Methodological Framework for Developing a Regional Circular Bioeconomy Roadmap

Prepared by: Tarmo Pikner, Kai Pata, Lianne Teder, Joonas Plaan, Galina Kapanen, Terje Tuisk, Grete Arro

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The report is designed by Tuumik Stuudio.

1. INTRODUCTION

The current work presents a methodology framework (henceforth "methodology") for development of a regional circular bioeconomy roadmap with its main stages and implementation components. The methodology is a practical tool for creation of regional roadmaps for circular bioeconomy based on local bioresources, communities' and local governments' needs and opportunities. It also aids the translation of the activities into innovative local initiatives and cooperation forms, empowering the growth and sustainability of the added value in the local bioeconomy[1]. This methodology may be applied by various organisations (e.g. county development centres, businesses, local governments and their unions, community initiatives) to map the potential for circular bioeconomy as well as for fixing and developing the roadmap.

The ambitious goals of the European Green Deal[2] require fundamental changes in business, life style as well as in societal norms in general. Bioeconomy[3] is a prerequisite for the green transition and at the same time its outcome. From the point of view of increasing sustainability, economic development and added value, bioeconomy is an interdisciplinary concept based on the principles of circular economy, thus we introduce the concept of circular bioeconomy to highlight the importance of combining the approaches and the potential of the bioresource to replace the (imported) fossil materials with more sustainable bio-based alternatives.[1,4] Integration of principles of circular and bioeconomy into the circular bioeconomy model means rethinking of consumption habits and value chains through sustainable use of bioresources and reduction of waste.[5]

The methodology offered in the current document empowers various stakeholders in implementation of the goals and activity directions of national Estonian circular bioeconomy, according to which: "Circular bioeconomy is the foundation for future economy and the enabler of the green transition which increases the added value of the produce in the area and assists in making Estonia the leader of regional circular bioeconomy". An important role in the process of green transition belongs to regional and local levels, the results of which are the step-by-step replacement of the fossil raw materials with renewable biomass, implementation of the circular economic model and creation of change in people's consumption habits. In the bioeconomy frame development, the current methodology is based on the definition of bioeconomy as given by the European Commission and Estonian national roadmap, which states that bioeconomy is production of renewable biomass and its transformation into food, bioproducts and bioenergy. Bioeconomy includes agriculture, forestry, fisheries, aquaculture, food, fibre and paper industries as well as partially chemical, biotechnological and energy industry.[6]

1 Ringbiomajanduse teekaart. 2023. Maaeluministeerium. https://www.agri.ee/media/7979/download

2 Euroopa roheline kokkulepe https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_et

3 European Commission, Directorate-General for Research and Innovation, European bioeconomy policy – Stocktaking and future developments: report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, Publications Office of the European Union, 2022, https://data.europa.eu/doi/10.2777/997651

4 Ringmajanduse valge raamat. 2022. Keskkonnaministeerium, Keskkonnaagentuur. Tallinn. https://ringmajandus.envir.ee/sites/default/files/2022-06/Ringmajandus_valge_raamat.pdf

5 Tan & Lamers 2021, *Circular Bioeconomy Concepts – A Perspective. Frontiers in Sustainability*, https://doi.org/10.3389/frsus.2021.701509

6 ADDVAL-BIOEC projekt. Tallinna Tehnikaülikool (TalTech). https://taltech.ee/biomajandus

The following megatrends, established in the foundational research for national planning, affect regional initiatives in circular bioeconomy[7]:

a. climate change and green policies create the need for space shifts in life activities;

b. digitalisation and automation support the space polarisation of life activity i.e. simultaneous concentration and dispersion;

c. geopolitical polarisation and the aftereffects of the Ukranian war cause constant slowdown of global processes and regionalisation of value chains;

d. cultural change increases the contest for quality space and diversifies the expectations for space quality.

Regional level is essential in circular bioeconomy for promotion of cooperation networks and circular relations and achievement of bigger development goals. The present roadmap methodology and its implementation contributes to the execution of the following national strategic goals: development of sustainable bioeconomy set in the strategy "Eesti 2035"[8] ; the climate neutrality goal set in Basic principles for climate policy until 2050[9], local climate programmes, TAIE (Estonian Research and Development, Innovation and Entrepreneurship Strategy) 2021–2035[10] aims and the focus area "valorisation of local resources", Development plan for energetics until 2035[11], White book of circular economy[3].

In addition to the current methodology's framework, numerous already existing background materials or guidelines may be used in facilitating the design of regional roadmaps. For instance, the guidelines of Institute for Health Development for creation of county health and well-being profiles[12], *Rohetiigri teekaardid* (Green Tiger's roadmaps)[13], open governance roadmap[14], regional research and bioresources mappings[15].

7 Trendide ruumilise mõju analüüs. 2023. Üleriigilise planeeringu „Eesti 2040" alusuuringu lõpparuanne, RAKE. Rahandusministeerium. https://skytte.ut.ee/sites/default/files/2023-04/Üleriigiline%20planeering%202050%20trendiuuring_Lõpparuanne%202023_ISBN.pdf

8 Strateegia "Eesti 2035". 2021. Eesti Vabariigi Valitsus. https://valitsus.ee/strateegia-eesti-2035-arengukavad-ja-planeering/strateegia

9 Kliimapoliitika põhialused aastani 2050. 2014. Keskkonnaministeerium. https://envir.ee/kliimapoliitika-pohialused-aastani-2050

10 Teadus- ja arendustegevuse, innovatsiooni ning ettevõtluse (TAIE) arengukava 2021–2035. 2022. Haridus- ja Teadusministeerium. https://www.hm.ee/korgharidus-ja-teadus/teadus-ja-arendustegevus/taie-arengukava-2021-2035

11 Energiamajanduse arengukava (ENMAK). 2021. Majandus- ja Kommunikatsiooniministeerium. https://www.mkm.ee/energeetika-ja-maavarad/energiamajandus/energiamajanduse-arengukava

12 Abimaterjalid tervise-ja heaoluprofiili koostamiseks. Terviseinfo. https://www.terviseinfo.ee/et/tervise-edendamine/tervise-edendamine-paikkonnas/tervise-ja-heaoluprofiil/abimaterjalid-tervise-ja-heaoluprofiili-koostamiseks

13 Rohetiiger. https://rohetiiger.ee/

14 Avatud valitsemise teekaart. 2023. Riigikantselei. https://www.riigikantselei.ee/media/2566/download

15 Värnik, R., Kriipsalu, M., Kaasik, A., Orupõld, K., Lillemets, J., Aro, K. 2022. Bioressursside kõrgema väärindamise huvi tõstmine ja ressursside uuring: Kagu-Eesti bioressursside uuringu aruanne. https://dspace.emu.ee/xmlui/handle/10492/7941

Methodology for framework development

The present methodology has been developed by a Tallinn University workgroup in collaboration with the Ministry of Regional Affairs and Agriculture (contact: Argo Peepson) during December 2022 – June 2023. The creation of the regional circular bioeconomy roadmap's methodological framework integrates methodological components and examples from various countries. The methodology is based on the synthesis of thematic international experiences (Australia, the Netherlands, Finland) and also presents examples suitable for Estonia's context and the outcomes of seven expert interviews and three focus group discussion (in Jäneda, Kuressaare, Väimela), which enabled to collect background information, map regional problems and develop and test various elements of the regional roadmap's creation methodology.

The expert interviews were conducted with the representatives of the following organisations: Saaremaa Development Centre, Saarte Kogu (a cooperation network of Estonian islands), Põlvamaa Development Centre, Võrumaa Development Centre, a business owner from Southern Estonia, Environmental Board, EAS/Kredex. In Kuressaare's focus group the public sector was represented by Saare Development Centre Foundation, Saarte Cooperation Network non-profit organisation and the leader of TalTech Kuressaare College's blue economy development centre, whereas the former of the aforementioned sees itself as the leader of circular bioeconomy in the region. The private sector's representatives included Saaremaa Lihatööstus (a meat processing company) and a local leader of aquaculture. The focus group meeting in Väimela was arranged in cooperation with Põlvamaa and Võrumaa counties' development centres. The representatives of both counties' businesses and citizens' organisations attending the meeting were specialists from Põlvamaa and Võrumaa Development Centres, a small business owner as well as representatives from a non-profit organisation and Räpina Horticulture School.

The members of the working group also participated in the discussions of the nationwide Estonian circular bioeconomy roadmap creation. Different problems were identified in various regions during the expert interviews and focus group discussions, which demonstrated the necessity for regional roadmaps. In Kuressaare, the main issues highlighted were animal by-products and regional cohesion with the rest of Estonia. Väimela discussions emphasised that the regional roadmap coordinator could be a county development organisation, and the roadmap should primarily be a dynamic document with practical value for regional businesses. At the seminar "Sustainable Communities" organised by Rural Information Centre in Jäneda the participants stressed the need for assigning the coordination responsibility to an already existing institution rather than creating a new council, pointed out the idea of creating a broader territorial coverage and expressed the necessity for a structured roadmap model that would facilitate its development allowing "to fill in the model", applying the already existing data.

2. MAIN FEATURES OF THE REGIONAL ROADMAP

Basic principles

The major basic principles of regional roadmaps are in correlation with the following foundational ideas of Estonian circular bioeconomy's national roadmap[1]:

- **Sustainability,** i.e. balance between economy, society and nature, which makes provision for future generations' needs;
- **Cascading use:** using and processing resources on the basis of the priority and highest possible added value;
- **Circularity:** smart, need-based and minimal use of the resources brought into circulation with the highest possible societal, social and economic value;
- **Resource security:** food first and foremost. Guaranteed provision of food is paramount: safe and healthy food must be available to everyone. Self-sufficiency and use of local resources is vital in energetics and other areas.

Regional roadmap's necessity or what problems it helps to solve

- Prioritisation of regional and local level in achievement of national and European development aims. Estonia has set ambitious national goals, but it is necessary to understand the roles in implementation of national policies in more detail and communicate on the regional and local level. It is also important to find ways how to support both local and larger businesses' motivation to be engaged in circular bioeconomy i.e. their understanding of how circular bioeconomy is valuable for them and promotes their business.
- A roadmap assists shaping of local and regional sustainability goals and empowers the local level (local governments) in meeting the accepted commitments, e.g. the need to fulfil the obligation of the EU agreements to direct into circulation at least 60% of household waste by year 2030 and 65% by year 2035.
- A regional roadmap creates the basis for involvement of foreign investments (e.g. via Enterprise Estonia), which would help to strengthen bioeconomic competence, regional specialisation and to decrease market failures when creating new products and services. It is essential to map the links of the renewable energy area to potential circular bioeconomic initiatives.
- The current challenge is that the major part of biowaste is incinerated as it is not sorted sufficiently and there is no publicly accessible comprehensive overview of the generated biowaste[16]. Creation of a regional roadmap should be initiated on the basis of initial information, which would supply businesses and various stakeholders with an overview of the generated biowaste and existing or potential value chains[17].

16 Database KOTKAS has an overview of biowaste (https://kotkas.envir.ee/). The issue is that bio raw material is not always waste and there is no sufficient information on it.

17 Ministry of Regional Affairs and Agriculture has started designing the methodology and data collection sytem to make the information on industries' by-products accessible to the public.

The process of developing a regional roadmap

- A roadmap and its development process could function as the connector between different levels in the decision making process, e.g. state and businesses; state and village communities. Thus it would ensure the bottom-up movement of interests and initiatives. The participation-based collaboration would aid to decrease the opposition to possible changes in the environment initiated by the green turn process (e.g. in renewable energy area).

- A regional roadmap is essentially an agreement between various stakeholders on that which regional resources and values are the pre-condition and priority in developing circular bioeconomy. This agreement is realised in developing focus topics, action plan and value chains (see section 3.3).

- The roadmap process is vital for creation of a shared understanding and awareness of circular bioeconomy, the features that are yet in the early stage of development in Estonia.

- The process of roadmap design enables to analyse the generated biowaste (in production and households) and determine for which of its type the value chain construction is easier and which waste would require bigger changes, development work and investments (e.g. sorting in overall waste collection).

- A roadmap helps to map necessary institutional and behavioural changes in resource use and creation of new value on different levels (from the person and live nature up to the regional and planetary level).

- The initial roadmap stage of mapping the existing situation employs maximum of the current statistical data, information obtained from the businesses, regionally conducted research, etc.

Examples of national and/or regional circular bioeconomy roadmap development process

The essence of the regional roadmap creation process is largely similar for both circular economy and circular bioeconomy, that is why we considered it necessary to include the process examples of circular economy roadmap making process which have been more widely applied in the world practice.

We have chosen three examples, one of which is related to setting up essential focus areas in roadmap creation (Australia), the second demonstrates stages of stakeholders' inclusion and roles division in the process (Finland) and the third shows connection of development goals to circular bioeconomy aims (the Netherlands).

Australia

Drafting Australia's circular economy Hunter & Central Coast regional roadmap 2022[18] has demonstrated the importance of negotiating the basic principles of the roadmap creation.

A regional roadmap may be a long-term direction indicator or, like in the Australia's example, a dynamic document which is reviewed periodically with new activities and priorities being added. The Australia's case emphasises the importance of the leader and exact identification of the included stakeholders' groups in the roadmap development process, especially for the reason that the roadmap is periodically reviewed and updated.

The roadmap steering group has to carry out the analysis of essential normative and strategic documents which guide the region on the basis of agreement. This analysis should first and foremost highlight and phrase important regional priorities and principles for the roadmap process and impact indicators. The part related to common guiding values and principles for roadmap creators needs special attention in negotiations with stakeholders, e.g. to what extent use of a local resource ensures preservation or restoration of the natural value and whether it also creates social value for the region or, on the contrary, the most part of the economic added value travels out of its territory.

The aim of the regional roadmap development with the stakeholder's involvement is achievement of justice and sustainability for nature, economy and society in creation of values using regional resources. At this point, it is important to reach consensus as to justice principles in the regional roadmap and also formulate these principles as basic values and agreements on the roadmap:

- **social justice** – nature as a joint national asset; consideration for balanced division of natural resources in the communities, businesses or society target groups, so that each of them has equal opportunities for development, work; social justice related to future generations;

- **environmental justice** – the right to clean environment which ensures health and well-being; responsibility for preservation of environment; fair division of environmental impact between all residents and layers of the population; taking responsibility for environmental impact; inclusion of society groups into creation of environmental legal acts and decisions; ensuring availability of environmental information, including circular bioeconomy value chains data; access to administration of justice in environmental disputes;

- **justice in treatment of nature** – considering needs of live organisms as their basic rights equally to humans' needs and rights to use natural resources; regarding the value of nature per se, whose complex network creates natural resources.

18 Hunter & Central Coast Circular Economy Roadmap 2022. Hunter Joint Organisation, the councils of the Hunter and Central Coast Regions. https://www.huntercircular.com.au/wp-content/uploads/2023/03/20220503-CE-Roadmap-Document-1.pdf

The following action areas were pointed out in the regional roadmap of Australian circular economy:

- **support systems for creation of economic added value** – e.g. systems for business self-analysis, agreed metrics for measuring impact, setting up the principles of local budget use for joint development;

- **supporting systems for skills, awareness and innovation** e.g. joint assistance for innovation and learning clusters, forms of learning at work to guarantee new skills necessary for circular bioeconomy, collection and administration of good examples, training, support of development of services and prototypes;

- **legislative and political support actions in the region**, e.g. for tender procedures;

- **joint development of infrastructure in the region to aid problematic areas**, e.g. innovation systems for common use; effective sharing of infrastructure, waste materials or resources in the vicinity of businesses and public infrastructures; transport systems supporting the circular bioeconomy supply chains; logistics for people's mobility;

- **promotion of evidence-based decision-making**, e.g. creation of metrics, data infosystems to evaluate the impact.

The Australian roadmap prioritised main initiatives in the three areas developed currently in the region – circular economy centre (hub), setting the economy's direction and promotion of circular economy markets. These are reviewed and updated every half a year.

Finland

Finland's first national circular economy roadmap was made under the leadership of the national foundation Sitra in 2016. It was updated in 2019 on the basis of its implementation experience, highlighting the nine concrete steps[19] which the regional roadmap leaders have to follow. These steps facilitate and accelerate the public engagement process and make it equitable for all the parties involved.

1. **Preparatory work and formulating the conditions**. Identify the advantages, make up the process project plan, establish the teams' roles and make sure you have enough resources.

2. **Stakeholders and participation**. Determine the major stakeholders' groups and make sure they are commited to the process and motivated to participate. Create the steering group and find out other working groups' needs.

3. **Situation's overview**. Clarify the current state of circular economy in your country or region. The overview of the current situation is a certain basis for next steps.

4. **Vision and goals**. Formulate the inspiring vision for the roadmap and set up concrete and measurable goals.

5. **Focus areas**. Identify the focus areas on the basis of the vision and strategic goals. Establish the indicators which help to measure the transition to circular economy.

6. **Action planning**. Plan the actions that lead to the roadmap's goals. At its best, the roadmap is a combination of strategy and a tangible action plan.

7. **Develop and make it public**. Start developing the regional roadmap. Ask the stakeholders for feedback and comments. Communicate with other regions' representatives to inspire promotion of circular economy with one's actions in other locations.

8. **Carrying out and implementation**. Determine the action plan's leadership model and ensure the stakeholders' commitment. Do not forget to communicate.

9. **Evaluation and review**. Evaluate the running projects, study additional actions and decide on updates if necessary.

19 Järvinen, L. & Sinervo, R. 2020. How to create a national circular economy road map. The Finnish Innovation Fund Sitra. https://www.sitra.fi/en/publications/how-to-create-a-national-circular-economy-road-map/

Finland has not designed a special regional circular (bio)economy roadmap; however, the roles of the following four different parties emerged in the process of transition to circular economy with the regional level clearly seen together with the direct correlation between the four parties:

National level administration's essential role is to create cooperation between all the ministries. Fostering circular economy has to be the strategic activity of all the ministries and for that permanent financial resources have to be allocated from the budget. The task of the ministries is also to design the relevant action plans and facilitate changes as well as create the demand for the circular economy solutions.

Local governments' role is to activate and empower the residents, communities and businesses of the region in circular economy processes and to put out national tenders relevant for circular economy. Additionally, the authority of the local government to plan the land use, carry out different commissions and constructions as well as issue various permits enables it to accelerate the evolution of circular economy's society.

Private sector's role is to change its action modes they have applied up to now in accordance with circular economy. There are five business models in circular economy: 1) renewability, 2) sharing platforms, 3) product as a service, 4) prolongation of a product's life cycle, 5) resource efficiency and reuse. A precondition for implementation of circular economy model is tight cooperation between public and private sectors.

A citizen's role is to demand the circular economy's relevant services and products. Our own consumption and behaviour patterns play a crucial role in this process. The citizen's position in implementation of circular economy has to be empowered through various national campaigns, and sustainable solutions must be made simple and attractive, which also requires raising the awareness.

EXAMPLE 1. Päijat-Häme county's roadmap

A good example of a regional circular economy roadmap is Päijat-Häme county in Southern Finland, which has designed a roadmap[20] with a part that also contains a circular bioeconomy action plan[21]. This roadmap directly follows the Finland's national circular economy roadmap created by Sitra and is divided between the five thematic areas, taking into consideration regional opportunities and operating businesses:

1) closed material circles,
2) energetics,
3) circular bioeconomy,
4) new consumption models,
5) innovative solutions.

The local government has stated clear goals in transition to circular economy related to each of the five areas, mapped the major businesses and sectors as well as sustainable practices that are already in use and /or which may be implemented in the future. The current roadmap has enabled Päijat-Häme local government to empower the necessary actions.

20 Päijät-Häme Roadmap towards Circular Economy. 2021.Päijät-Häme. https://paijat-hame.fi/wp-content/uploads/2021/03/Roadmap_CE_eng.pdf

21 Päijät-Häme Bio-based Circular Economy Action Plan, 2019. Päijät-Häme Regional Council, Lahti University of Applied Sciences. https://projects2014-2020.interregeurope.eu/fileadmin/user_upload/tx_tevprojects/library/file_1559896937.pdf

EXAMPLE 2. Circular bioeconomy in Päijat-Häme county.

The production plant Etanolix of an energy production company St1[22] uses biobased production process leftovers which mostly come from making of Hartwalli[23] drinks. They also bring waste materials from several other local plants using grains, such as bakeries, grain mills and beer plants. St1 produces bioethanol from these by-products, which is later mixed with petroleum to acquire biofuel for vehicles. The waste material from Hartwall mostly contains production yeast waste and drinks, which cover 30–40% of the material needed for producing bioethanol. The remaining yeast is used as feed. The location of the St1 plant directly next to the Hartwall plant enables to transport the yeast via pipes between them. The St1 Etanolix plant has been in operation since 2010 and produces one million litres of bioethanol per year.

EXAMPLE 3. Finland's experience:

seven suggestions to future leaders of regional roadmaps for circular bioeconomy:

- Prepare a roadmap suitable for your local conditions.
- Cooperation with the parties involved is the starting point and precondition for success.
- Make sure you have agreed measures as well as flexibility.
- Make a thorough overview of the current situation.
- A very rigid roadmap cannot keep up with changes.
- Measure success, monitor successful steps and set up milestones.
- Don't forget to invest into roadmap implementation.

22 https://www.st1.com

23 https://export.hartwall.fi/%20

The Netherlands

Setting goals in Amsterdam City region's local government and circular bioeconomy follows the so called "doughnut model", according to which the regional development priorities are implemented to achieve goals of sustainable welfare and to adapt to planet climate changes (see Figure 1). This model has 4 strategic components (the so called "doughnut" consists of a model, strategy, implementation plan and monitoring). Its aim is to finish wasting, achieve climate neutrality, preserve values, find opportunities for innovation and socio-ecological balance. The focus is on the challenges related to value chains in food and organic waste as well as in the constructed environment.

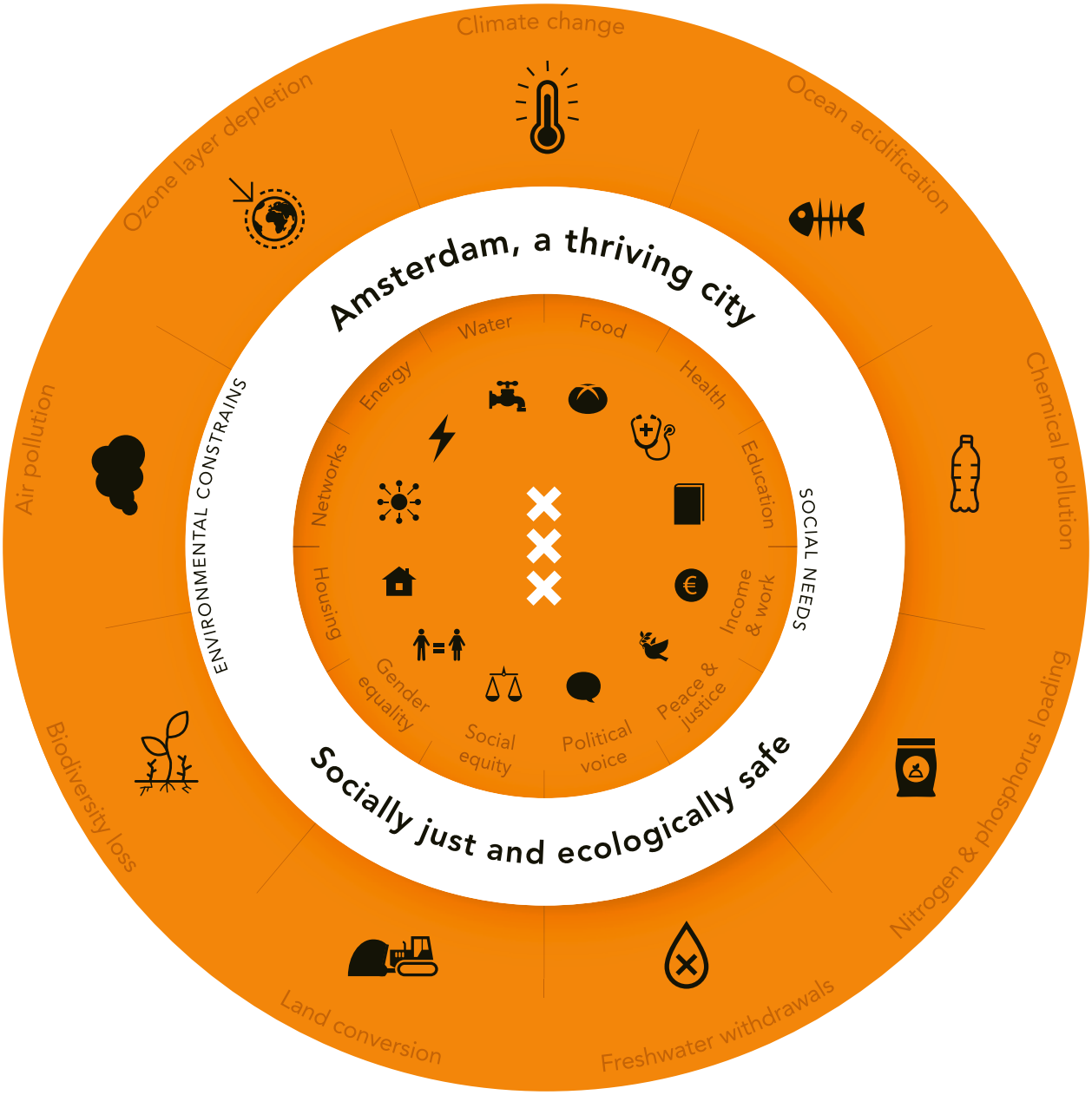


Figure 1. Linking sustainability on the planetary level to area goals in Amsterdam City region[24]

24 Amsterdam Circular 2020–2025 Strategy, Circle Economy and the City of Amsterdam. 2020 Municipality of Amsterdam. https://assets.amsterdam.nl/publish/pages/867635/amsterdam-circular-2020-2025_strategy.pdf

3. METHODOLOGICAL FRAMEWORK FOR DEVELOPING A REGIONAL ROADMAP

The circular bioeconomy involves the so called "double transition", including simultaneous replacement of fossil resources with biobased ones and of a linear economic model with a circular one. This requires significantly more support, guidance, demand stimulation and creation of pre-conditions and new governance models[25]. The existing development plans, strategies and other development documents and cooperation forms approach this in a fragmented manner, covering only some aspects of circular bioeconomy. That is why it is essential to employ a multilevel and participation-based process when designing a regional roadmap.

In the current document, the methodological framework of a regional roadmap comprises four main stages and associated actions (see Figure 2). These stages are described in the following chapters together with practical techniques possible to adapt in the roadmap designing process, taking into consideration the advantages and needs of a concrete region.

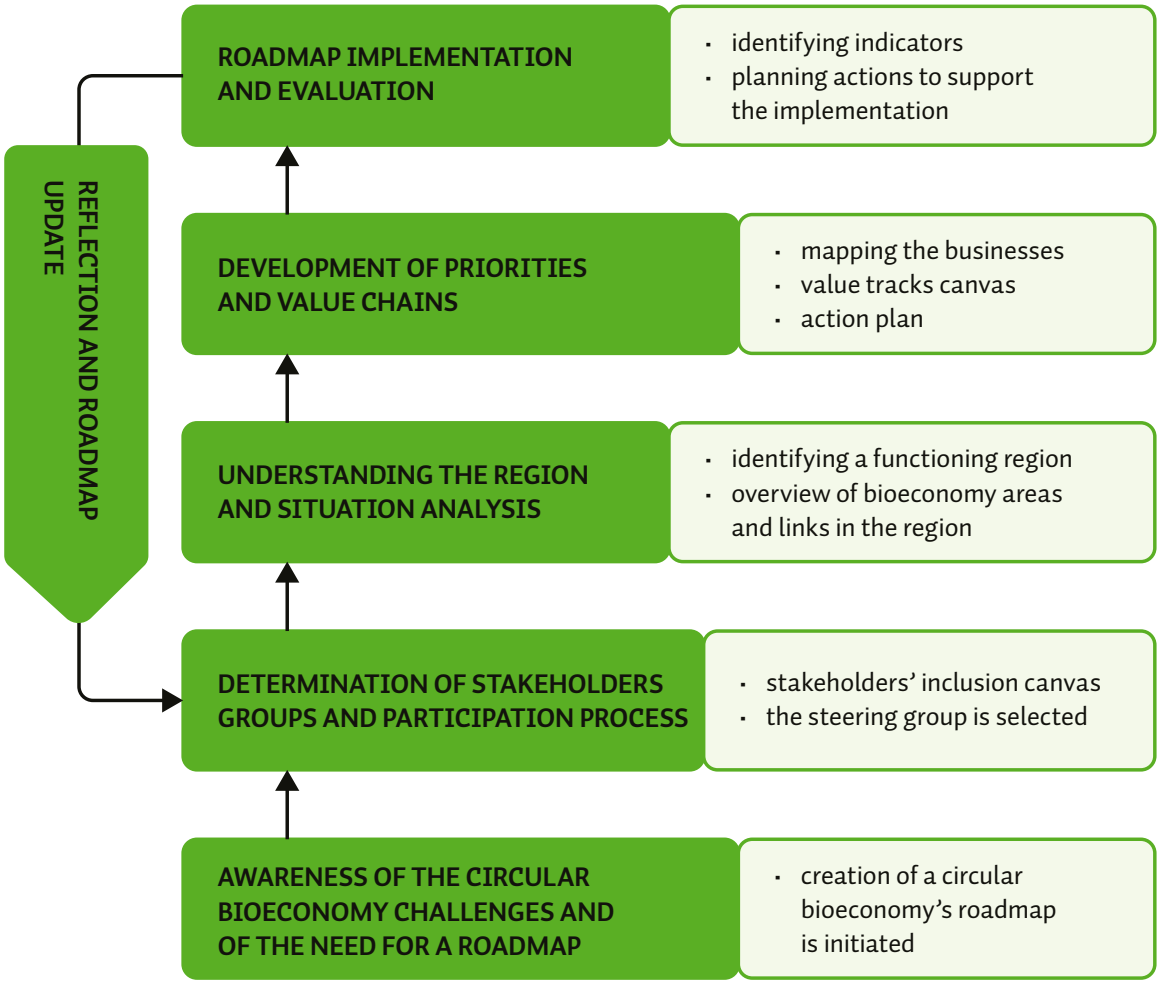


Figure 2. Stages of regional circular bioeconomy roadmap design process.

25 Ringbiomajanduse teekaart https://www.agri.ee/media/7979/download

In the multilevel and participation-based process of developing a regional roadmap, the following aspects should be taken into consideration:

- it is essential to create a nationwide Estonian coordination group for circular bioeconomy with one expert from each county;

- roadmap creation would be quicker and more effective if each region hired an expert or a project manager for the job and the regions acquired a consultant for the initial period;

- designing regional roadmaps could take place simultaneously with creation or updating of a regional strategy (e.g. county development programme, regional policy plan, etc) under which different areas and stakeholders may share information and empower each other;

- Estonia's advantage is the existence of intensive communities of practice and a good level of digitalisation and automation enabling to test different innovations in cooperation.

3.1 Identifying stakeholders and the participation process[26]

The process of engagement of stakeholders' groups and public in the regional circular bioeconomy's roadmap development should follow the good inclusion practices[27] and especially the good practice specified by the Ministry of Regional Affairs and Agriculture[28]. Involvement of public is an activity aimed at giving to citizens or unions representing them an opportunity to participate in making of the decisions which affect their lives.

Taking into consideration the regional division (see Figure 6), the steering group for regional circular bioeconomy's roadmap creation is formed from the representatives of the regional counties' development organisations[29]. During the first stage (see Table 1) this group maps regional stakeholders and plans how to reach out and engage them.

The target of mapping the stakeholders is to find regional organisations from public, private and the third sector as well as their umbrella organisations connected with bioresources valorisation, biowaste generation and collection, business and environmental topics development or research, organisation of local life. At this point the regional local governments play an important role, because on this level it is possible to change and create development advantages for circular bioeconomy, which may be realised by businesses via their ideas. The legal private law entities working in the region should also be involved, e.g. universities.

The second stage includes determining the potential interest of the mapped organisations and their readiness to participate and engage in various stages of roadmap development and its implementation. For example, the names of organisations may be entered in Table 1, where the columns headers from the left to the right reflect the growth of concrete and increasing involvement, whereas the left column shows recommended stages or activities.

The mapping outcomes become the basis for planning of inclusion of concrete organisations' representatives into creation, implementation and evaluation of the regional circular bioeconomy's roadmap. It ensures optimal engagement of the stakeholders and at the same time an opportunity to participate in the discussion of the decisions affecting their lives. The methods and timing of involvement of the stakeholders depends on the practicality. Following the good practice of public inclusion, it is essential to guarantee the balanced representation of the interests and consider the regional specific features.

For example, the interviews conducted in South-Eastern Estonia pointed out that larger businesses must be involved which have already analysed different environmental topics and also carried out evaluation relevant to their business. If they do not alter their activities, no big changes are to be expected. The greatest benefit for the businesses involved is an opportunity to see their activity area in a broader perspective (including social and political); it may also help them to better plan the future or see their business potential. It is possible to motivate them to become the pioneers and examples for others. For that, the described larger business should be entered in the involvement Table 1 in cells 1A, 2D, 3C, 4C, 5B, 6D, 7D, 8A or 8C.

26 Kodanikuühiskonna lühisõnastik. https://heakodanik.ee/kodanikuuhiskonna-luhisonastik/

27 Kaasamise hea tava. Riigikantselei. https://riigikantselei.ee/kaasamise-hea-tava

28 Maaeluministeerium. https://www.agri.ee/ministeerium-uudised-ja-kontakt/kaasamine-osalemine

29 Regionaalpoliitika kujundamine. Rahandusministeerium. https://www.fin.ee/riik-ja-omavalitsused-planeeringud/regionaalareng-ja-poliitika/regionaalpoliitika-kujundamine#Maakondlikarendustegevus

Table 1. Inclusion of stakeholders' groups. Participation of regional organisations in creation of a regional circular bioeconomy roadmap according to the extent of their involvement.

Stage / involvement interest	A. Being informed	B. Consulting	C. Participation in the discussion	D. Co-creation
1. Mapping the situation				
2. Setting goals				
3. Making the action plan				
4. Metrics setting				
5. Informing				
6. Implementation				
7. Creation of cooperation models				
8. Evaluation				

The following stakeholders' roles emerge according to their involvement (see Table 1):

1A: are involved in the situation mapping, when the existing bioresources and functioning systems are described, the data are taken from the current research and statistics, the study is carried out as to the business's understanding, vision and problems in relation to circular bioeconomy and informing the business of the roadmap process. In addition, an opportunity is offered to forward the data owned by the organisation.

2D: the business is involved in the working group setting goals in order to set up the regional goals on the basis of existing data.

3C: making of action plans takes place also in the working groups, where different roles of the stakeholders and participants as well as tasks in achieving the roadmap's goals are clearly seen.

4C: setting the metrics involves creation of the indicators that show the achievement of the agreed goals, which is also necessary from the point of view of the business, and the decision will affect their activity.

5B: informing the public involves first and foremost wider outreach to the organisations linked to the roadmap and bringing the goals and actions set up in the roadmap to the public's attention. Thus, the business may have a consulting role when the methods are being planned for reaching out to different parties involved.

6D: the roadmap actions implementation is carried out in collaboration between stakeholders and partners in different areas.

7D: one of the most likely activities of the roadmap is working out of cooperation models. The stakeholders are directly involved into joint implementation of these activities.

8A: if the evaluation is conducted externally, it is important to inform the business of the outcomes and to enable them to evaluate their activity in the context of the achieved indicators. If the assessment is carried out internally, the business leader may be involved into the assessment, e.g. 8C.

The interviews carried out in Saaremaa showed that, in addition to larger businesses, small business must also be involved as they are often already working in the framework of sustainable development but are not yet aware of it or has not formulated it in such terms. According to the interviewed, larger businesses have difficulties to fit their activities into the new business models, while small companies are more flexible and quicker to go along with the innovations. Finland's roadmap also demonstrates that businesses must be involved together with other parties who are future and solution oriented.

The steering group assigns the person responsible for inclusion and communication who ensures necessary engagement of the interested parties and communication with them.

Terminology for public inclusion (see Table 1):
Informing is sharing objective and balanced information which enables to understand the aim of the decision making and possible solutions.[30]
Consulting includes asking for feedback and suggestions related to stating problems, prepared analysis, determination of goals, alternative solutions and decisions plans.[30]
Participation in a discussion means taking part in discussions of workgroups and commissions, preparing drafts and plans.
Co-creation is a cross-sector innovation process when the parties together define the problems, find new solutions, implement them and evaluate the outcomes on the basis of equal partnership with the aim to increase the value for society. [31]

The included stakeholders are given sufficient time for submitting feedback. Inclusion requires clarification of the background issues, asking concrete questions (together with problems and new activity directions) about what feedback is collected and feedback giving methods. The participants are also given an opportunity to voice new topics which were not pointed out by the involvement leaders. When choosing the channels, the stakeholders' access to the acquired information and documents is taken into consideration. The stakeholders are given feedback on whether their suggestions were accepted, explaining the considerations and reasons for that.

For reaching out to the broader public, actions are planned enabling businesses and individuals to evaluate the area and monitor the circular bioeconomy regional roadmap.

EXAMPLE 4. Making the open governance roadmap[32] took place at the national level, and it demonstrates the diversity of public involvement and the applied methods. The roadmap drafting process lasted seven months with two assigned coordinators and the working group made up according to the tasks. The working group formulated their task and the expected outcome: to design the suggestions (roadmap) to improve the inclusive decision-making and arrange collaboration methods in dealing with public issues; the outcomes of implementation of the roadmap's suggestions are: clearer rules, methods relevant for co-creation, better skills and attitudes. There were three meetings of the expert group and broader theme meetings, individual interviews and sharing information during the roadmap designing process that included representatives of stakeholder groups – governmental and other public sector institutions, umbrella organisations, cooperation networks, local governments, community, social partners, and specialists' organisations, free unions and experts as representatives of a university.

30 Hinsberg, H., Kübar, U. 2009. Kaasamise käsiraamat ametnikele ja vabaühendustele. Eesti Mittetulundusühingute ja Sihtasutuste Liit. https://www.siseministeerium.ee/media/519/download

31 Torfing, J., Ansell, C. 2021. Viidatud Riigikantselei lehel https://riigikantselei.ee/valitsuse-too-planeerimine-ja-korraldamine/koosloomeranits

32 Avatud valitsemise teekaart. https://www.riigikantselei.ee/media/2566/download

Several parties interested in or related to circular bioeconomy roadmap creation were highlighted in the interviews and focus group discussion carried out in South-Eastern Estonia in the framework of designing the methodology (see Figure 3). The list is not complete and mapping of the stakeholders was not followed by planning how to involve them. The interviewed mainly pointed out private companies and public sector institutions, but at the same time had less knowledge of the non-profit sector organisations.

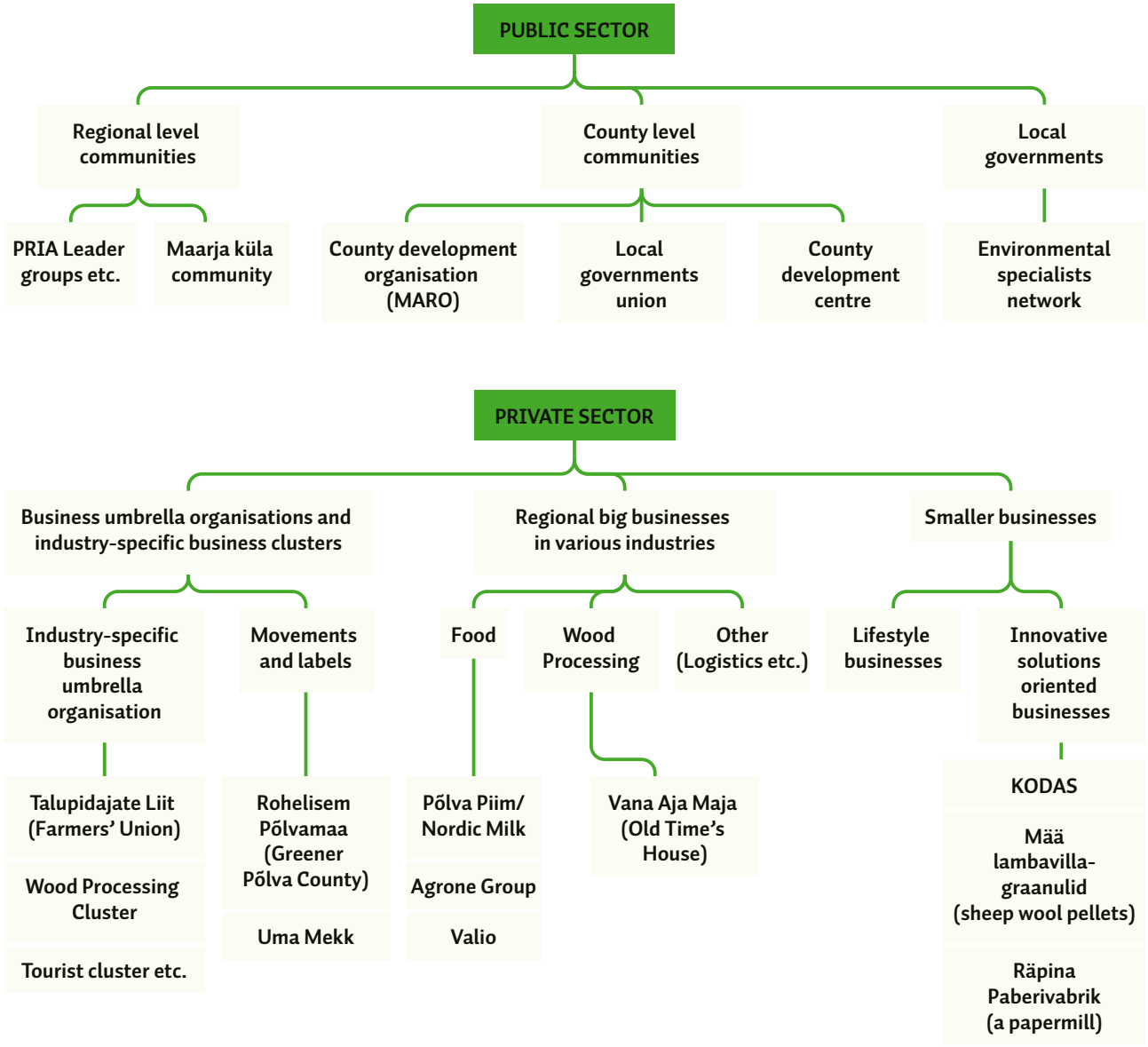


Figure 3. Possible stakeholders in circular bioeconomy (on the example of a focus group discussion in South-Eastern Estonia)

The businesses are interested in the circular bioeconomy' roadmap to obtain information about resources, global trends related to usage of local resources, acquisition of quality labels, security as to the observable trends in the public sector, development of business models. Several businesses have carried out their carbon footprint mapping, evaluation of compliance with ISO standards, analysis of green networks or the analysis of the business environmental, social and governance standards (ESG).

The interviews in Saaremaa highlighted the importance of communication, however, inclusion and communication between the parties has to be well-considered and involve all the stakeholders.

Methods for inclusive discussion

When planning concrete steps, the regional steering group thinks how to engage people and guarantee everyone's involvement so that the gathering would not end up with only the boldest participants taking the floor.

Choose the inclusion methods suitable for you. The methods have been introduced in various handbooks on inclusion of public. The handbook for officials and free communities[33] has a separate chapter describing a concrete meeting with its stages from goals setting through resources mapping to the concrete action guide. For instance, a non-profit organisation Ruumiloojad introduces four possible inclusion methods[34] – *circle*, *open space*, *world cafe* and *acknowledged discovery*. Another non-profit organisation Strateegialabor has arranged co-creation trainings for public institutions and offers introductions and tools for several methods[35], e.g., *community canvas*[36], *six thinking hats*, *co-design workshop*, *co-creation canvas*.

EXAMPLE 5. World cafe is the most widely used method to engage wider stakeholders' circles[36]. It requires making of thematic table groups with one table leader for each table. So, for example, when designing a circular bioeconomy regional roadmap on the basis of available resources, one could arrange the following table groups: e.g. Food Production Industry, Agriculture, Blue Economy, Wood Processing Industry or even wider or, on the contrary, more specific areas. Next, 4–5 questions are prepared which are discussed one by one by each table group. Each table group finds answers to one given question during a set time (e.g. 20–30 min) and the table leader marks the answers on a big sheet of paper or in the agreed environment (e.g. Padlet, Google Jamboard). For example, the first question might be: what characterises this sector in our region (e.g. operating businesses, available bioresources, information on the generated waste, how it is dealt with, etc.)? After this, the participants move to the next freely chosen table group. The table leader remains at the same table. The next round is for a new question. At the start, the table leader gives an overview of the answers to the previous question, which is followed by a discussion of the new question similarly to the previous session. Thus, the participants move from table to table 4–5 times. The second question may be about the challenges in this area for the region, the third might be to study good examples and practices, the fourth to map potential resources (e.g., closely located universities and their related scientific studies, stakeholders, etc.). When all questions have been discussed in the table groups, the table leaders present the summary to the participants. The information collected as the result of the table groups' work is the input for designing the initial version of the regional roadmap. A good inclusion practice would be to inform the participants how their created input was used for making of the roadmap. It is also a good opportunity to send the draft of the regional circular bioeconomy roadmap to the participants for them to get acquainted with it.

33 Kübar, U., & Hinsberg, H. 2014. Kaasamine avalikus sektoris ja vabakonnas. Käsiraamat ametnikele ja vabaühendustele. Vabaühenduste Liit EMSL. https://heakodanik.ee/sites/default/files/files/Kaasamine%20avalikus%20sektoris%20ja%20vabakonnas.pdf

34 Kaasamise meetodid. Ruumiloojad. https://kaasamine.ee/meetodid/

35 Koosloome tööriistad. Sotsiaalse innovatsiooni labor. https://koosloome.ee/filter/

36 Canvas is a template supporting design thinking which helps to structure the thoughts in a certain way and supports generation of ideas.

EXAMPLE 6. In Australia's Hunter & Coast circular economy roadmap creation[37], the leading organisation was Hunter Joint Organisation (Hunter JO), which together with local state representatives made up a steering group and contacted various regional stakeholders to design the roadmap and support the actions developed for it. The representatives of the national and local government support different roadmap initiatives via partnerships in the roadmap's projects. A wider participants' circle involved in promotion of circular economy includes universities, representatives of the regional government, community and businesses representative organisations, who all together make up the regional roadmap support group. The support group made roadmap success indicators and is also responsible for impact evaluation.

The process of identification and inclusion of the participants in Finland's roadmapping example took about 3–4 months. Though this process may be time-consuming and complicated, it is essential for acquisition of wide-reaching support and promotion of sustainable transition to bioeconomy. It is also important not to carry out the inclusion process in a hurry as one has to take into consideration different participants' capability, human and time resources.

37 *Hunter & Central Coast Circular Economy Roadmap 2022. Hunter Joint Organisation, the councils of the Hunter and Central Coast Regions.* https://www.huntercircular.com.au/wp-content/uploads/2023/03/20220503-CE-Roadmap-Document-1.pdf

3.2 Understanding the region and reviewing the situation in roadmap development

The main challenge for further development of domestic bioresources valorisation on the national level in Estonia is the absence of comprehensive wide-scale industry planning both for the locally focused community circular bioeconomy and for larger area industry; an additional issue is insufficient cooperation work supporting the growth of circular bioeconomy added value, as the small volumes of bioresources and the transport costs caused by dispersion set the limitations for implementation of different technologies and economic activity[38]. Local and regional level in circular bioeconomy exist together with several other levels, which influences everyday practices, innovation, shaping of policies and environmental impact (see Figure 4). The regional roadmap and its update are directly linked to all the levels, but first and foremost focus on the regional level of influencing the thematic development of circular bioeconomy's priorities and initiatives. The regional level is not directly related to certain institutions or administrative borders, but takes them into consideration in designing the development advantages and cooperation networks. If necessary, the current methodology may also be applied (partially) on a minor scale, e.g. to find out the bioeconomy challenges for a business.

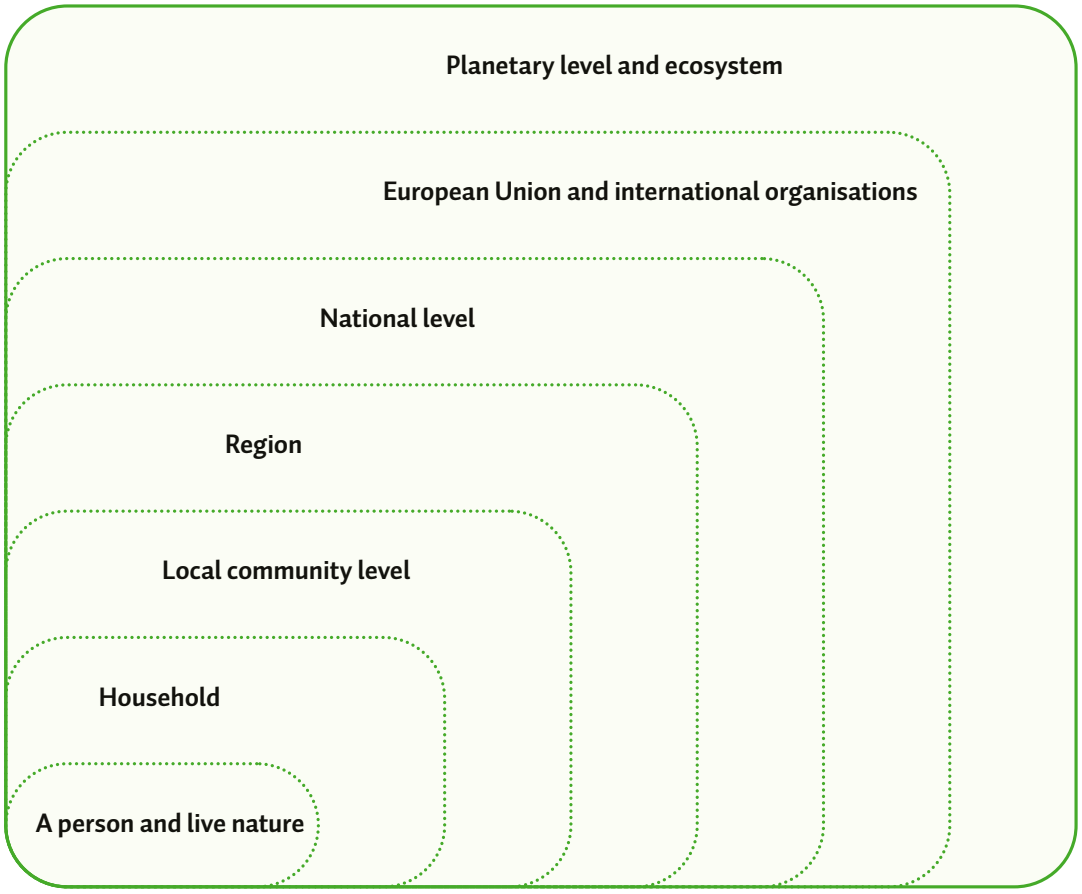


Figure 4. The location of regional level in relation to other levels in circular bioeconomy.

38 Üle-Eestiline ringbiomajanduse teekaart. 2023. Maaeluministeerium. https://www.agri.ee/media/7979/download

EXAMPLE 7. Understanding circular bioeconomy directions and regions[39].

The Netherlands has three following circular bioeconomy directions:

- **Biobased economy:** this direction focuses on production and marketing of bioresource-based products to decrease consumption of fossil fuels and carbon dioxide emissions.
- **Biobased industry:** an economy branch that uses renewable bioresources like plants, microorganisms and animal by-products to produce materials and energy.
- **Biobased society:** this direction focuses on environment-friendly lifestyles that use nature-derived technologies and products.

All the Netherlands regions which develop circular bioeconomy were established according to how they may support promoting circular bioeconomy. E.g., the region has an operating business environment with all the necessary infrastructure and production resources as well as volunteers wishing to contribute to fostering the circular bioeconomy to decrease carbon dioxide emissions and create a healthier and more sustainable lifestyle.[40]

The country has a long-standing tradition of innovation in agriculture and many worlds' leading biotechnology and food production companies are based in the Netherlands. The country's circular bioeconomy is supported by several public and private sector partnerships like Biobased Circular Delta and Platform for Accelerating the Circular Economy (PACE).[41]

EXAMPLE 8. Some circular bioeconomy focus areas in Netherlands various regions (see Figure 5)[42]

Friesland	Biomass as a valuable raw material Soils fertility
Flevoland	Bioenergy
Delta (Noord-Brabant, Zuid-Holland and Zeeland)	Bio-building blocks Biobased aromatic compounds High-value plant components Aquacultures biomass
Oost Brabant	Valorisation of minerals from animal and plant waste for application in food, feed and pharmaceuticals.
Limburg	Biomedical materials Biobased horticultural solutions and refining Food supplements and cosmetics
Oost Nederland	Bioenergy (pyrolysis/fermentation) Biobased fibres, textiles and biopolymers Valorisation of cellulose materials, use of manure and sewage sludge and application of new biomass flows (e.g. algae and grasses)
Drenthe	Green (fibre) chemistry, agriculture and horticulture

39 Strategic Biomass Vision for the Netherlands towards 2030. 2016. Ministry of Economic Affairs, pp. 42. https://knowledge4policy.ec.europa.eu/sites/default/files/92465_visie_biomassa_engels_def.pdf

40 Bioeconomy Factsheet The Netherlands. https://www.nweurope.eu/media/4663/180369_biobase4sme_2luik_netherlands_v4_lr.pdf

41 Biobased Circular Delta, https://circularbiobaseddelta.nl/. PACE, https://pacecircular.org/

42 Kwant, K., Siemers, W., Hamer, A. & Both, D. (2017). *Monitoring biobased economy in Nederland*. 2016. Netherlands Enterprise Agency (RVO.nl), Utrecht. Pp. 112. https://www.rvo.nl/sites/default/files/2017/06/Monitoring%20Biobased%20Economy%20NL%202016%20Hoofdrapport%20finale%20versie%202.pdf

The current methodological framework presents some starting points and prerequisites for understanding the regionality in development of a circular bioeconomy roadmap and carrying out the process. In the context of Estonia, counties play an essential role at circular bioeconomy's regional level. At the same time, the challenges of circular bioeconomy require collaboration on a wider scale, which in some context may cross the counties borders. The following are some initial points for understanding the regional dimension in roadmap creation:

- The functioning regional cooperation organisations on the county level (e.g. county development organisations[43] MARO, local governments' unions OVL) which consolidate information and social networks. EAS (Enterprise Estonia) also implements its support measures via county development centres MAK, however, the potential of these centres varies in different counties.

- The bioeconomy resources and perspectives on the level of a county or counties' group have been mapped or will be mapped in the nearest future (see Figure 6)[44]. It could be an important input for creation of a regional roadmap.

Figure 5[45]. Provinces of the Netherlands.

EXAMPLE 9. Biobased Delta[46] (Noord-Brabant, Zuid-Holland and Zeeland provinces): South-Western Netherlands is the home for a unique eco-system and region in the world, where biomass is valorised into building blocks for different applications. Circular Biobased Delta Foundation (CBD) is a network organisation facilitating the cooperation between business circles, local governments as well as scientific and educational institutions in Noord-Brabant and Zeeland provinces.

43 https://www.fin.ee/riik-ja-omavalitsused-planeeringud/regionaalareng-ja-poliitika-regionaalpoliitika-kujundamine#Maakondlikarendustegevus

44 Bioressursside kõrgema väärindamise huvi tõstmine ja ressursside uuring: Kagu-Eesti bioressursside uuringu aruanne, https://dspace.emu.ee/xmlui/handle/10492/7941; Lääne-Eestis on sarnane uuring koostamisel

45 https://www.wanderlustingk.com/

46 https://circularbiobaseddelta.nl/netwerk/ons-ecosysteem/

- Statistics is collected on the county or county groups level (e.g. NUTS 3 level[47]) which is necessary for finding out the regional development advantages of circular bioeconomy.

- County centres as regional functional hubs have evolved into the meeting places for people and businesses, which may support the development of cooperation networks.

- To understand the county level, it is necessary to consider the administrative reform of 2017 which altered local governments borders and county level's functions.

- The county-wide networks depend on the areas of the region and bioeconomy and need more exact clarification in the course of roadmap making. The focus group discussions for designing the current methodology pointed out that the challenges of the larger islands Saaremaa and Hiiumaa may not necessarily align well with the remaining Western Estonian region's needs. At the same time, the South Eastern regional circular bioeconomy is affected by the existence of the necessary resources, their availability and gravity centers. The South Eastern Estonia's region needs to be dealt with in the wider context of Southern Estonia.

- Shaping of a regional level also depends on the regional resources and knowledge-based advantages. E.g. South Eastern Estonia's potential (and Southern Estonia's in general) is mostly based on agricultural and forestry resources. At the same time, Western Estonia's resource is mostly the blue economy advantage.[48] In many regions there are science research institutions in the form of universities and their regional colleges, e.g. Tartu region is the centre for biotechnology, while TalTech's Kuressaare College and Tartu University's Pärnu college develop the blue economy expertise. The Life Sciences University has a strong bioeconomy competence. Therefore, the knowledge-based competences reach over the counties' borders and at the same time may support the regional circular bioeconomy with their presence.

- The county perspective is closely related to food supply and energy safety issues, which may very sharply rise in (potential) crises situations.

- The development strategies on the county level have been designed and, if integrated, guarantee a higher probability of achieving the regional roadmap goals for circular bioeconomy. To do that, the circular bioeconomy theme must be explicitly formulated in the development strategies of counties and local governments.

- Considering the future perspectives, roadmaps could help to shape the regional focus areas i.e. specialization in circular bioeconomy.

- The interest of one local government, business or community would need the empowerment in a wider regional context to create synergy and innovation. Determination of business practices and needs in the process of bioresources valorisation enables to clarify the regional focus areas and supportive activities.

- In creating a regional roadmap, it is essential to also consider international networks which reach over the state borders and affect shaping of regional and cooperation clusters.

47 https://et.wikipedia.org/wiki/Statistiliste_territoriaaljaotuste_nomenklatuur

48 Lääne-Eesti vesiviljeluse ja ringmajanduse teostatavusuuring 2020–30. Saare arenduskeskus. 2021. https://www.sasak.ee/application/files/3616/5651/2784/West_Saaremaa_Report_version_05_June_2021_final_EST.pdf

Taking the aforementioned into consideration, we suggest to start conceptualising and testing of regions in the initial stage of a roadmap development from the following county groups (see Figure 6). In case it does not work, there is an opportunity to determine the territorial scope on the roadmap differently (e.g. to focus on one county and then include neighbour counties and/or local governments to support the creation of the added value related to circular bioeconomy). Similarly to the Netherlands' view of circular bioeconomy's development in 4 major regions, one has to identify prerequisites for consolidation of regions in circular bioeconomy in Estonian context. At the same time, the current methodology offers possible development trajectories for Estonian circular bioeconomy regions, which in reality may evolve first and foremost through local and regional bottom-up initiative. The regional dimension would develop together with the process of identification and participation of stakeholders' groups (see section 3.1). That is why the shaping of the region may be arranged through shared common resources and cooperation networks which bring together public sector, businesses and communities and in future create new advantages and opportunities for sustainable circular bioeconomy.

NUTS 3 level regions

Figure 6. Counties' groups (according to NUTS 3 division and additionally South-Eastern Estonia separately). Conceptualising and testing of regions in the initial stage of a roadmap creation could start from these county groups. Source: Estonian Statistics Board

3.3 Developing priorities and value chains

The methodology for creation of a regional circular bioeconomy's roadmap was developed in several stages. We applied expert interviews to understand the motivation of the roadmap's makers. The interviews highlighted the barriers and opportunities in development of a regional roadmap: e.g. businesses' low interest, their focus on production process and profit; production and export which do not value the region and its natural resources, living environment and social capital; businesses often do not see the necessity of creating social value and saving the natural resources (sustainability, resilience, fulfilling climate aims, attractiveness of the region etc) and do not perceive wider opportunities of circular bioeconomy aiming at added value creation (e.g. valorisation of leftovers in the production process and via partnership connections, partial substitution of production with services, substitution of resource intensive production process with technologies' prototypes, sale of know-how etc.). They also pointed out the absence of a central initiative group as an obstacle. Such a group is necessary to facilitate making connections between businesses, regional stakeholders' groups, organisations and innovation development centres.

To develop the methodology, members of the working group participated in discussions of national circular bioeconomy's roadmap, where we mapped a common need for structurisation of collaborative work in a purposeful way to highlight various achievable activities on a roadmap and to point out the development of social value and natural sustainable value in addition to economic added value through circular bioeconomy. For structured discussion, we suggested the canvases that direct the collaboration process. The canvas is a base template supporting design thinking[49] which helps to structure the thoughts in a certain way and promote generation of ideas.

We designed the initial roadmap canvas to support the joint discussion and described making of a roadmap which we piloted in three expert groups in Jäneda, Kuressaare and Väimela, which included businesses and regional development specialists representatives. The mapping process revealed a clear necessity to use the aims of a business company as a starting point. We found that the previously prepared ideas based on the company's interests would support them, and these would be easier to integrate with other businesses' and regional and social stakeholders' views in the common discussion. Thus, we decided to complement our methodology with the stage of focusing on the company's mapping their details which could be carried out before the joint roadmap discussion. It would enable the business to think in more detail about their own view of circular bioeconomy. Potentially, both quality framework[50] as well as ESG (Environmental Social and Corporate Governance) framework would be suitable for such mapping [51].

With the help of interviews and development group's improvement suggestions we arrived at the concept of the three improved canvases which show the business's view (Canvas 1), regional view of value tracks (Canvas 2) and the roadmap table of regional empowerment actions to promote circular bioeconomy (Canvas 3). The current methodology was not piloted in a concrete region's roadmap making in the framework of the present research and this may be carried out in its next stage.

The following is a methodology suggested for roadmap creation in workshops. To manage the process, a regularly meeting working group is made up (see section 3.1 on stakeholders' inclusion) which involves representatives of local government, development centres, environment protectors and social groups as well as businesses (several larger and smaller businesses representatives). The working group leads making of the roadmap, monitoring of its implementation and regular update.

To support the process of a regional roadmap design (see Figure 2), we suggest the use of canvases. These may be printed on a bigger sheet of paper so that removable paper stickers can be used.

49 The main principle of design thinking is that different canvases supporting each other enable to focus on the solution's different aspects. E.g. Opportunities, problems, solutions. https://www.designminds.ee/disainmotlemisest

50 Ettevõte kvaliteediraamistik https://efqm.org/

51 https://eas.ee/ettevotluseauhind/kestlik-ettevote/

I. The outcomes of the first mapping stage are the identified interested local businesses and the data collected from them. That is why the starting point for mapping the circular bioeconomy prerequisites should be the needs of an individual business. We advise to use the canvas (see Figure 7) containing quality features from the quality framework[52]. The canvas helps the company's representative to evaluate how and to what extent their activities support sustainable development. The canvas may be digitalised and the measures found to motivate the regional businesses to evaluate the quality (e.g. via reports, industry unions' quality assessment, issuing quality labels to inform the consumers or other similar actions).

MAP THE BUSINESS'S QUALITY FEATURES FOR REGIONAL CIRCULAR BIOECONOMY

MAP PROCESSES, PRODUCTS AND SERVICES IN THE BUSINESS	FIND OUT WHAT YOU ALREADY HAVE IN YOUR BUSINESS AND WHAT ELSE MAY BE ACHIEVED: setting direction	implementation	outcomes	WHAT CAN YOU CHANGE YOURSELF OR WITH OTHERS HELP?
MANAGEMENT	The business has visions and clear values which are in accordance with the climate and sustainable development goals 50 points	The changes are managed flexibly and quickly 50 points	The business is run sustainably and is resilient 50 points	MANAGEMENT
RAW MATERIAL, ENVIRONMENT	Natural resources are used sparingly and respectfully and the environment is preserved 50 points	There are actions to reproduce the natural resources and to meet the climate goals 50 points	The business preserves, improves and restores natural resources and makes amends for their use 50 points	RAW MATERIAL, ENVIRONMENT
PRODUCTS, SERVICES			The services and products are necessary, durable and repairable 50 points	PRODUCTS, SERVICES
LEFTOVERS	Leftovers and their amount are mapped 50 points	Production process recycles the leftovers 50 points	Clients value the products made from leftovers 50 points	LEFTOVERS
PARTNERS	The region has the goal to increase the capacity of the joint circular economy 50 points	There are circular bioeconomy's partners and collaboration forms 50 points	The circular bioeconomy roadmap is created and implemented together with the partners 50 points	PARTNERS
WORKERS' SKILLS	The goal is to learn while creating innovation 50 points	Workers have skills for sustainable production 50 points	There are actions that support the workers' creativity, talent growth, retention and innovation 50 points	WORKERS' SKILLS
INFRASTRUCTURE	Infrastructure and production process are waste-free 50 points	The regional infrastructure supports circular economy 50 points	There are actions creating social well-being, infrastructure, living environment 50 points	INFRASTRUCTURE
LIVING ENVIRONMENT	The community and region have a good living environment 50 points			LIVING ENVIRONMENT

NB! These actions are the input for creating the joint regional map of circular economy opportunities

Figure 7. Canvas 1 with circular bio economy's quality features of a business (find printable canvas in Appendices).

- In the canvas's left part, a business can map its processes, products and services, resources, infrastructures and leftovers. The central part of the canvas enables to find to what extent the current activities of the business are in accordance with circular bioeconomy's values. In this part it is possible to collect points evaluating the current situation (max 1000 points).

- In the right part of the canvas the business may make suggestions based on the need for change, which may later be used in the stage of creation of the joint regional roadmap. We suggest to do this individual mapping before the companies start the common mapping of the regional value chains with the regional stakeholders.

- The roadmap development stage at the individual business level assists companies in finding their own quality features with which they contribute to achieving regional sustainability.

- Suggestions for further development of Canvas 1: Earlier research into assessment of the quality model has shown that the business's economic success depends on these quality criteria. Our suggested circular bioeconomy assessment model requires yet validation how a company's economic profit as well as environmental and social footprint affect the company itself and economy in general. The business may follow the evaluation framework of a sustainable business, e.g. SDG (Sustainable Development Goals) or ESG[52], which should be more clearly linked to various created values and circular processes possible to apply with maximum efficiency in circular economy. We would also suggest to more directly connect the Business Innovation Stairs model, designed in cooperation with the Estonian Employers' Confederation[53], with circular economy's value creation (see Figure 8).

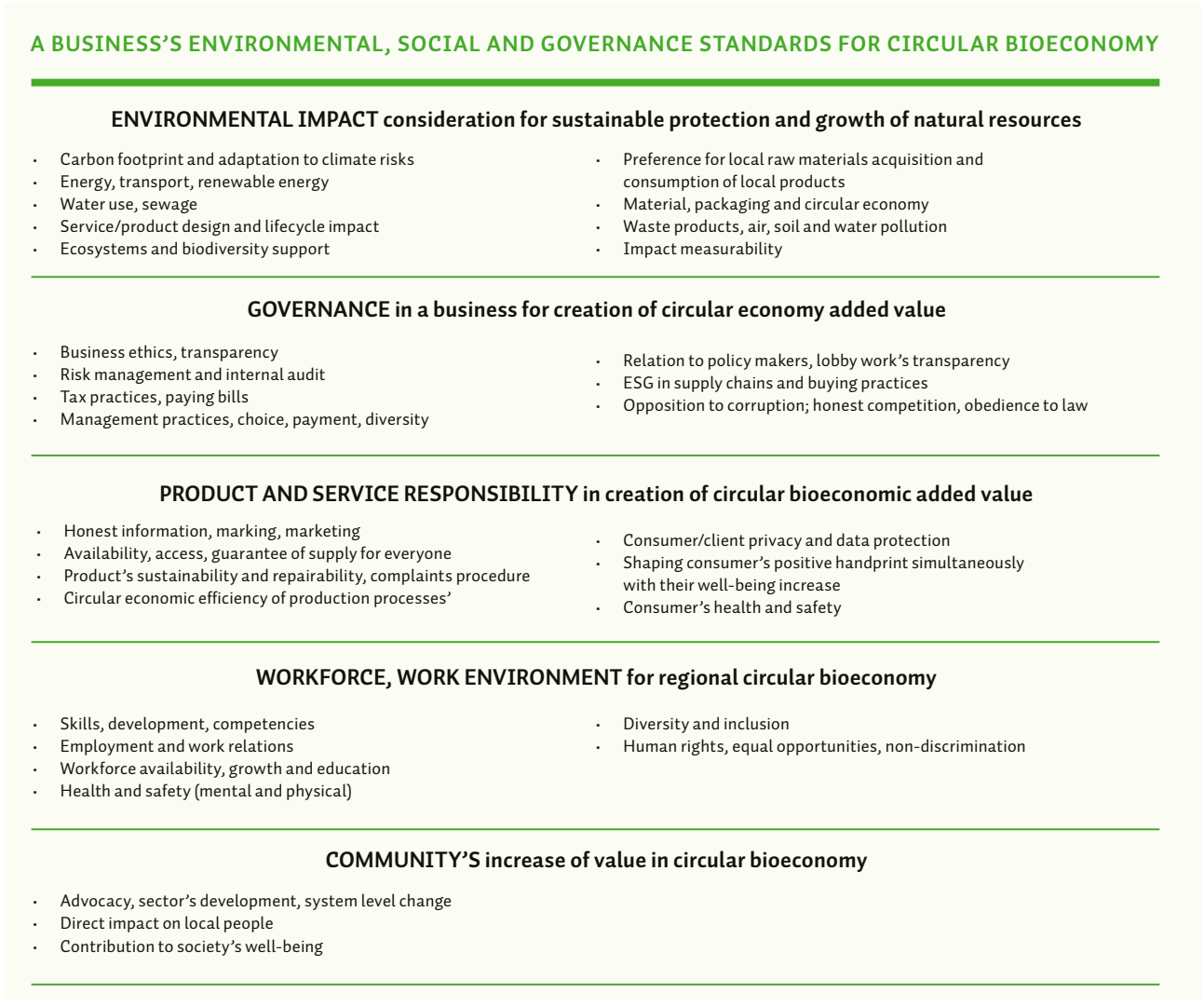


Figure 8. ESG (*Environmental Social and Corporate Governance*) measurement model in a business.

Assessment models on the business level need further development by connecting the measurements tools to e.g. greenhouse gases (GHG) footprint calculation[54] to measure the achievement of climate aims and to other similar measurement tools of sustainable development we did not research in-depth in the current methodology.

52 https://eas.ee/ettevotluseauhind/kestlik-ettevote/

53 https://employers.ee/innovatsioonitrepp-kiirendab-ettevotete-arengut/

54 Organisations' GHG footprint. Estonian Ministry of Environment. https://envir.ee/kliima/toetavad-materjalid/organisatsioonide-khg-jalajalg

II. In the next stage, the roadmap coordination organisation (e.g. MARO in Estonian context) invites together businesses and other regional stakeholders (see section 3.1) to a roundtable discussion day to clarify together the expectations related to the creation of the thematic roadmap and to map (also applying the existing research and strategies) the circular bioeconomical way to increase the regional value. The aim is to make a visual map of regional resources, which shows regional natural and human resources[55] as well as main opportunities and needs of the businesses to increase the value (e.g. see Figure 10).

- It is recommended to make mixed groups of 6–8 members, in which there are several businesses and regional social stakeholders related to each other. Moderators may be used at each table helping to manage the process of filling in the canvases. The input for the mapping is the businesses' canvases previously filled in by them.

- The first step in the mapping process is mapping of main regional strengths by regional stakeholders' groups and businesses on the left side of Canvas 2. When mapping, it is convenient to add information to the canvas using paper stickers so that each sticker has the description of a resource or strength. The main aim of using the canvas is to avoid random and undirected conversation by systematically following the canvas's guidelines.

- In the following activity of working with the canvas the groups discuss which development visions, agreements and limitations are important for businesses and stakeholders. They also attempt to formulate the priorities, to which extent it is necessary to take into consideration sustainable natural resource, economical added value and creation of social values in the region.

- After that they discuss each individual business case and map how the company can use the leftovers from the production process to create different values. It is essential to think that the resources are in limited supply and that with circular economy decisions the resources are redistributed with the aim to develop the living environment, businesses and social partners. It is advisable not to engage in the discussion of the bottlenecks dealt with in Canvas 3 (see Figure 11).

- One of the outcomes of the roadmap making process is a comprehensive chart of resource flows (see a similar chart of Amsterdam's example, Figure 10), which can be used regionally in planning and informing the public. The regional resources mapped in the planning process may be measured by indicators (e.g. monetary added value, number of jobs, saved natural resources, restoration indicator of the natural environment, indicator of social services creation, indicators of CO_2 emission reduction and carbon sequestration etc.).

55 It is possible to use the national Estonian Land Board's geoportal for mapping natural resources: https://geoportaal.maaamet.ee/est/Kaardirakendused-p2.html

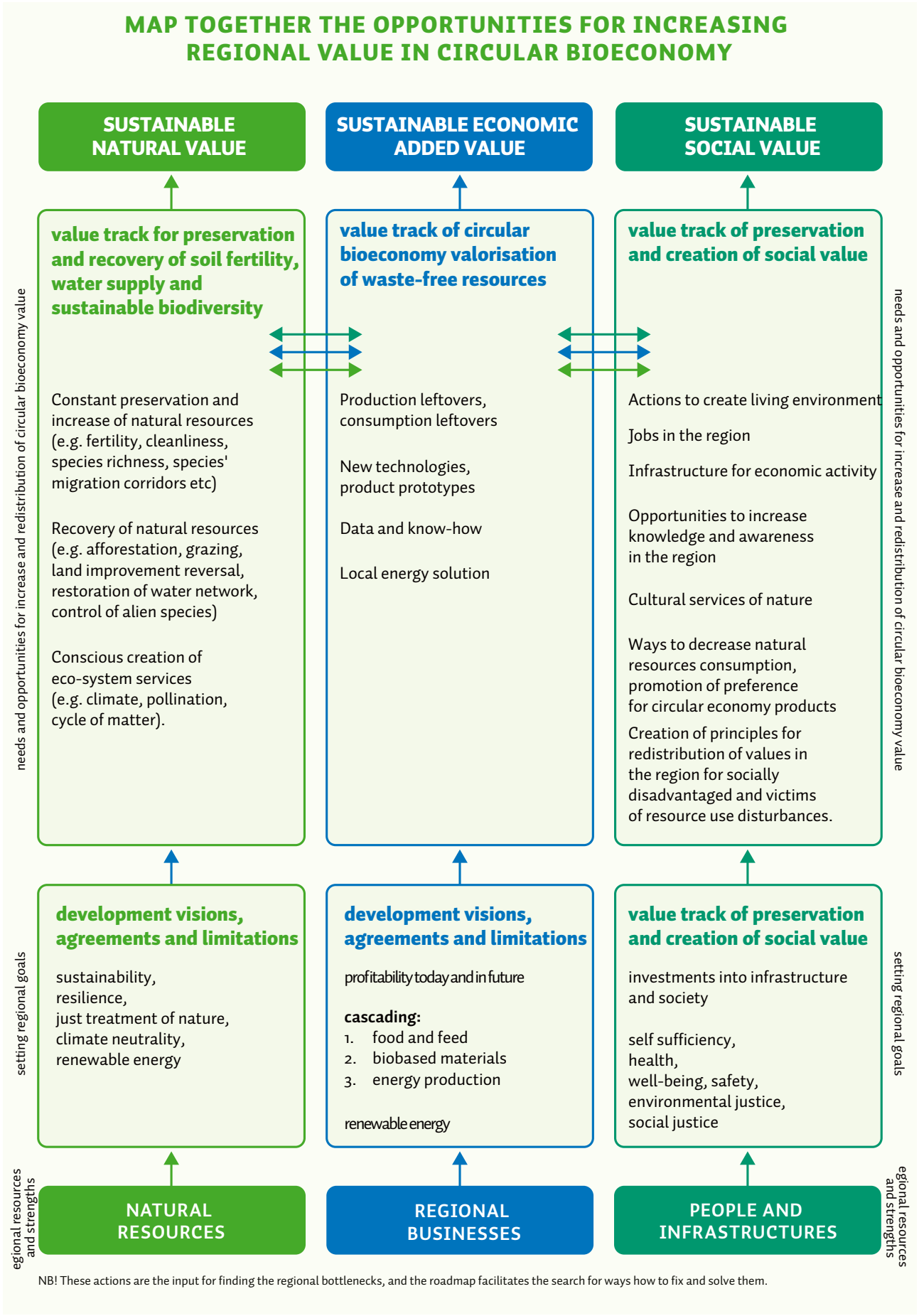


Figure 9. Canvas 2 of circular bioeconomy opportunities to increase regional value (find printable Canvas in Appendices).

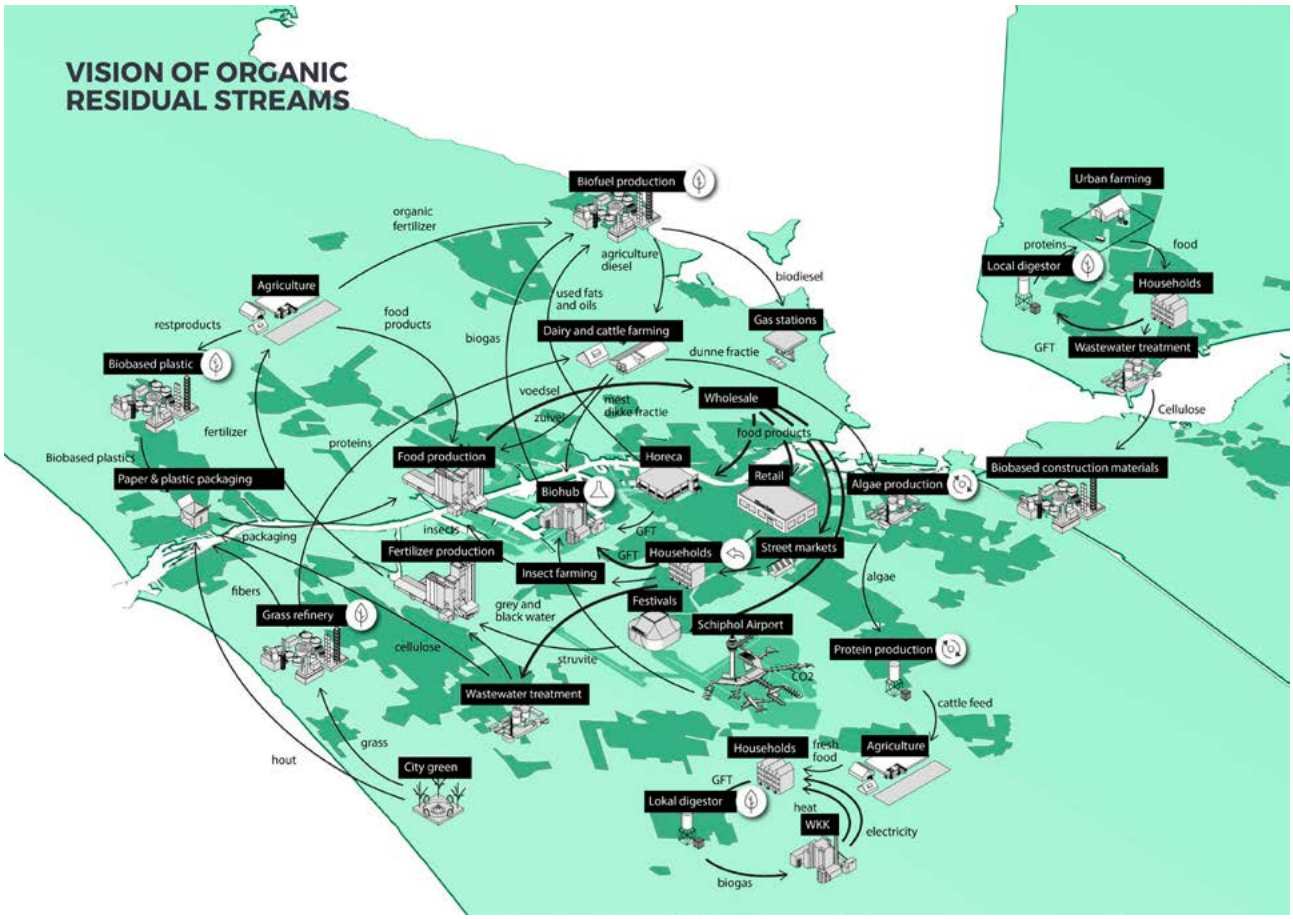


Figure 10. The example of Amsterdam city regional circulation of resources and leftovers flows[56]

EXAMPLE 10. Figure 10 shows the journey of various resources flows and leftovers circulation in different Amsterdam's sectors. The arrows signify the flows and demonstrate the movement of resources and leftovers through the city of Amsterdam, for example food leftovers circulation, materials reuse, energy production and other processes related to other resources flows. One example of a marked flow may be the circulation of food leftovers. The picture shows how food leftovers are collected separately and directed to special compost or bioenergy production facilities. Compost is produced in waste processing and is further used in agriculture or greenery maintenance. It is also possible to produce biogas from food waste which is used as an energy source, for instance, in transport or the city energy supply system.

56 Amsterdam Circular 2020–2025 Strategy, Circle Economy and the City of Amsterdam. 2020 Municipality of Amsterdam. https://assets.amsterdam.nl/publish/pages/867635/amsterdam-circular-2020-2025_strategy.pdf

III. In the second part of the workshop for creation of a regional circular bio economy roadmap, the focus is on the barriers which at the moment hinder circular bio economy in businesses, region or at the national level. The third canvas (see Figure 11) assists in planning the roadmap measures which would empower circular bioeconomy in the region. The input for the canvas is the regional value tracks that have been previously designed by working groups (see Figure 9. Canvas 2).

- In the process of making the roadmap, each business has to discuss which barriers and bottlenecks do not enable them to produce maximum economic added value, sustainable natural value and societal value, using circular bioeconomy opportunities. Clarify how barriers affect circular bioeconomy implementation. In the Amsterdam's roadmap planning process the barriers are prioritised (see Figure 12).

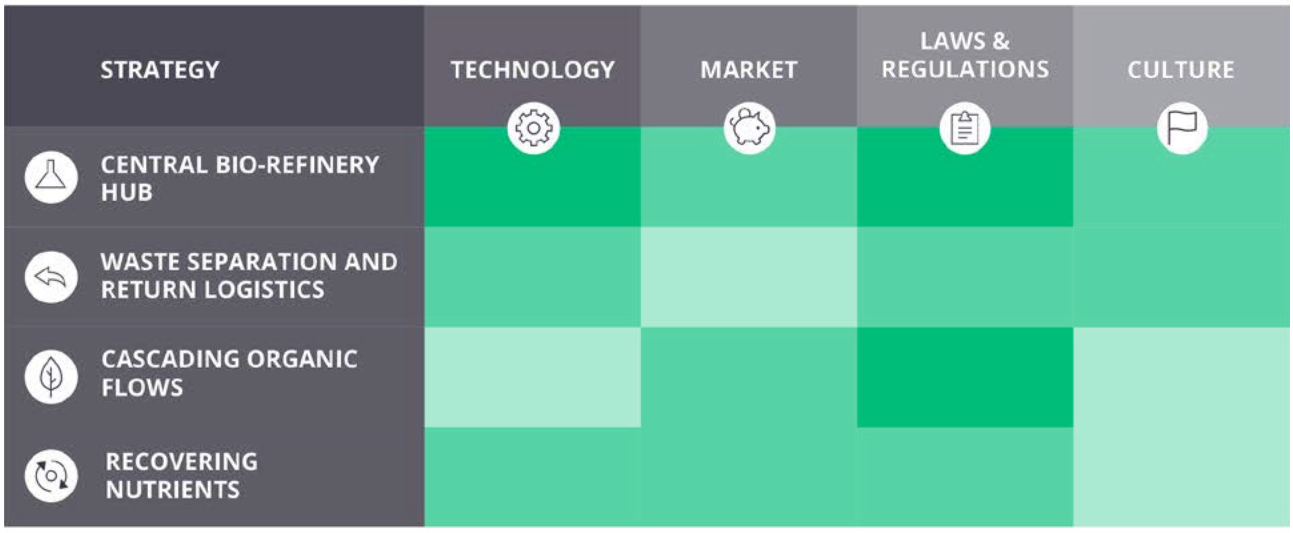
COMPILE THE ROADMAP FOR PROMOTION OF CIRCULAR BIOECONOMY MEASURES WITH THE REGIONAL LEADER

	Leadership methods Partnerships creation and competition	Data, carrying out analysis	Need for legislation, regulations and taxes	Maintenance and creation of infrastructure	Creation of technology and product development potential	Providing workforce and skills	Marketing and sales barriers (Shaping consumption preferences and consumer awareness)	Opportunities for shaping awareness, behaviour and attitude	Common regulations for justice principles, consideration, inclusion methods
Barriers for circular bioeconomy in the region									
Joint actions to overcome the barriers in the region on the national level									
Prioritising regional actions Action leaders Resources for implementation When possible to implement									

*the roadmap is a live document to be periodically reviewed, so a Gantt chart may help to manage the periods' activities

Figure 11. Canvas 3 for a roadmap of promoting regional circular bioeconomy (find printable Canvas in Appendices).

	The flow of organic residual streams is highly varied, both geographically and across time (impacted, among other things, by seasonal variations in green waste such as roadside grass), which forms an obstacle when trying to complete the business case.
	High-value bio-refinery technologies are in the early stages of development. For up-scaling and commercial viability, significant investment into additional research and development (R&D) is required. A lack of funding for this can make both the speed of and the chances for success uncertain.
	Market demand for end products of bio-refining is currently low due to factors such as ignorance of market players, a limited ability to realise significant supply and a lack of clear quality criteria.
	The production of high-quality protein by growing insects (larvae) on organic residual streams must comply with the current laws and regulations regarding slaughter of live animals, which raises practical and, thus, financial barriers.
	Policies that aim to increase the share of green gas into the natural gas network give too little consideration to the interests of importers and more to the interests of (traditional) network operators.
	Recovered nutrients, such as phosphates (by processing of struvite, for example) from waste water may, under current laws and regulations, not be applied as fertiliser on agricultural land and can, therefore, not be capitalised on, which makes the business case more difficult. A recently signed green deal provides an adjustment in the classification of waste under VANG and REACH (Sloover, 2014).
	According to current legislation, digestate from anaerobic digestion cannot be used as fertiliser on agricultural land (to replace artificial fertilisers), which complicates the profitability of digester plants.
	For waste substances, a waiver on the legislation is required per waste substance and per installation. This is an intensive and lengthy process that has been undertaken for struvite in Amsterdam.
	European regulations concerning the 'expiry date' and food hygiene create uncertainty for the high-value reuse of food.
	Various technological possibilities to enable greater source separation rates of organic residual streams are being examined. The technological complexity of these solutions (such as the link between technological installations in households and the necessary infrastructure) raises challenges that require both further technological development and the planning of underground installations and infrastructures.



This table indicates how high the barrier to a circular economy is for each of the strategies. (Source: Insights from interviews, literature and assessment of the research team.)

SMALL BARRIER | MODERATE BARRIER | LARGE BARRIER

Figure 12. Amsterdam's example of barriers definition and determination of their importance[58]

- When the barriers are jointly mapped, they are changed into actions to empower circular bioeconomy. The actions have to be grouped into those possible to implement under the leadership of a business, those which need the leadership of a regional circular bioeconomy union and those which should be delegated to the national level.

- Each action is then given an importance rating, and the activities of all areas are prioritised on the basis of monetary opportunities or their impact.

- Creation of a roadmap is a dynamic periodic activity in which working group sets goals and monitors the success and impact of the activities. In this stage the Gantt chart[57] may be used to show the duration of activities and their essential milestones. See e.g. Figure 13 for the Amsterdam example of time planning.

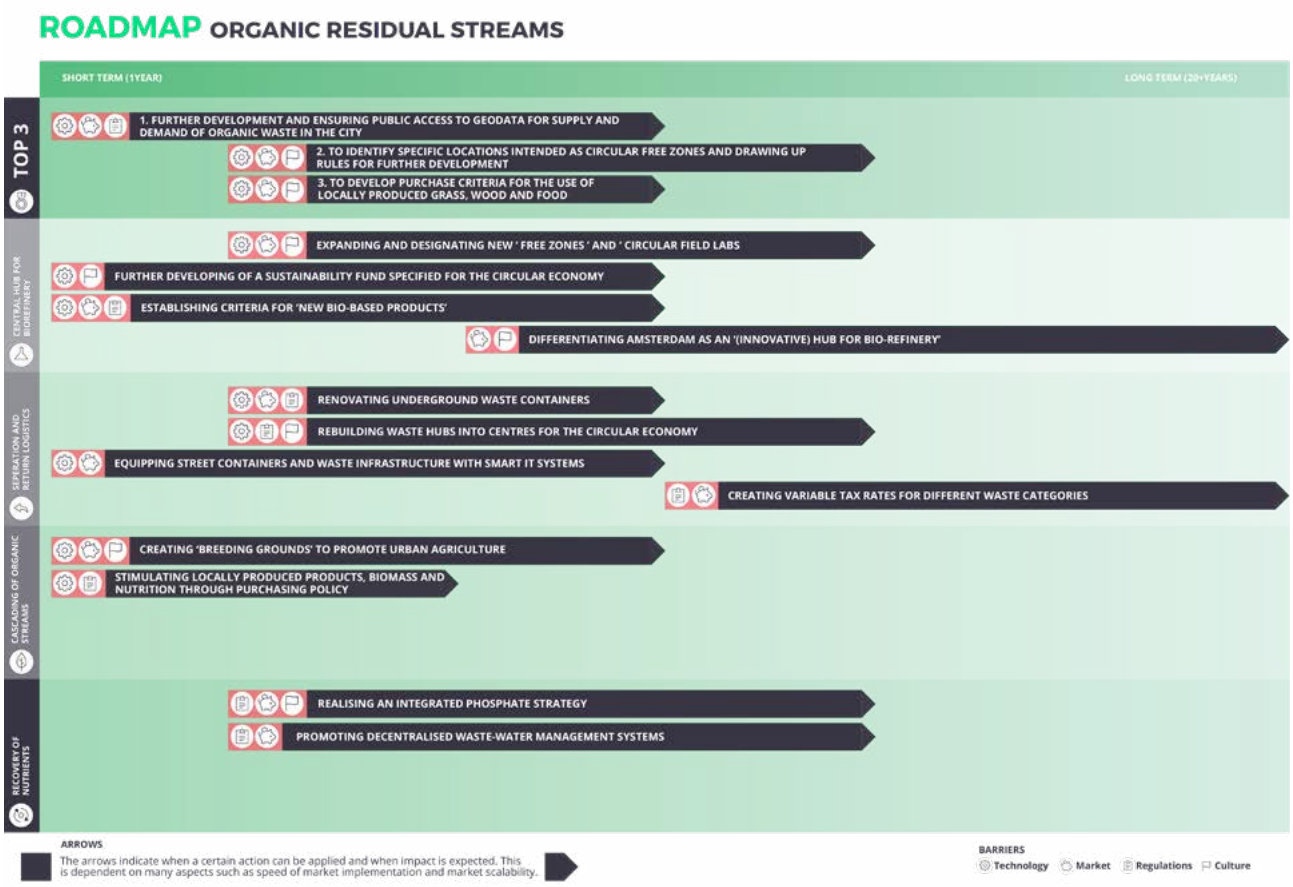


Figure 13. Amsterdam's example of roadmap time planning[58]

57 A Gantt chart. https://www.gantt.com/

58 Amsterdam Circular 2020–2025 Strategy, Circle Economy and the City of Amsterdam. 2020 Municipality of Amsterdam. https://assets.amsterdam.nl/publish/pages/867635/amsterdam-circular-2020-2025_strategy.pdf

3.4 Implementing and evaluating the roadmap

In implementation of the roadmap an important role belongs to the steering group, developed in the previous process, and to the cooperation networks between public sector, businesses and communities. The strategy of Amsterdam city area is an example of regular communication and planning of activities which promote the implementation of the circular bioeconomy roadmap.

EXAMPLE 11. Activities supporting the implementation of the circular bioeconomy roadmap of Amsterdam[58]. Amsterdam has several regional projects of bioresource use (e.g. reuse of biodegradable materials) and several information campaigns, for instance, the Get It Right campaign to raise the residents' awareness of reuse and recycling of bioresources. Additionally, various actions are arranged to increase knowledge of circular bioeconomy, e.g.:

- **Information days and seminars:** Amsterdam regularly hosts seminars and information days to discuss the circular bioeconomy related topics, introduce new solutions and share experience and best practices.
- PR campaigns: numerous PR campaigns are aimed at introduction of circular bioeconomy principles to a wider audience.
- **Education programmes:** meant for different target groups, including children, students and businessmen. For example, special educational programmes for schools where students can learn circular bioeconomy principles and solutions.
- **Partnership programmes:** the city has initiated partnership programmes where various organisations, businesses and government institutions can cooperate to develop circular bioeconomy and raise awareness. E.g. programmes where businesses can share experience and best practices and cooperate in creation of new solutions.
- **Web pages and social media:** Amsterdam has numerous web pages and social media channels introducing circular bioeconomy principles, solutions and news. For instance, the web page "Amsterdam Circular".

To analyse the outcomes and impact of a regional roadmap, one requires indicators, the data for which is collected in the course of implementation. Specific indicators create a clear view of the roadmap's implementation and also give an opportunity to reflect on different stakeholders' groups' outcomes and future perspectives. It is necessary in the periodic process of the roadmap's update, during which the agreed aims and action plans of circular bioeconomy are reviewed and updated if necessary. It is essential to link the roadmap implementation indicators to the inclusion process (see section 3.1) and the value chains creation (see section 3.3). It is necessary to avoid overly general indicators, they must be measurable. The support group, which created the roadmap, carries out evaluation of the roadmap's regional success. Thematic indicators are introduced in the following examples of Australia, Finland and the Netherlands, some of which are connected with economy in general but are also transferrable to circular bioeconomy.

EXAMPLE 12. In Australia the following indicators are applied to evaluate the effectiveness of a regional circular economy roadmap[59]:

- Number of started and implemented initiatives
- Success of cooperation and inclusion systems
- Level of awareness of circular economy in local governments and other organisations
- Direct economic benefit
- Reduction of waste amounts
- Benefits of circular economy for local region, including economy diversification
- Increase of future-oriented jobs
- Valuable input into the region's strategic goals which develop the region's resilience and sustainability

EXAMPLE 13. The criteria for evaluation of circular bioeconomy promotion project BIOSYKli in Finland, Päijat-Hämen[60]:

- The products, components and materials of circular economy remain as long as possible in the economy cycle.
- Biobased products are made completely or partially from organic raw materials.
- The circular bioeconomy sector is resource effective and economically profitable in accordance with the principles of circular economy.
- Waste production is directly or indirectly minimised according to waste hierarchy, where the first priority is avoidance of waste production, followed by recycling, re-use, energy recovery, with safe disposal being the last resort.
- Cooperation between stakeholder groups has strengthened; for example, between businesses, universities, public sector and consumers. Cooperation is the foundation of a functioning circular economy.
- Activities are transferrable and implementable in other European areas.

EXAMPLE 14. The main indicators for evaluation of circular bioeconomy in the Netherlands include[61, 62]:

- The share of the biomass produced energy i.e. how much of the consumed energy in the Netherlands comes from biomass.
- The amount of the biowaste taken for recycling i.e. how big is the share of the recycled biowaste in the biobased economy.
- The market share of the biobased products and services i.e. how big is the share of the Netherland's economy coming from biobased products and services.
- Innovation in biotechnology sphere i.e. how much the Netherlands contributes to the biotechnology innovation which is essential for the development of biobased economy.

59 Hunter & Central Coast Circular Economy Roadmap 2022. Hunter Joint Organisation, the councils of the Hunter and Central Coast Regions.

60 Project BIOSYKLI – Circular Bioeconomy in Päijät-Häme Region. 2022. LAB University of Applied Sciences. https://lab.fi/en/project/biosykli-paijat-hameen-biokiertotalous

61 A Circular Economy in the Netherlands by 2050. Government-wide Programme. (2016). The Ministry of Infrastructure and the Environment and the Ministry of Economic Affairs, on behalf of the Ministry of Foreign Aff airs and the Ministry of the Interior and Kingdom Relations. pp. 72. https://circulareconomy.europa.eu/platform/sites/default/files/17037circulaireeconomie_en.pdf

62 Strategic Biomass Vision for the Netherlands towards 2030; 92465; Ministry of Economic Affairs, 2016; p 42. https://knowledge4policy.ec.europa.eu/sites/default/files/92465_visie_biomassa_engels_def.pdf

To monitor the process, one may apply various programmes, for instance *Material Flow Monitor* (MFM) is an indicators' system containing all the material flows in the economy[63]. MFM is already used to derive indicators for transition to circular economy[64]. *Bio Flow Monitor* (BFM) is an augmented MFM which also includes biobased economy and is applied to design the indicators related to circular bioeconomy policies[65]. The product perspective is the basis, because each product is categorised in the pyramid irrespective of the industry where it is used. This way all leftovers and waste are divided into waste flows regardless of that if they are used for energy production, feed or raw materials. After that the monetary value of the biomaterial is determined, ignoring the actual value of other materials used in the product. For instance, in case of a product consisting of 40% of biomass, it is assumed that 40% of its monetary value comes from biomass.

63 Berkel J. van, Delahaye, R., 2019. Material Flow Monitor 2016 – technical report, Statistics Netherlands, The Haque.

64 Hanemaaijer, A., Kishna, M., Kooke, M., Brink, H., Koch, J., Prins, A.G., Rood, T., 2021. Integrale circulaire economie rapportage 2021, Planbureau voor de Leefomgeving, Den Haag.

65 Delahaye, R., Tunn, V. (2022). Monitoring the biobased economy from a macro-economic perspective. Statistics Netherlands (CBS). https://www.cbs.nl/en-gb/longread/discussion-papers/2022/monitoring-the-biobased-economy-from-a-macro-economic-perspective

4. SUMMARY

The current methodology of developing a circular bioeconomy roadmap is based on various countries' experience of creation roadmaps that support and promote circular bioeconomy. The circular bioeconomy roadmap development process has not been researched very thoroughly in the world, that is why we have also presented for the overview the examples of circular economy roadmaps methodologies which have been more widely applied and described in detail.

Different countries' experiences highlight the following as the most essential aspects of roadmap creation:

1. **Regional awareness of the need to make the roadmap:**

- the roadmap development process gives an opportunity for wide-scale negotiations between businesses, public sector and society representatives on transition to circular bioeconomy and promotes consideration for the needs of environment, society and economy.
- Enables to initiate the negotiations and find partners for the circular use of resources.
- Allows to create the vision of the region's circular bioeconomy, which would perform wide-scale communication and information.
- The roadmap helps to supply the input for the data-based usage of resources in the region.
- Participation in the roadmap process may give the in-depth understanding of circular bioeconomy's aims to the businesses and assist them in finding better strategies for the transition to circular economy which also considers environmental and societal values.

At this stage the roadmap makers have to decide which aims the roadmap fulfils:

- whether it gives a general static vision of the regional development activities or
- leads dynamically the empowerment of circular bioeconomy in the region through concrete activities and enables to monitor the success of the support to circular bioeconomy.

2. **The process of the roadmap creation needs a steering group for a long-term leadership of the roadmap and involvement of the essential stakeholders of the area** – businesses, social area, representatives of local governments and bigger settlements, leaders of the region's communities.

3. **In the stage of the roadmap's conceptualisation, the steering group's task is to determine the impact area of the roadmap and the process principles,** for which the current methodology gives examples from the world practice.

In this stage it is essential to **create connections with the development plans, strategies, roadmaps of other activity areas already existing in the region to connect the circular bioeconomy's roadmap with expectations, opportunities and limitations.** Here it is necessary to get to know the already existing digital data on usage of the region's resources, businesses as well as environment protection and social needs.

4. **The stage of making the roadmap's value chains involves various stakeholders on a wider scale.** Here we suggest to think from the point of view of the businesses as the implementors of the circular bioeconomy in their companies, which may precede or follow the creation of the regional roadmap. **In this stage the visual form of the regional circular bioeconomy roadmap is designed through co-creation process,** showing the relations of environmental, social and economic value creation in the region. The major outcome is the **regional roadmap which identifies main support activity areas of the circular bioeconomy in the form of an implementable activity plan**.

A roadmap as a dynamic document needs the leadership of the steering group. The **leaders, noted** in the roadmap, of the circular bioeconomy **regional supporting activities are involved in the roadmap implementation process.** The funding of the roadmap's activities is monitored and the steps are prioritised, which of them are possible to be carried out together in the region and which should be taken to the national decision-making level. **A good roadmap has the regularly assessed metrics that monitor the progress and the necessary updates are put in the roadmap.**

In the process of a roadmap methodology creation, we tested thoroughly only part of the steps marked on the roadmap. That is why the methodology requires validation on the example of another region to evaluate the compatibility of the world practices and our designed work methods. Such testing would enable to acquire examples which would certainly make the methodology clearer for every user.

5. APPENDICES

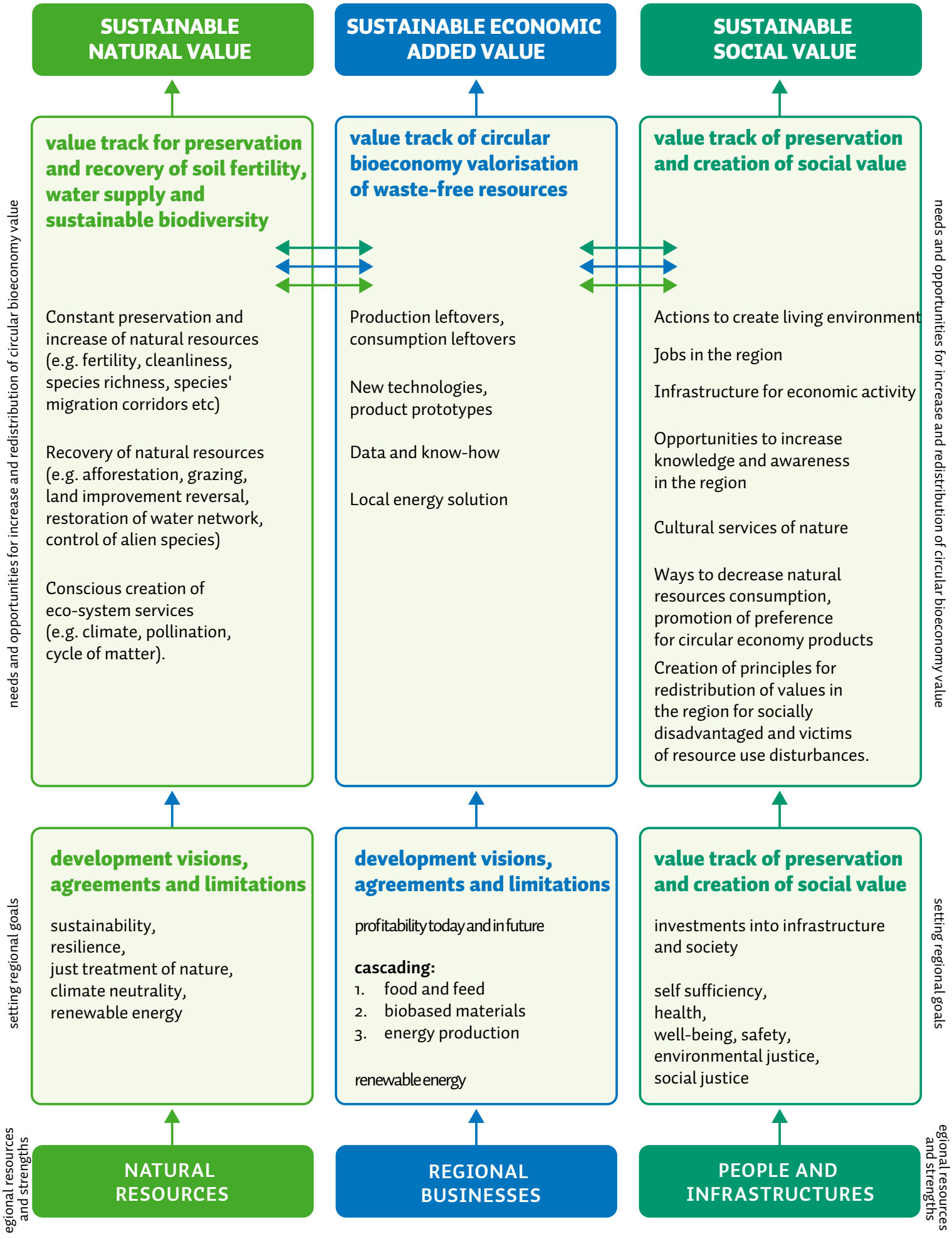
Canvases 1–3 in larger format

MAP THE BUSINESS'S QUALITY FEATURES FOR REGIONAL CIRCULAR BIOECONOMY

MAP PROCESSES, PRODUCTS AND SERVICES IN THE BUSINESS	FIND OUT WHAT YOU ALREADY HAVE IN YOUR BUSINESS AND WHAT ELSE MAY BE ACHIEVED: setting direction	implementation	outcomes	WHAT CAN YOU CHANGE YOURSELF OR WITH OTHERS HELP?
MANAGEMENT	The business has visions and clear values which are in accordance with the climate and sustainable development goals **50 points**	The changes are managed flexibly and quickly **50 points**	The business is run sustainably and is resilient **50 points**	**MANAGEMENT**
RAW MATERIAL, ENVIRONMENT	Natural resources are used sparingly and respectfully and the environment is preserved **50 points**	There are actions to reproduce the natural resources and to meet the climate goals **50 points**	The business preserves, improves and restores natural resources and makes amends for their use **50 points**	**RAW MATERIAL, ENVIRONMENT**
PRODUCTS, SERVICES			The services and products are necessary, durable and repairable **50 points**	**PRODUCTS, SERVICES**
LEFTOVERS	Leftovers and their amount are mapped **50 points**	Production process recycles the leftovers **50 points**	Clients value the products made from leftovers **50 points**	**LEFTOVERS**
PARTNERS	The region has the goal to increase the capacity of the joint circular economy **50 points**	There are circular bioeconomy's partners and collaboration forms **50 points**	The circular bioeconomy roadmap is created and implemented together with the partners **50 points**	**PARTNERS**
WORKERS' SKILLS	The goal is to learn while creating innovation **50 points**	Workers have skills for sustainable production **50 points**	There are actions that support the workers' creativity, talent growth, retention and innovation **50 points**	**WORKERS' SKILLS**
INFRASTRUCTURE	Infrastructure and production process are waste-free **50 points**	The regional infrastructure supports circular economy **50 points**	There are actions creating social well-being, infrastructure, living environment **50 points**	**INFRASTRUCTURE**
LIVING ENVIRONMENT	The community and region have a good living environment **50 points**			**LIVING ENVIRONMENT**

NB! These actions are the input for creating the joint regional map of circular economy opportunities

MAP TOGETHER THE OPPORTUNITIES FOR INCREASING REGIONAL VALUE IN CIRCULAR BIOECONOMY



NB! These actions are the input for finding the regional bottlenecks, and the roadmap facilitates the search for ways how to fix and solve them.

COMPILE THE ROADMAP FOR PROMOTION OF CIRCULAR BIOECONOMY MEASURES WITH THE REGIONAL LEADER

	Leadership methods Partnerships creation and competition	Data, carrying out analysis	Need for legislation, regulations and taxes	Maintenance and creation of infrastructure	Creation of technology and product development potential	Providing workforce and skills	Marketing and sales barriers (Shaping consumption preferences and consumer awareness)	Opportunities for shaping awareness, behaviour and attitude	Common regulations for justice principles, consideration, inclusion methods
Barriers for circular bioeconomy in the region									
Joint actions to overcome the barriers in the region on the national level									
Prioritising regional actions Action leaders Resources for implementation When possible to implement									

*the roadmap is a live document to be periodically reviewed, so a Gantt chart may help to manage the periods' activities