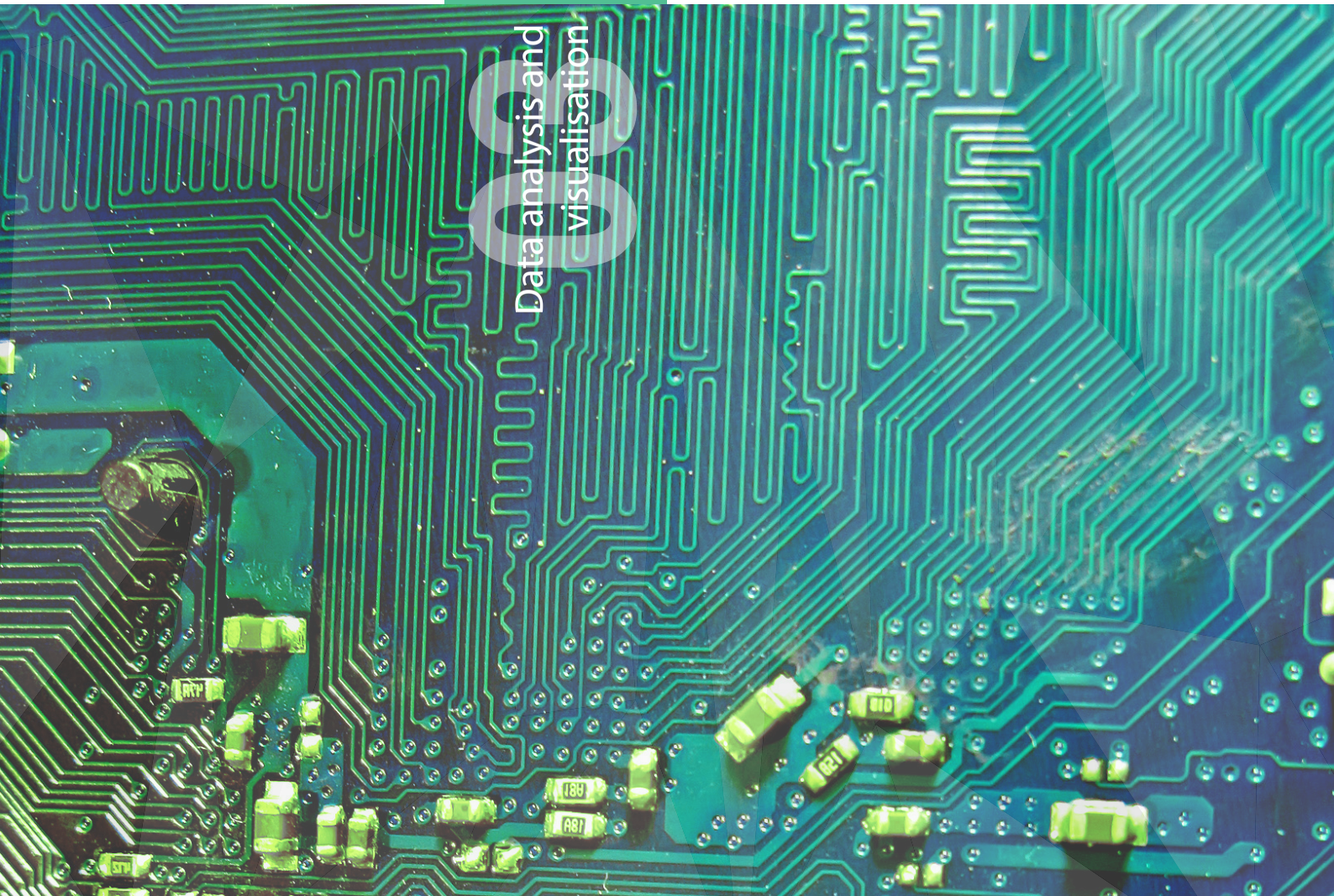
scaling up the answers of the company to the regional level by using the relative employment or revenue of this company in the value chain link. The qualitative stakeholder position data should be stored in the same place and formated the same as the stakeholder mapping data of Step I. The list and data on emerging circular ideas and initiatives of the primary stakeholders should be stored in the hotspots and emerging ideas sheet of Appendix 3. It is important that you assure careful treatment of this potentially confidential company data after collection and throughout the subsequent storage and analysis steps. If you want to use an easier but less comprehensive way of saving your data about emerging ideas, you can also use the spreadsheet provided in Appendix 5.

Finally, when all the planned interviews are conducted, a last check should be done if all required stakeholder and material flow data is collected. If not, additional primary stakeholder interviews should be considered.

In most cases, you will not need to interview secondary stakeholders, because you will not need quantitative data from them and because they typically play a less significant role in the value chain. If, however, you identify secondary stakeholders with significant importance for the value chain, it can be a good idea to interview them and gather their views on the value chain.

If you are doing the light version, you should not use the interviews to gather quantitative data on material flows and you should not fill in Appendix 2. For these interview, you should instead gather qualitative data about the opinions, strategies, initiatives, and barriers related to circular economy and sustainability. It is recommended to still use the interview guide in Appendix 1 as a foundation for these interviews.





8 Data analysis and visualisation

STEP 3: DATA ANALYSIS AND VISUALISATION

After all data is collected, the material flows and stakeholders can be analyzed and visualized. The purpose of this step is to provide the insights and overview that are necessary to define good solutions in the workshop. At the end of this step you should have:

- A visualization of the material flow analysis (e.g. a Sankey diagram)
- A visualization of your stakeholder analysis with the stakeholders plotted according to their respective affect and affected scores.
- An analyzis of the most important hotspots in the value chain. This can be added to the visualization of the material flow analysis or be a stand-alone visual.

STEP 3.1: MATERIAL FLOW ANALYSIS

In this step, the material flow analysis will be carried out and vizualised to provide a clear understanding of the material flows throughout the value chain. The value chain map of Step I and the material flow data collected and stored in the input sheet in Appendix 1 during Step II should be combined to create this visualisation. You should ensure that uniform units are used for all data in the input sheet so that the flows can be appropriately scaled in the actual visualisation. A last check on this is thus important.

The goal is to have the sequential flow of materials through the value chain is presented in a way that makes the different value chain links, types of materials and quantities clear. There are different ways to achieve this, but we advise drawing out a Sankey diagram. An example of a Sankey from our work can be seen in Figure 5. There are multiple ways to build a Sankey: it can be drawn on paper, designed digitally or made with Sankey software. In the end, you should choose a visualization method that fits you and is clear in its visual representation of the value chain and material flows. Most important is that the flows are correctly connected between the value chain links and that the description and relative size of the material flow values, as collected in Appendix 1, are assigned to these flows.

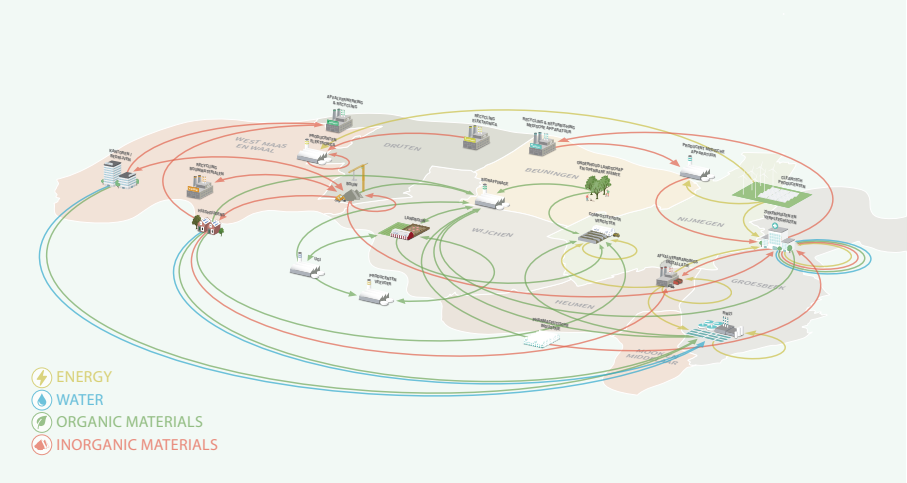


Figure 5: Example of a Sankey diagram to visualize a material flow analysis

STEP 3.2: STAKEHOLDER ANALYSIS

As described in Concepts section, the stakeholder analysis should ideally function as a socioeconomic layer to the material flow analysis and it should help to give a better sense of the actual people and organizations that are involved in the value chain. Just as with the mapping step, the analysis and visualisation of stakeholders can become a complicated process as well, which can cloud the general overview so we advise that you keep the visualization simple.

First, the affecting and affected scores should be reassessed for the interviewed primary stakeholders. Answers to the interview questions should be evaluated to reassess the affecting and affected scores, considering primarily these questions:

- Company size; larger companies tend to be more affecting and more affected.
- Current circularity and sustainability initiatives; novel established initiatives can indicate a more proactive approach towards affecting the value chain.
- Drivers and barriers for sustainability; reacting mainly to external drivers or perceiving many external drivers can indicate a position where a company is mainly affected by the value chain and not able to affect it by own effort.

- Regional suppliers and customers; when a company's customers and suppliers are mainly within the region, then this company is in the position of being both affected by and affecting the value chain.
- Location in the value chain; Very downstream companies are consumer sensitive and upstream companies are more resource sensitive. Look at the position of the actor and its relevance for this value chain.

These five aspects are examples of interview answers. It is advisable however to evaluate the whole interview and then set together two to four people and talk about the scores. After the reassessment, you can make a map and categorize the different stakeholders as is shown in Figure 6. It is a good idea to add both primary and, if important, secondary stakeholders in the diagram and then assess where in the diagram they are located.

Use the different categories to interpret the position of the different stakeholders and to consider how and when to include them. That said, it is important to not get too focused on these categories and maintain a general, nuanced understanding of each stakeholder and its connections with other stakeholders.

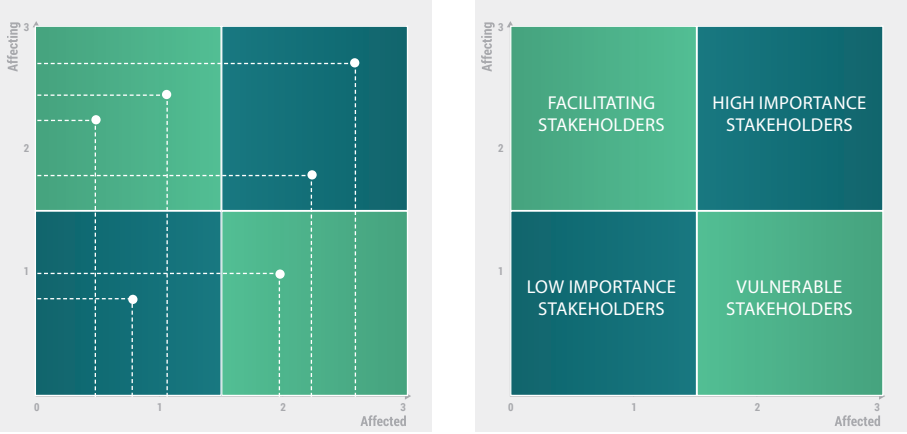


Figure 6: Stakeholder visualization

Facilitating stakeholders are placed in the top left corner and are characterized by a strong ability to affect the value chain with little risk of being affected themselves. These kinds of stakeholders can be quite rare but also very important. They are not so likely to get involved on their own initiative because they are not affected by the value chain, but if the you manage to get them involved, they can have significant impact. Facilitating stakeholders are typically secondary stakeholders (i.e. local governments, scientific organization, or the media) or providers of secondary input for the value chain such as utility companies.

High importance stakeholders have a clear ability to affect the value chain and are also sensitive to changes themselves. It is important to know and understand these stakeholders as they will be at the center of any interventions that will be made. Without their consent and ideally their cooperation, it is difficult to create real positive change. These stakeholders are often primary stakeholders operating within the value chain.

Vulnerable stakeholders have a high risk of being affected by changes in the value chain but cannot do much themselves to invoke changes. Social issues that evolve around a value chain often involve these kinds of stakeholders and it is important to include them to ensure the long-term legitimacy of the value chain. These kinds of stakeholders are often workers, consumers or local communities.

Low importance stakeholders are generally irrelevant and if any of the stakeholders are located here, it is worth considering whether they should remain a part of the process.

STEP 3.3: IMPACT AND HOTSPOT ANALYSIS

After the material flow analysis and stakeholder analyzis, a prioritization of the most important impacts to address should be performed. The purpose of this process is to identify the hotspots in the value chain where change is most urgently required.

Identifying potential impact areas for action

Ultimately, determining the extent of an impact is entirely context dependent. Since a full impact assessment is not within the scope of this project, we provide some rough approximations and rules of thumb to identify potential impact areas of relevance. Performing this assessment, even in a simplified manner, is highly technical and time consuming. It might, therefore, be necessary to get help from an expert in supply chain assessment or environmental assessment either from within or outside of your organization.

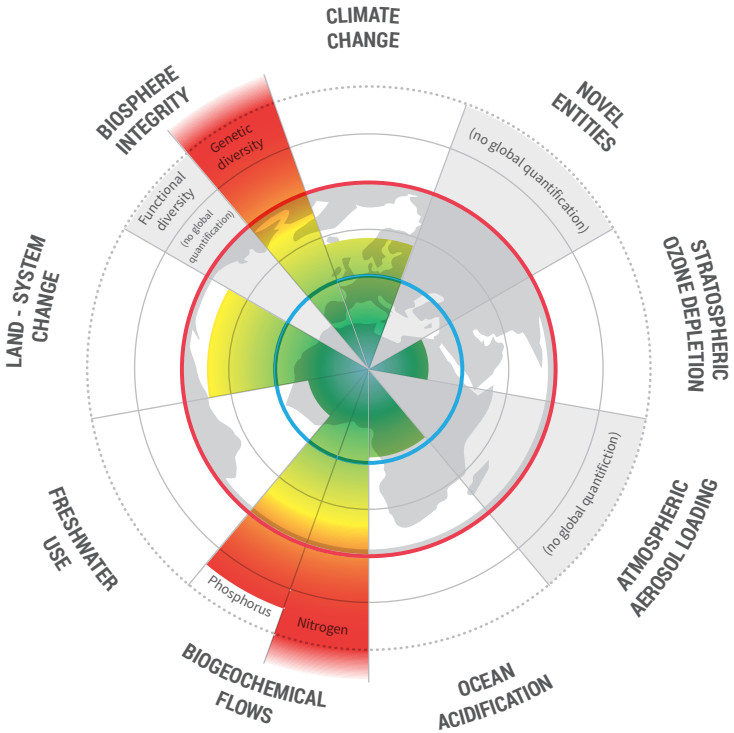


Figure 7: The planetary boundaries of Earth

The basic notion is to identify the flows that have the highest volume and those that are associated with a high social or environmental impact by plotting these in a two-axis matrix. This is done by assessing all the main flows in the analyzis and identifing which are related to:

- Environmental impacts - in particular those overstepping the planetary boundaries (Figure 7, Rockström, 2009), such as:

    a. Carbon and greenhouse gas emissions, as well as air pollutants, for example from products that require high energy in their production or were transported long distances.
    b. Nitrogen and phosphorus emissions, especially from agricultural waste streams.
    c. Biomass extraction and land use conversion, especially for threatened species or materials produced in vulnerable, high-biodiversity areas such as rainforests, wetlands, or coral reefs.
    d. Materials that are related to highly polluting emissions, such as those used in some chemical processes and in products such as electronics.

- Socioeconomic impacts and impacts related to human well-being, such as:

    a. Materials whose production requires the use of products with high human toxicity.
    b. Materials that are associated with unfair production practices or supply chains, for example, when there are risks of slavery or human rights violations.
    c. Materials whose production requires the use or depletion of scarce and critical materials, including non-renewable resources, such as metals, minerals, and fossil fuels.

In making this assessment, it is necessary to get detailed data on the different impact metrics related to individual materials and production processes. Examples of these are: greenhouse gas emission per tonne of production output, water consumption per tonne of production output, and nitrogen and phosphorous emission per tonne. Desk research can often provide reliable detail, but in some instances it can be necessary to obtain access to databases with life cycle analyses, such as Ecoinvent.

When the required data for the impacts of the flows has been obtained, it is necessary to put it in a meaningful context, in order to assess whether a specific impact is big or not. For this purpose, it is best to compare the identified impacts with other similar cases (similar companies, products, or processes) from other regions or to compare them with best practices in the industry. This kind of contextualization gives a sense of the scale and ability to evaluate the impact.

All flows are then mapped considering volume and impacts and then plotted on the two axes as represented in Figure 8. Often it can be tempting to just focus on the material streams with the highest volume and pay less attention to the severity of the impact because it is more challenging to assess. Doing that would, however, be a mistake as it would typically lead to inaccurate conclusions. When all the flows have been mapped, you can take a closer look and initiate action following these priorities:

1. Flows with high volume and high impact potential.
2. Flows with low volume and high impact potential.
3. Flows with high volume and low impact potential.
4. Flows with low volume and low impact potential.

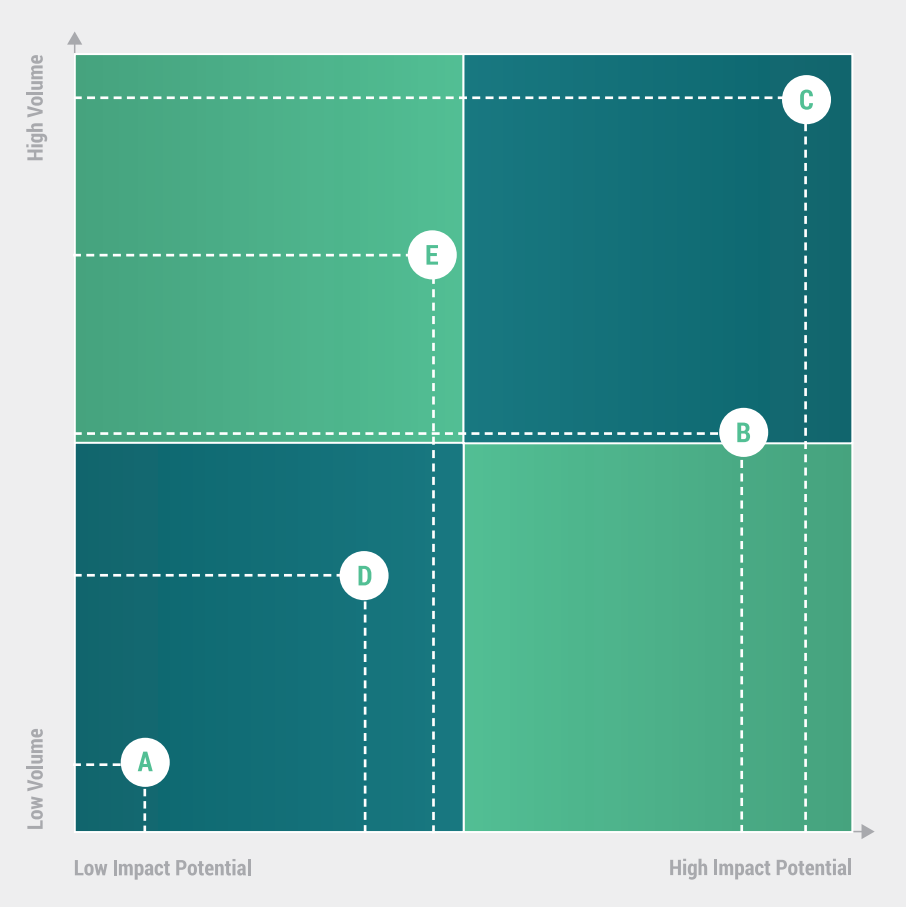


Figure 8: Visualization of the volume and impact potential of material flows analysis

The flows that are positioned in the upper right corner constitute the main hotspots in the value chain. These hotspots can be visualized by plotting them into a depiction of the regional value chain or by using the diagram above. Flows that are positioned in the two adjacent quadrants can also be relevant and can be highlighted in a different colour.

Prioritizing hotspots within different impact categories

When there are multiple impact categories that need to be addressed, it is important to consider what to deal with first and, if a choice must be made between two different issues, to carefully consider where it is more acceptable to not act.There are several principles that should be considered:

- If the damage will be irreversible, such as with species extinctions.
- Whether the impact will be there for the long-term or if it will be naturally reversed in the short- to medium-term.
- The magnitude and level of impact on humanity and the environment, including socioeconomic effects.
- Whether the environmental pressure risks causing an ecosystem collapse, for example due to the trespassing of planetary boundaries.

For example, if we must choose between sourcing a material (such as timber) from two different ecosystems, we can consider which one has a larger capacity to produce this material but also which one has less pressure on it (less extraction). A higher priority would come, however, if one of these two ecosystems hosts more unique biodiversity and is at higher risk of collapse. The decision might also affect local populations at both sites, as it will lead to changes to livelihoods. It is also possible to consider, for example, which population would be most affected by losing this source of income.

To put things in perspective, we can consider the choice between supplying transport with biofuels, which are renewable, and fossil fuels, which are not. Resource depletion presents severe economic risks in the long-term, hence biofuels might seem preferable. However, given the extent of land required to produce earlier generation biofuels, these generally present a higher impact on biodiversity loss. Considering that biodiversity loss is irreversible, and that fossil fuels can be substituted in the long-term with other energy sources and technologies, it might be preferable to use fossil fuels in the current situation.

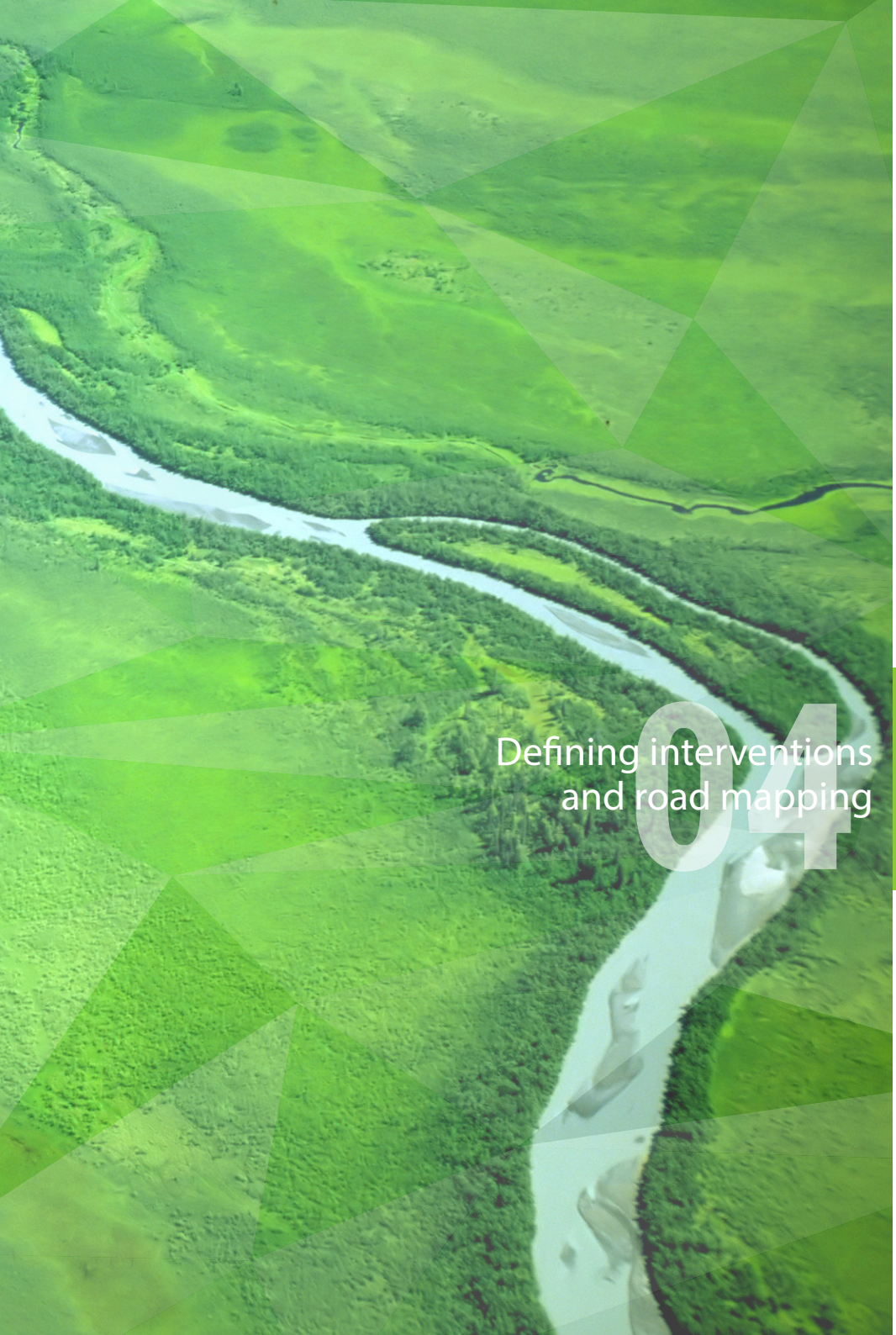
Looking for circular opportunities

The hotspots of the three high impact or high volume quadrants, including their impact categories, should be entered in the hotspots and emerging ideas sheet in Appendix 3. This sheet will be expanded in Step IV to form a detailed list of regional hotspots that can be matched with the listed emerging ideas and initiatives to unlock their circular potential. After the regional workshops of Step IV, the hotspots and emerging circular ideas from different regions will be

aggregated to facilitate the identification of cross-regional synergies. While the regional synergies can mainly be found in exchanging and reuse of waste flows, the cross-regional synergies will be more focused on exchange of knowledge, technology and best practices rather than physical flows due to the long geographical distance.

This aggregated sheet can be regarded as a living document which provides a kind of marketplace where hotspots represent a demand for circular solutions and the emerging ideas and initiatives can supply these circular solutions. Identifying and initiating these projects around these regional and cross-regional synergies will be the focus of Step IV and is facilitated by classification of demand and supply in common categories, this will be further explained in Step IV.

The outcome of step III are three visualisations: the material flow analysis, the stakeholder analysis, and the impact and hotspot analysis. Additionally, an initial listing of hotspots and emerging circular ideas and initiatives should be completed. Depending on the complexity of the illustrations, it can sometimes be helpful to merge all the insights into one illustration so that the hotspots are shown in the material flow diagram where they occur and stakeholders are similarly pinpointed in the diagram together with the relevant material flows. This will form the starting point for the next step.



04 Defining interventions and road mapping

STEP 4: DEFINING INTERVENTIONS AND ROAD MAPPING

At the end of Step III, the material flow analysis, the stakeholder analysis and the hotspot analysis have been finished and the results have been visualized. With these products ready, it is time to gather the most relevant stakeholders for a workshop to collectively formulate a vision for a more circular value chain and to define concrete regional interventions to get there.

The workshop should foster a strong shared understanding of the challenges and opportunities within the regional value chain as well as an idea about which challenges and opportunities can be handled through cross-regional synergies and which can be handled within the region itself.

This is also where the concept of leverage comes into use. Recall that leverage consists of: weights, the impacts that you want to change; fulcrums, the processes that govern the weights; and levers, the interventions that can be used to affect the targeted processes. Hold these concepts in mind when carrying out the workshop. Make sure that the participants understand that the purpose is to see the value chain as a system and to define interventions that function on a systemic level.

STEP 4.1: WORKSHOP

After the workshop, three key deliverables should have been produced during the process:

- 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 emerging ideas (interventions) that need the extra capacity of cross-regional synergies to be effective.

The framework for the process that will get the project team there to these deliverables is inspired by the Backcasting method (Robèrt et al., 2012) but has been modified to fit this purpose.

The method of the workshop consists of the four steps (Figure 9).

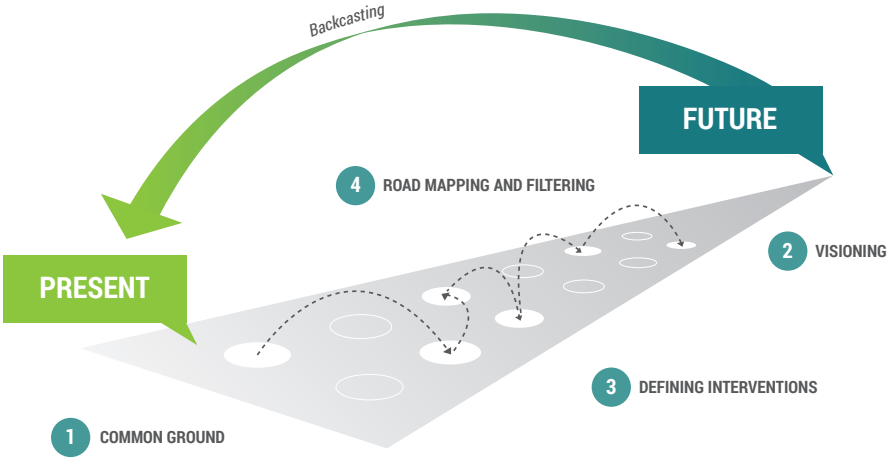


Figure 9: Overview of the workshop process

1. Common ground (45 minutes plenary)

In this first part, everyone is presented with the results of the research that has been leading up to the workshop (Step I – III). The efforts spent on structuring the data and visualizing the results will come to the forefront at this point. This first stage of the workshop has two elements:

1. Presentation of the results from the analysis of the value chain (results from Step IV)
2. Discussions about the hotspots and the processes connected to the hotspots

Start out wth presenting the result from the preceding analysis and make sure everyone has clearly understood the results. You can also provide handouts that summarize the results for use in the rest of the workshop.

With the presentation of the results as a starting point, the workshop group can move on to discussing and defining the most important weights and fulcrums in the system. The weights are basically the hotspots that have already been identified, but 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. Use this session to discuss the processes that function as fulcrums in the system and try to reach a common understanding of the connection between the weights (hotspots) and the fulcrums in the value chain. 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 best be 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.

As inspiration for the process, we refer to Gladek (2017). It explains in more detail the seven pillars of circular economy, which can be used as a starting point for shaping your own vision.

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 and filtering (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). At the end, it is important to ensure that all participants agree with the outcome of the workshop. Gather the best interventions and sort them according to their time horizon - i.e. how soon can they be implemented.

Some of the interventions that have been found in the third stage of the workshop, will be possible to implement within the region together with the stakeholders that are present at the meeting. Others of the defined interventions will be really promising but require certain capabilities that are not in the region itself. These are the interventions that are suited for the cross-regional synergies and they should be stored in Appendix 3 as emerging ideas. These are some of the ideas that can be taken forward in the SCREEN partnership to establish synergies.

To clearly identify whether a promising intervention can be implemented within the region itself, it can be helpful to ask:

- Do we have the right technology to implement this intervention?
- Do we have the right expertise to implement this intervention?
- Do we have the funding to implement this intervention?

If you cannot answer 'yes' to all these questions, the intervention should be added to the list of emerging ideas in Appendix 3 (See Step V). If you can answer 'yes' to all the questions, it should be possible to implement the intervention within the region itself.

Note that this guideline only provides the content and the aims of the workshop, not the processes. It is therefore essential that the hosts of the workshop spend time on deciding how to best facilitate the desired results. Activities like time keeping, negotiating different opinions, getting to conclusions and facilitating creative processes are necessary for a successful outcome but cannot be standardized in this protocol.

At the end of Step IV, all relevant data on hotspots and emerging ideas should be documented in Appendix 3. Completing the classifications and descriptions in the appendix ensures proper matching of initiatives and hotspots in Work Package 3.1 where the cross-regional synergies are identified.

Participants

Getting enough participants at the workshop is essential for the optimal result. The more participants, especially primary stakeholders, the better the chance of achieving change in the long run. A suitable number of participants would be around 10 to 15, but it also depends on the value chain in question and the number of stakeholders within the region. To ensure a high rate of participants, it is important to schedule the workshop early in the process and make sure to invite all relevant stakeholders.

The participants should be taken primarily from the list of primary and secondary stakeholders. It is important to have a strong representation of primary stakeholders at the workshop and all participants should be able to speak and make commitments on behalf of the organisation that he or she represents. It might also be worthwhile to have an external facilitator present.

Suggested schedule

Duration: 4 hours and 45 minutes

Welcome (15 minutes)
- Walk in, registration and refreshments
- Signing of informed consent form in Appendix 4

Opening (15 minutes)
- Introduction to workshop program
- Short introductions: name, organisation, and motivation for participating

Workshop parts (4 hours)
- Common ground (45 minutes - plenary)
- Visioning (45 minutes - plenary)
- Break (15 minutes)
- Defining interventions (60 minutes – break out)
- Break (15 minutes)
- Road mapping and filtering (60 minutes – break out)

Sharing outcomes (30 minutes)
- Sharing outcomes of the workshop with the group and closing remarks

Materials to prepare

- Basic presentation outlining the results of the research so far and the purpose of the day
- Print-outs of the visualizations of the most important material flows and hotspots within the value chain
- Support materials, such as: principles of circular business models, focus areas for the circular economy, and successful examples of circular initiatives
- Informed consent form (Appendix 4)
- Post-its and pens for brainstorming, materials for presenting and a whiteboard or flip board for the plenary sessions.

05 Gathering data for synergies

STEP 5: GATHERING DATA FOR SYNERGIES

The purpose of Step V is to ensure the availability of the necessary data on emerging ideas and hotspots. These data will allow the process of analytically discovering and establishing effective cross-regional synergies in the next step. To arrive at that end, this step will introduce: the assessment criteria that indicate the potential of hotspots and emerging ideas to form valuable synergies as well as the method to gather the required data. At the end of this step, you should have a complete overview of the emerging ideas and hotspots with values for the criteria and classifications.

Effectiveness of cross-regional synergies

Setting up successful cross-regional synergies can be a time- and resource-intensive process. Many pitfalls and miscalculations can occur between the identification of a potential synergy and the moment that an agreement between the partners is reached. This section therefore provides a framework, in the form of the spreadsheet in Appendix 3, by which data on the hotspots and emerging ideas can be structured to later facilitate the focused analytical identification of potential cross-regional synergies. Supplying these data will save time and resources, and result in more regional benefits when the proposed cross-regional synergies will be pursued.

STEP 5.1. COLLECTING DATA ON HOTSPOTS AND EMERGING IDEAS

The data that you collected in Work Package 2.2 and in 2.3 forms the basis for the classifications and criteria, but additional data should be collected to complete the spreadsheet in Appendix 3.

Sources for data on emerging ideas and hotspots are: the SCREEN tool which was already completed prior to this protocol, interviews with primary stakeholders, and the workshop. Contacting experts or the stakeholders that proposed an emerging idea or are involved in the value chain can also be a good source of information. It might not be possible to obtain all outlined data on all hotspots and emerging ideas. That is understandable and not a strict impediment to identifying any cross-regional synergies but more complete and detailed data is likely to result in the identification of valuable synergies. The less important data points have been market with 'optional' to make it clear what data is important and what is less so.

A list with the criteria, the data that needs to be gathered for these criteria, an explanation, and a potential source is presented below for the emerging ideas and hotspots.

Emerging ideas

The list of criteria below is set up in the same order as in Appendix 3. The criteria in the spreadsheet are listed and explained below:

Environmental impact (Optional)

Indicate for this criterion which of the planetary boundaries will be affected by the emerging idea.

Socioeconomic impact (Optional)

Choose in the spreadsheet which of the socioeconomic impact categories are potentially mitigated through the emerging idea.

Impact reduction (Optional)

Indicate what the impact reduction potential of the emerging idea is, based on the targeted material flow and impact. This can for example be the percent energy reduced, volume of waste reused, or amount of emissions prevented. Accurate data on this might not always be available, but estimations from previous projects can help.

Capital investment (Optional)

You should indicate here what the initial capital investment is to establish the emerging idea. If data is not accurate, available, or sharable then an estimate will help as well.

Operational costs and revenue (Optional)

Here you should indicate what the operational costs and revenues of the emerging idea are annually. Again, estimates from previous projects can help.

Technology Readiness Level

This relates to the maturity of the emerging idea. The Technology Readiness Level (TRL) classification is an indicator for the maturity of the initiatives on a scale of 1 to 9, in which: 1 indicates an idea; 2, a plan; 3, an internal test; 4, an evaluated internal test; 5, a pilot; 6, an evaluated pilot; 7, a commercial demonstration; 8, an evaluated commercial demonstration; and 9, a mature offering. The TRL of the emerging idea should be indicated on this scale.

Employment impact (Optional)

Indicate what the added or lost employment that results from the establishment of the emerging idea might be. This could be based on past experience, or on an estimate of the expected added value in combination with the average employment per unit of added value.

Contact details

Describe where additional information on the emerging idea can be requested. In case of a documented pilot or mature offering by a company, a website or links to reports will be valuable. In any case a contact person, including an email address, that can be reached for further questions should be provided.

Hotspots

Similarly, a sheet to assess hotspots is available in Appendix 3. These criteria in this sheet are:

Opportunity costs (Optional)

Here you should indicate what the opportunity costs of the hotspots are on an annual basis. In other words, what is the missed revenue compared to a circular value chain where the hotspot is avoided. This can, for example, be in the form of costs of disposing waste flows, inefficient energy use in processes, or low valorization of by-products. Estimates from comparable projects can help.

Contact details

Here you should indicate where additional information on the hotspot can be requested. In case of a hotspot with documented information by the concerning company, a website, or links to reports will be valuable. In any case a contact person, including an email address, that can be reached for further questions should be provided.

After the results of Step V are shared with the SCREEN project team, an external partner will start to identify and assess the most promising synergies. During this process additional information might be requested to better facilitate the identification and scoring. Eventually your region will be supplied with a couple of potential cross-regional synergies that are worth exploring. These cross-regional synergies have the potential to benefit your economy, increase employment, and provide leverage to transform your regional value chain towards a more circular state.

06 Exploring synergies

STEP 6: EXPLORING SYNERGIES

Step VI shows you how to explore the data on emerging ideas and hotspots to find possible synergies across regions. At the end of this step you should have all the data from the regions collected in one Excel-file and a list of possible synergies that can be explored further.

While it is possible that each region browses through the data to find synergies for themselves, we recommend that it is done exhaustively by only one centralized party. It is in other words not recommended that each region performs this step, so make sure to coordinate the execution of this step.
For this last step, a few new concepts will be presented to start with followed by a description of how to identify and explore synergies.

Emerging ideas and synergies

When looking for synergies, it is helpful to make it clear what we are, and what we are not, looking for. Because the regions in question are spread all over Europe, it does not make sense to think of synergies in terms of physical materials, because it is almost guaranteed not financially feasible to transport, for example, waste streams between countries. That means that you should not consider material stream exchange, as seen in industrial symbiosis, or platforms for sharing physical objects.

Instead, it makes sense to consider synergies that are related to research, knowledge sharing, technologies, investments, business development programs, and policy frameworks. These are all activities that are important for the circular economy but they are not physically bound to a location and can therefore better be shared and developed across Europe.

But when are different synergies relevant? To answer that, it is necessary to look at how emerging ideas arise from challenges and become manifest as innovations that push the transformation to a circular economy.

How emerging ideas develop

Emerging ideas play a central role in the SCREEN partnership as in the general transition to circular economy. Often, we think of technological innovations when hearing or using the word 'emerging ideas' but it is important to keep in mind that emerging ideas can be much more than technology. It can be new policy frameworks, social movements, new behavioral patterns, novel business models and even old ideas applied in a new context. In the following, the words

innovation and emerging ideas will be used to refer to this broad spectrum of options. Similarly, the word challenge is considered synonymous to hotspots.

To describe how emerging ideas evolve, we have broken the process down into 5 stages. In the first stage, you are unaware of the specific challenges that need solutions but you know that a certain sector or value chain is important for your region and the search for emerging ideas is driven by this topical focus. As the value chain is studied and understood in detail, important challenges are uncovered, which is stage 2. Slowly, because organizations are looking to solve these challenges, these challenges become the driving force behind the development of emerging ideas and in step 3, you have identified what kind of innovation are needed to address the challenges. In stage 4 the needed innovations are being developed and tested but are still not ready for a bigger market. At this point, the process becomes opportunity driven because solving the challenge entials societal and often commercial advantages. Finally in stage 5, the innovation has matured and is ready to be scaled. The emerging idea has gone from a topical curiosity to a mature solution that can be scaled. In figure xx below, the 5 stages are displayed along with ranges of technology readiness levels (TRL) that fit the stages.

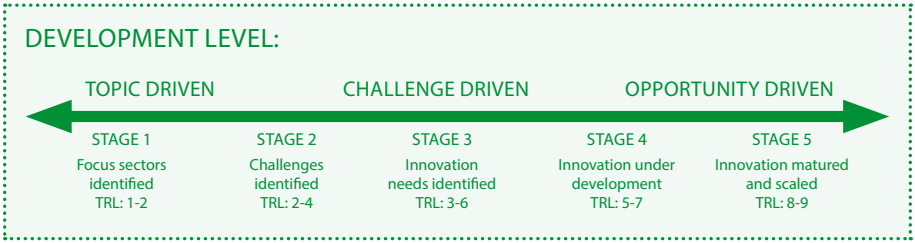


Figure 10: The development of emerging ideas in five stages.

When you make your regional analysis, you will come across emerging ideas with different levels of maturity. Some emerge through research, others arise as commercial ventures and yet others might be found by you as you get to know the value chain in question. The important thing is that you identify the emerging ideas and recognize that it is necessary to facilitate their further development towards a mature and scalable state so they can unlock the advantages of circularity. In this sense, you can think of the synergies as cross-regional and collaborative activities that help emerging ideas to mature and solve critical challenges.

Different synergies for different stages

Thinking of synergies as activities that promote emerging ideas at different stages of development helps us to make a comprehensive list of the possibilities for regional collaboration. Based on this framework, we have developed eight cross-regional synergies that address barriers at different development stages. These eight synergies are not necessarily exhaustive but they cover most situations and needs. In figure xx+1 below, the synergies are displayed at the different stages of development where they are most relevant.

Figure 11: Eight synergies matched to the development trajectory of emerging ideas.

WORKING GROUP

This is a topic-oriented working group that collaborate to explore a specific value-chain and identify critical challenges that need to be addressed. This is the first breeding ground for new emerging ideas and the activities in the working group can include workshops, inspirational visits, idea sharing, discussions and so forth.

SECTOR ANALYSIS

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 understand the challenges better and to carve out and test potential innovations that could address the challenges. The research consortium is different from the sector analysis in that it from the beginning is focused on a specific challenge rather than a whole sector or value chain and aims to provide much more specific understanding of the challenge and its possible solutions.

STRATEGIC INVESTMENT

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 by investing in different innovations that together can form a solution or by supporting the development a similar innovation in different regions to allow for more market players and a better chance of a great outcome. The investment can also be directed to the development of an innovation that is hosted at multiple research institutes in different regions or through innovation competitions that aim to solve specific problems by supporting the most promising participating innovations.

BUSINESS MODELING

Emerging ideas sometimes unlock value that is challenging to monetize commercially. It is not always easy for example to get more money for a product just because it can be disassembled and recycled easily although this is clearly smart for society as a whole. Therefore, it can be necessary to innovate on the business side to capture this value. 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. The group can then go into a collaborative process of experimenting with different solutions and providing financial support if necessary.

MARKET UNLOCKING

Sometimes, though, it is not the business model that is missing but some outdated regulation that is stopping a valuable innovation from providing its benefits. This is common in relation to waste where old regulation restrict the options for recycling and 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 but the means to do that is in this case instead experimentation with new policy frameworks or temporary dispensations to operate under monitoring.

TECHNOLOGY EXPORT

When an innovation is fully matured and ready to scale, other regions can often benefit from adopting it instead of developing a solution themselves. Therefore, this synergy is a group of regions that are potentially interested in importing a technology and one region that is the technology-exporter. Collaborating closely around this process can be extremely fruitful as technologies often need to be adapted to the regional context to fulfill its potential.

KNOWLEDGE TRANSFER

This kind of synergy is used when an innovation is under development or fully matured. 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 mentor program among regions if one region is clearly leading technologically or a more mutual exchange of knowledge if regions possess different relevant capabilities.

6.1: FINDING THE SYNERGIES

With the different kinds of synergies defined, we will turn to the method for identifying synergies using the collected data. Three simple methods for identifying potential synergies are presented in the following and for each of the methods we suggest which types of synergies are often relevant. These are only suggestions and you should always consider for yourself whether other synergies would be more suiting based on barriers, the maturity of the innovation, and other conditions.

The search for synergies will to a large extend rely on your evaluation of specific emerging ideas and hotspots as well as you judgements on possible fits between these. It is therefore important that you are well-familiarized with circular economy in general and have a good sense of the data on hotspots and emerging ideas that you have received from the other regions. Diagrams of the regional value chains and details about stakeholder can serve as valuable support material but are not necessary for the process. This qualitative approach that relies on personal analytical judgements is most effective when the amount of data is not too big, so with around 15 or less regions participating.

In the following, you will be taken through the process of preparing the data and identifying possible synergies with the three methods: Match, Challenge partnership and Open innovation. Finally, we will shortly discuss how to develop the synergies further as they have been identified.

Preparing the data

The following steps assume that you have received data from most regions on their respective emerging ideas and hotspots, gathered in Appendix 3. If this is not the case, you should consider whether it is possible to get the remaining datasets before starting. Developing synergies with too few participating regions will not only make it harder to identify good synergies, it will also lead to double-work if you later have to include more datasets and go through the process again.

To be able to find synergies, you want to have all the emerging ideas from the regions gathered in one spreadsheet and all the hotspots in another spreadsheet. Each emerging idea or hotspot is one 'entry' and should only occupy one row in the respective spreadsheet.

You can use an empty version of Appendix 3 and copy the entries, you have received from the regions, into this spreadsheet. Add one column called 'Region' and add the name of the region that has provided the entries. This way you can easily find the owner of the hotspot or emerging idea.

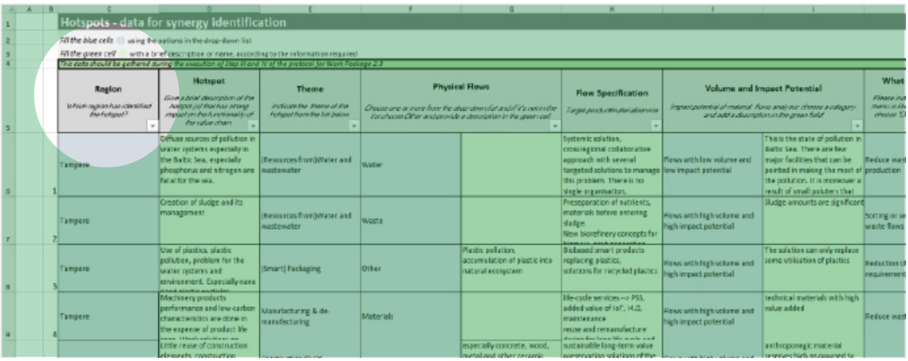


Figure 12: Screenshot showing 'Region' column

This should leave you with two spreadsheets. One for emerging ideas and one for hotspots, each of them with all the data you have received from the regions. Each of the column headers in the top row of the table should be activated for filtering, which is indicated with a button with a small triangle in the bottom right of the cell. If it is not activated, you can do this by marking all the data and the column headers and press 'Sort & Filter' in the Home ribbon and then choosing 'Filter'.

This functionality is important for the following procedure and if it is new to you, we recommend that you spend a bit of time familiarizing yourself with it.

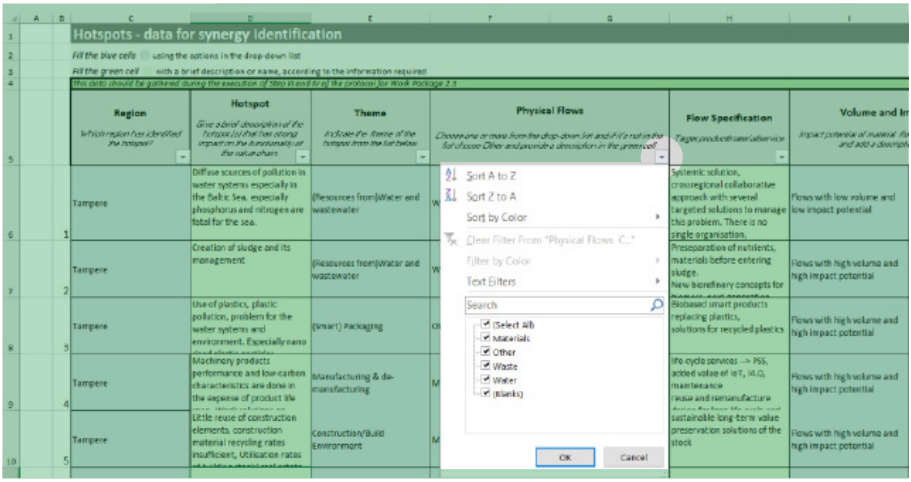


Figure 13: Screenshot showing filter function

Match

This method is the most intuitive and the easiest to develop into a successful synergy, as it is based on a demand and supply model. It consists of one regional hotspot and one or more emerging ideas that address the hotspot. Sometimes one emerging idea is sufficient to address the hotspot and sometimes different emerging ideas can together form a solution. It is even possible that more regions have similar hotspots that can be pooled and matched with emerging ideas.

Synergies identified with this method often lead to Technology export because of the demand-and-supply nature of the method but with less mature innovations it can also lead to Sector analysis, Research consortium, or Strategic investment.

Identification process

The easiest way to go about this is to go through the list of hotspots and choose one hotspot to focus on. When you have chosen a hotspot, you should spend some time to get to know it. Note down the sector of the hotspots as well as its positions in the value chain and the barriers that are described. If the region has provided a diagram of the relevant value chain, you can also inspect this to get a clearer understanding of the hotspot.

Upon this short review of the hotspot, you turn to the spreadsheet with emerging ideas and sort the data for values in the category 'Theme'. Now all the emerging ideas from the same theme will be placed in sequence and you can scroll down to the theme that fits the hotspot.

If there are too many emerging ideas in that theme to get an immediate overview, you can make a sub-selection in the category 'Value Chain Position' by using the activated filter function to display only the emerging ideas from the same or adjacent value chain positions.

Now you should be left with a subset of the most relevant emerging ideas and you can go through each of them to look for one or more that match the hotspot.

Examples of matches:

Sludge recovery and utilization

HOTSPOT

LAZIO AND TAMPERE:

Lazio in Italy and Tampere in Finland face a challenge with the production of sewage sludge that contains important nutrients. Current sewage systems dilute the sludge, making it harder to valorize and there is a lack of technologies to productively extract the valuable materials.

Barriers

1. Lack of filtration
2. Lacking consumer acceptance
3. Absence of specific legislation

Stakeholders

Tech-Marketplace

TAMPERE UNIVERSITY OF TECHNOLOGY

PIRKANMAAN JÄTEHUOLTO OY

UNIVERSITÀ DEGLI STUDI DELLA Tuscia

EMERGING IDEAS

FRIESLAND:

Cirtec and KNN Cellulose BV have developed a filtering technology that filters only the cellulose out of the sludge making it possible to use it for example as drainage inhibitor under roads. The extraction of the cellulose also makes the rest of the sludge easier which can lead to a cost reduction of 15-20% for aeration.

KNN Cellulose BV

CIRTEC

Ecophos in Friesland have developed a system that can extract almost 99% of phosphate from incinerated sludge, making it easy to add this highly effective valorization step at the end of the process.

SYNERGY

TECHNOLOGY EXPORT

Because the innovations are so mature in this case, we would suggest a Technology Export, from Friesland to Lazio and Tampere.

Valorization of grass

HOTSPOT

FRIESLAND:

Friesland experiences that processing of wild non-fodder grass could become much more efficient, thus leading to more value creation.

Barriers

1. Feedstock needs to be fresh
2. Lack of mature business case

Stakeholders

provinsje fryslân
provincie fryslân

van hall larenstein
university of applied scien

EMERGING IDEAS

LIMBURG:

In Limburg, NewFoss has developed a method to use this kind of grass to make packaging material that is currently used for egg boxes.

Huhtamaki

NewFoss®
Biobased products and techniques

staatsbosbeheer

SYNERGY

STRATEGIC INVESTMENT

In this case, Strategic Investment could be used to extend the use of this technology to other kinds of packaging, thus creating a high-value use for the grass.

Challenge partnership

The challenge partnership is formed by two or more regions that are confronted with similar hotspots or different hotspots but similar barriers. So instead of one region having a challenge and another a solution, this is a situation where one or more regions share a significant challenge and join efforts to develop a solution.

For this reason, the synergies that come out of this method will often be more challenge-driven or even topic-driven. The likely synergies are therefore Research consortium, Sector analysis, Business modelling, and Strategic investment.

Identification process

For this process, you will only be using the sheet with hotspots. What you are looking for is two or more descriptions introducing a similar challenge or two sets of barriers that are similar.

There are two main trajectories to identify Challenge partnerships. The first is to sort the hotspots by the category 'Theme' and look through them to see if any hotspots have similar descriptions or barriers. If there are too many hotspots within one theme to get an overview, you can again make a sub-selection using either the categories 'Value Chain Position' or the 'Target Sectors/NACE Category'.

The other way to identify challenge partnerships, is to look across themes and focus on a specific value chain position. To do this, you filter the hotspots with the category 'Value Chain Position' and select only one of the options to be displayed. Here you will rarely find descriptions that are similar, so you should instead read through the barriers to see if some of them reoccur in that specific point in the value chain.

Example of Challenge partnership:
Making bioplastic competitive

CHALLENGE #1

FRIESLAND:

Friesland in Netherlands has identified sewage sludge as a potential feedstock for bioplastic production, which is a high-value utilization of the waste stream. But it is difficult for bioplastic to compete with traditional plastic on price and performance.

Barriers

1. No established market for PHA
2. Not price-competitive

Stakeholders

cew centre of expertise water technology

stowa STICHTING TOEGEPAST ONDERZOEK WATERBEHEER

CHALLENGE #2

TAMPERE:

Tampere is confronted with the problem of plastic waste in the Baltic sea and would like biodegradable plastic to be more widely used. Similarly they struggle with the barrier that bioplastic cannot so well compete with traditional plastic.

Barriers

1. Conventional plastic is cheap and functional
2. Good plastics are lacking
3. Lack of consumer awareness

Stakeholders

TAMPERE UNIVERSITY OF TECHNOLOGY

VTT

TAMK TAMPERE UNIVERSITY OF APPLIED SCIENCES

SYNERGY

MARKET UNLOCKING

Since this Challenge partnership is oriented toward making bioplastics more competitive in the market, we suggest a Market unlocking synergy.

Open innovation

Open innovation is a new trend in commercial R&D that proposes that collaborating with value chain partner and even direct competitors can lead to far better innovations and a more lucrative result for all parties in the end. This is especially a popular approach for early-stage development, where a market application has still not been pinpointed but it can also be used at later stages if it can serve all involved parties.

In this particular case, Open innovation is a method of forming synergies where two or more similar emerging ideas are united in a collaboration for mutual benefit.

This method will often lead to synergies that are opportunity-driven, such as Market unlocking, Knowledge transfer, or Strategic investment. But it can also in some cases result in a Research consortium if an emerging idea needs more development.

Identification process

To identify possibilities for open innovation, you can apply a procedure that is just like that for Challenge partnerships described above but applied on the emerging ideas instead. Either you can look at emerging ideas within one theme and maybe even for only a segment of the value chain or you can look for similar emerging ideas across themes but all within one part of the value chain.

Example of open innovation:

Biogas from waste streams

EMERGING IDEA #1

FRIESLAND:

WETTERSKIP FRYSLÂN

Wetterskip Fryslân in Netherlands is producing biogas from sludge and is looking for more waste streams that could provide a profitable source that could add to the production and revenue

EMERGING IDEA #2

TAMPERE:

Tampere is establishing a biogas plant that will treat up to 160,000 tonnes of bio-waste and sludge per year. It is still not certain which waste streams and which amounts would create the best and most profitable combination for the plant.

SYNERGY

BUSINESS MODELING

For both of these emerging ideas, the technology is already in place and the further development is more a question of finding the right sources of biomass to ensure profitability and stable production. A Business modelling synergy is therefore recommended for this case.

6.2: TAKING THE SYNERGIES FURTHER

When a synergy has been identified using the data, it should be developed further with the relevant parties and naturally it will sometimes turn out that there is not a good enough foundation for a synergy whereupon it must be discarded. The identification of synergies through data only suggest possible options. But the more detailed the data is, the higher is the likelihood that the identified synergies will be successful.

Especially the data about hotspots has proven to be valuable for the identification process. This is partly because hotspots tend to be underrepresented in the data but also because hotspots, or challenges function as the foundation of emerging ideas and long-term opportunities.

When you have identified a series of synergies, you should collect them in a separate spreadsheet with all the relevant data about them. This will allow you to structure and further develop the synergies.

After the analysis, you can reach out to the relevant regions and ask for feedback on the proposed synergy. As a second step, you can include the regional stakeholders in the process as well. If only one region is interested in proceeding to explore the synergy, you can also post it as an open opportunity to other regions that have not been identified as possible partners through the data analysis.

For proposed synergies that receive interest from more regions and regional partners, you should move on to host a workshop for all the interested parties to more specifically define the purpose and scope of the collaboration. The eight models for synergies can be used as a framework to structure the discussion in the workshop but the further planning of such a workshop is beyond this protocol.

A last general recommendation for the process of identifying synergies is make the complete list of emerging ideas and hotspot openly available for all participating regions. The list will then function as a marketplace where regions can also themselves go and look for possible partners that share a hotspot or develop similar innovations.

Finally, if regions themselves can enter new hotspots and emerging ideas and even display synergies that are being established, it could function as an open platform for regional collaboration and knowledge sharing.

CONCLUSION

This document introduces a guideline that allows regions to further explore their value chains and potential crossregional synergies that were identified in workpackage 2. It basically brings the identified potential synergies further by introducing leverage points, material flow analysis and stakeholder analysis in a systemic and replicable way. It supports regions to further detail their regional context on a certain value chain and finding the synergies with other regions.

In the connecting with the deliverables in workpackage 2, this deliverable offers some tools for extended/more detailed analysis, value chains synthesis and synthesis on synergies/ emerging ideas. The explored synergies reported in this document shows the way the guideline supports the creation of cross-regional synergies.

Evaluation of this guideline shows that the guideline is useful for regions. Especially the steps focussing on stakeholders and leverage points are higly appreciated. For regions the material flow still seems to be difficult to perform due to a limited acces to the required data and sometimes some missing expertise and time. Before applying this guideline one should be aware that it is a time consuming analysis, but could also generate a lot of positive energy when value chains are finally synthesised.

APPENDIX 1:
PRIMARY STAKEHOLDER INTERVIEW GUIDE

Date:
Location:
Organization:
Name:
Interviewed by:

1. Position of organisation

- What are your most important products or services?
- How many people does your organization employ?
- What is the annual revenue of your organisation?
- Who is your client target? (mention specific names, if possible)
- What are your key markets: regional (where), provincial, national, European, glocbal?

2. Sustainability and Circular Economy

- Are you currently already incorporating sustainability in your own production chain? If yes:
    a. What initiatives?
    b. Is this initiative applicable to other sectors as well? What sectors?
    c. What physical flows are tackled? (e.g. energy, waste, water, materials)
    d. Are the initiatives plans, pilots, or established projects?
    e. Are you actively looking for partners or clients to develop or up-scale these projects?

- Which part of your production chain has the most potential to become more sustainable?
    a. How could this be achieved?
    b. Are there barriers or gaps that hinder this? (e.g. knowledge, technology, markets)

- Are you planning to initiate projects or currently offer products or services that could incorporate sustainability in other production chains?

a. What initiatives?

b. Is this initiative applicable to other sectors as well? What sectors?

c. What physical flows are tackled? (e.g. energy, waste, water, materials)

d. Are the initiatives plans, pilots or established projects?

e. Are you actively looking for partners or clients to develop or up-scale these projects?

3. Material flow analysis

The aim is to map the most important material flows including energy and water of the region. This is will help to find leverage points and possibilities for circular synergies.

A. Energy demand

- What is your annual energy consumption?
  a. For heating (m^3 gas/year)
  b. For cooling (kWh/year)
  c. For electricity (kWh/year)
  d. Which fuels are used for local energy production (gas, coal, wood, diesel)
  e. How much? Where is the energy coming from?
  f. Are you producing renewable energy? If yes, how and how much?

  Note: Mention the three major energy flows (or processes) and their source per year.

B. Water demand

- For which processes do you use water? What is the most important function of the used water (e.g. heating, cooling, irrigation, domestic water usage, fire protection, process water)?
  a. How much water do you need? (litre per day)
  b. Where is the water coming from?
  c. What quality? (drinking water, rain water, other)
  d. Which activity produces the most wastewater?
  e. How much wastewater is produced?
  f. How is the wastewater collected, transported and treated?

  Note: Mention the three major water flows (or processes) and their source per year.

C. Waste

- Are you producing:
  a. Organic waste?
  b. Chemical waste?
  c. Hazardous waste?
  d. Domestic waste?
  e. If yes, what kind of waste is produced in what quantities?
  f. How is the waste stored, separated, and processed? (if applicable)
  g. Who is collecting the waste at this moment?
  h. Do you know if these streams are reused, recycled, burned with energy production, burned without energy production, or landfilled?

  Note: Mention the three major waste flows (or processes) and their source per year.

D. Materials

- What is the mass of your annual production?
- Are you purchasing materials (plastics, paper, metals, biomass, wood, or synthetic materials)?
- If yes, in what quantities and where do they come from? Where are they produced? (Local, regional, national, international)
- Are they dangerous? (e.g. high volume of toxic compounds, such as lead or cadmium)

  Note: Mention the three major material flows and their source per year.

4. Are there other companies/facilities of other sectors that could be relevant for your organisation regarding materials or waste treatment?

- Check if you talked about: renewable energy production, water treatment, usage of local residues, reducing emissions, recycling of materials.

5. Conclusion

- Are there other interesting companies in your regional value chain that you think we should consider for our research?
- May we contact you for further information and potential opportunities if needed?

APPENDIX 2-8 ARE DELIVERED AS A SEPARATE FILE ALONG WITH THIS REPORT.

Appendix 2: Material flow analysis input sheet
Appendix 3: Hotspot and emerging ideas sheet
Appendix 4: Informed consent form
Appendix 5: Simple form for emerging ideas
Appendix 6: Lazio Value chain analysis
Appendix 7: Tampere Value chain analysis
Appendix 8: Friesland value chain analysis

APPENDIX 9:

THE PROTOCOL – DEVELOPMENT PROCESS AND EVALUATION

The development of this protocol was hosted by the province of Fryslân, Netherlands who had gone through a process of analytically identifying regional opportunities for transitioning to the circular economy. With the SCREEN program aimed at exploring cross-regional synergies as the foundation and support from Metabolic, a first draft of the protocol was produced in the early summer 2017 and presented at a workshop for all SCREEN parties at a workshop on the 28th and 29th of June in Milan.

Subsequently, the research process described in the protocol was used by the participating regions to carry out regional research and was evaluated throughout the process as well as on a number of meetings. This process led to a second version and the first identified synergies, which was presented on a second SCREEN workshop in London on December 20th to 22nd, where also more feedback was given on the protocol. Using the received feedback and ideas from the SCREEN parties, a final version was produced in December 2017. Based on informal and formal feedback from the external project evaluator and EASME project advisor, the deliverable was revised - basically it improved its alignment with other deliverables within the SCREEN-project.

The protocol should at best be a living document, whereby the research process that it outlines can be further adjusted as more regions apply it in the future or new versions can be made to tailor the guideline to a specific value chain. Generally, the protocol was well received, and the SCREEN parties found it comprehensive yet clear and understandable.

Below is some of the critical feedback that the protocol has received along with responses to the feedback. This can help you to get a sense of what others have found challenging and might cause you to consider whether it would be advantageous for you to modify the process.

"I would like to do the light version, but I fear that I will not get good enough results"

Most participants have used the light version. The research process is challenging, and it is better to use the light version and get some results instead of getting stick in the middle of the full version of the research process.

"The protocol did not fit so well to our value chain"

The protocol is made generic to fit all imaginable value chains. For the same reason, it will not fit perfectly to one specific value chain. Adjusting it further to fit your own value chain and/or situation can be necessary and would also be a great contribution to the community.

"We would like to focus more on opportunities than on problems"

This is a common theme in circular economy. It is valuable to focus on opportunities, and indeed it is the most common approach because it tends to motivate companies and other stakeholders more. Focusing on opportunities can thus be a great way to create an initial momentum.

Circular economy would, however, not even be relevant if we as a global society were not confronted with some serious global challenges. Resources are being depleted and some of the essential systems supporting life on Earth, such as the climate, ecosystems, and nutrient cycles are being disrupted. Omitting this fact entirely can lead to 'solutions' that do not solve these essential challenges.

"Some of the data collection processes were too difficult and time consuming"

That is one of the most challenging parts of the protocol and it is advisable to appoint or consult someone who is accustomed to life cycle assessment or similar analyses.

"The data that is requested is not possible to obtain"

It is possible to obtain. Some of it is challenging to obtain and requires creative solutions or expert consultations. Do consider in the process whether data that is challenging to obtain is essential for your further work. If not, then skip it and move on in the process. The goal is to get tangible and actionable results not to obtain complete data.

APPENDIX 10:

SYNERGIES

In this appendix, all the identified synergies are shown. The identified synergies are primarily based on data from Tampere, Finland and Friesland, Netherlands. Limburg in Netherlands, Lazio in Italy and Scotland in UK all also contributed with a smaller amount of data.

The method for identifying synergies has been effective consideing the available data. With data from more regions, more synergies could be identified.

Sludge recovery and utilization

HOTSPOT

LAZIO AND TAMPERE:

Lazio in Italy and Tampere in Finland face a challenge with the production of sewage sludge that contains important nutrients. Current sewage systems dilute the sludge, making it harder to valorize and there is a lack of technologies to productively extract the valuable materials.

Barriers

1. Lack of filtration
2. Lacking consumer acceptance
3. Absence of specific legislation

Stakeholders

Tech-Marketplace

TAMPERE UNIVERSITY OF TECHNOLOGY

PIRKANMAAN JÄTEHUOLTO OY

UNIVERSITÀ DEGLI STUDI DELLA Tuscia

EMERGING IDEAS

FRIESLAND:

Cirtec and KNN Cellulose BV have developed a filtering technology that filters only the cellulose out of the sludge making it possible to use it for example as drainage inhibitor under roads. The extraction of the cellulose also makes the rest of the sludge easier which can lead to a cost reduction of 15-20% for aeration.

KNN Cellulose BV

CIRTEC

Ecophos in Friesland have developed a system that can extract almost 99% of phosphate from incinerated sludge, making it easy to add this highly effective valorization step at the end of the process.

SYNERGY

TECHNOLOGY EXPORT

Because the innovations are so mature in this case, we would suggest a Technology Export, from Friesland to Tampere.

Valorization of grass

HOTSPOT

FRIESLAND:

Friesland experiences that processing of wild non-fodder grass could become much more efficient, thus leading to more value creation.

Barriers

1. Feedstock needs to be fresh
2. Lack of mature business case

Stakeholders

provinsje fryslân
provincie fryslân

van hall larenstein
university of applied scien

EMERGING IDEAS

LIMBURG:

In Limburg, NewFoss has developed a method to use this kind of grass to make packaging material that is currently used for egg boxes.

Huhtamaki

NewFoss®
Biobased products and techniques

staatsbosbeheer

SYNERGY

STRATEGIC INVESTMENT

In this case, Strategic investment could be used to extend the use of this technology to other kinds of packaging, thus creating a high-value use for the grass.

Making bioplastic competitive

CHALLENGE #1

FRIESLAND:

Friesland in Netherlands has identified sewage sludge as a potential feedstock for bioplastic production, which is a high-value utilization of the waste stream. But it is difficult for bioplastic to compete with traditional plastic on price and performance.

Barriers

1. No established market for PHA
2. Not price-competitive

Stakeholders

cew centre of expertise water technology

stowa STICHTING TOEGEPAST ONDERZOEK WATERBEHEER

CHALLENGE #2

TAMPERE:

Tampere is confronted with the problem of plastic waste in the Baltic sea and would like biodegradable plastic to be more widely used. Similarly they struggle with the barrier that bioplastic cannot so well compete with traditional plastic.

Barriers

1. Conventional plastic is cheap and functional
2. Good plastics are lacking
3. Lack of consumer awareness

Stakeholders

TAMPERE UNIVERSITY OF TECHNOLOGY

VTT

TAMK TAMPERE UNIVERSITY OF APPLIED SCIENCES

SYNERGY

MARKET UNLOCKING

Since this Challenge partnership is oriented toward making bioplastics more competitive in the market, we suggest a Market unlocking synergy.

Biogas from waste streams

EMERGING IDEA #1

FRIESLAND:

WETTERSKIP FRYSLÂN

Wetterskip Fryslân in Netherlands is producing biogas from sludge and is looking for more waste streams that could provide a profitable source that could add to the production and revenue

EMERGING IDEA #2

TAMPERE:

Tampere is establishing a biogas plant that will treat up to 160,000 tonnes of bio-waste and sludge per year. It is still not certain which waste streams and which amounts would create the best and most profitable combination for the plant.

SYNERGY

BUSINESS MODELING

For both of these emerging ideas, the technology is already in place and the further development is more a question of finding the right sources of biomass to ensure profitability and stable production. A Business modelling synergy is therefore recommended for this case.

Eutrophication in the Baltic Sea

HOTSPOT

TAMPERE:

The Baltic Sea provides important resources for Finland and as excess nutrients enter, the sea from different water streams, the stability of the sea's ecosystem is threatened.

Barriers

1. Lack of knowledge
2. No problem owner

Stakeholders

TAMPERE UNIVERSITY OF TECHNOLOGY

Verte

ECO3

EMERGING IDEAS

SCOTLAND:

Aquascot in Scotland is breeding a bean that does not need additional nitrogen as fertilizer. The crop even leaves extra nitrogen in the soil after harvest, which makes it possible to use a natural fertilizer by rotating it with other crops.

Aquascot

FRIESLAND:

Wetsus in Friesland is working on technologies to use targeted algae cultivation as a natural filter to capture excess nutrients and simultaneously produce valuable biomass.

wetsus

SYNERGY

COLLABORATIVE SECTOR ANALYSIS

This hotspot is important for most coasts along populated or cultivated areas. It is also a highly complex problem that needs more understanding and we suggest a Collaborative Sector Analysis with several parties to understand the problem better and deploy relevant emerging ideas.

Reducing waste from milk production

HOTSPOT

FRIESLAND:

The dairy farmers in Netherland and many other parts of Europe experience diminishing margins on milk production and look for other ways to valorize the milk. Technology being developed in Friesland makes it possible for farmers to dehydrate the milk to save money on transportation and refrigeration. It can also potentially be used for more high-value products such as milk-powder. The challenge is that the technology requires a big investment.

Barriers

1. High investment cost
2. Untried business case

Stakeholders

provinsje fryslân
provincie fryslân

FrieslandCampina
nourishing by nature

EMERGING IDEAS

SCOTLAND:

A technology based on spectral analysis that is being developed at Scotland's Rural College makes it possible to immediately analyze the nutritional value and water content of milk. This technology can be used to identify the dairy farms that would benefit the most from the dehydrating the milk.

SRUC Scotland's Rural College

SYNERGY

BUSINESS MODELING

The dehydration of milk is a promising process, but it is still uncertain under which conditions It would be profitable. A Business Modelling synergy is therefore suggested to help carve out the potential of this process and the use of spectral analysis.


SCREEN
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Economy across
European regioNs