

Article

Stakeholder Engagement in the Co-Design of Regional Bioeconomy Strategies

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Abstract: Increasing recognition and importance is being given to regions for their role in supporting Europe's transformation towards a sustainable and circular bioeconomy system. Regions are often feedstock producers and can provide the proximity of regional actors along the value chain. If supported and mobilized, actors can coordinate strategic paths for regional bioeconomy development and keep value added in the region. Regional bioeconomy strategies are an important instrument to reach such a process, which implies great efforts of coordination among relevant stakeholders. In this research, we developed a guideline to establish flexible dynamic bioeconomy platforms—Regional Bioeconomy Hubs (RBHs)—that bring together bioeconomy-related stakeholders from policy, academia, industry, and society in a structured procedure (quadruple-helix context) and to establish regional bioeconomy strategies. The guideline was applied to five Central and Eastern European regions and validated in the framework of the POWER4BIO project. As a result, all regions successfully applied the guideline, established their RBH, and developed a regional bioeconomy strategy or recommendations for the development of such a strategy.

Keywords: bioeconomy guideline; regional stakeholders; quadruple helix; bioeconomy strategy; sustainability; European regional bioeconomies

1. Introduction and Goal Setting

Bioeconomy strategies are developed in many countries to foster societal and economic transformation. The bioeconomy itself relies on renewable biomass resources for the production of materials and energy apart from its traditional supply of food and feed and it holds the potential to support sustainable development and thus the attainment of the Sustainable Development Goals (SDGs) [1]. The bioeconomy is considered to support major global challenges such as food security, natural resource scarcity, fossil resource dependence, and climate change while achieving sustainable economic development [1,2]. However, it might also be related to social and environmental risks, especially excessive

exploration of biogenic resources [3]. There is no unified definition for the bioeconomy, rather it has been defined according to geographical contexts and evolution paths [4,5]. The European Commission (EC) describes the bioeconomy, in the last update of the EU Bioeconomy Strategy (2018), as covering “all sectors and systems that rely on biological resources (animals, plants, micro-organisms and derived biomass, including organic waste), their functions and principles” [6].

The bioeconomy definitions of several EU countries show commonalities: in general, they contain the utilization of renewable resources, prioritization of food production for human consumption, and a focus on the valorization of biomass residues towards the creation of economic value according to country priorities, and the reliance on R & D and innovation to drive forth various forms of biomass pathways. A few countries (such as Germany, Poland (in preparation), or the region of Flanders in Belgium) mention the cascade principle directly in the definition of bioeconomy in their national bioeconomy strategies. In general, national strategies reveal at first glance the priorities for the development of their bioeconomy. Spain, for example, highlights the importance of the development of rural communities, while the Czech Republic places emphasis on enhancing the role of primary producers (agriculture and forestry). Concepts regarding environmental risks, responsible use of resources, and long-term sustainability of ecosystems are mentioned in the strategies of Germany, Spain, and Poland, and have been highlighted by Hungary, the Czech Republic [7], and Ukraine in declarations about national bioeconomy. While Poland names primary and secondary sectors explicitly in its bioeconomy definition, Belgium (Flanders) highlights bio-based technologies. Italy includes a reference to its sea resources, marking the maritime economy as a key sector of its bioeconomy and in particular emphasizes the maritime bioeconomy in the “cities”. Germany’s definition of bioeconomy is distinctively focused on innovation and technological processes for better utilization and transformation of usable biomass, as well as on the development of future-oriented processes and systems. Bioeconomy also highlights in its definition the interlinkages between ecosystems and their services, the sectors that produce biological resources (i.e., agriculture, forestry, fisheries, and aquaculture), and the industrial sectors that use those resources and process them to supply all economic goods and services [8]. Thus, if well designed and implemented, the bioeconomy can offer a transition path towards a post-fossil-carbon economy that contributes to the reduction in GHG emissions in the provision of food, feed, biomaterials, and bioenergy [9–12], and knowledge-based management of resources.

To support the transition towards a bio-based economy, major policy-making efforts have taken place in Europe. Typically, the instruments used are direct regulation, economic instruments, voluntary approaches, information exchange, advisory systems, and market-based signaling approaches [13]. In addition, a series of other policies related to the bioeconomy field, such as in the areas of climate and energy, food, feed, forestry and fisheries, waste, or environment influence bioeconomy activities. For example, environmental regulations play an important role in bioeconomy-related issues such as water, biodiversity, and pollution from industrial activities [13].

Visions, strategies, and roadmaps are other examples of policy instruments used by governments to influence the development of the bioeconomy in their countries. Dedicated bioeconomy strategies at national or regional levels are exclusively developed for the field, whilst in other cases, bioeconomy topics are included in existing/other national strategies (e.g., agriculture or innovation strategies) or regional strategies (smart specialization strategies, regional development strategies) [1,5].

Initial development of bioeconomy visions and strategies at the macro-regional level (greater than the national scale) was carried out by the OECD [14] and the European Union (EU) as forerunners. The EU Bioeconomy Strategy was launched in 2012 [15] and updated in 2018 [6]. Both the initial strategy and its update aim at an accelerated bioeconomy implementation to contribute to the 2030 agenda for the fulfillment of the SDGs and the Paris Agreement, whilst the updated strategy also aims to contribute to the European Green

Deal. This European initiative has been followed by several national strategies and other macro-regional initiatives emerging all around the world. To date, at least 15 countries have dedicated bioeconomy strategies from a current total of 56 countries with policy strategies directed toward bioeconomy development. Among the most recent developments are the bioeconomy strategies of France, Italy, Latvia, Norway, Spain, and Thailand [16]. This has given impulse to other European endeavors such as the Central-Eastern European Initiative for Knowledge-based Agriculture, Aquaculture and Forestry in the Bioeconomy (BIOEAST) for the development of a unified bioeconomy vision in Central and Eastern Europe and fostering synergetic national strategies [17]. Other recent macro-regional initiatives are present in Eastern Africa led by the Bioresources Innovations Network for Eastern Africa Development (BioInnovate Africa) or in Latin America and the Caribbean with the coordination of the Economic Commission for Latin America and the Caribbean (ECLAC) [16].

Although most bioeconomy strategies and related policies have been developed at the national level [5,18,19], the relevance of the bioeconomy for regional development and the role of regions in the bioeconomy is rising and with it the establishment of regional strategies that leverage local strengths and priorities [20,21]. The last report from the EC's Joint Research Centre (JRC) [22] indicates dedicated regional bioeconomy strategies in 27 regions in the EU including Spain, France, Italy, Germany, Belgium, Sweden, Denmark, Finland, Latvia, Slovakia, and Romania. Outside the EU, the Canadian provinces of British Columbia, Alberta, and Ontario, as well as South Australia, currently have regional bioeconomy strategies. The regional role in the bioeconomy is gaining importance; in Germany, for example, according to a German bioeconomy council study, stakeholders of 15 of the total 16 federal states recognize the role of regions and promote regional bioeconomy [23].

In the context of regional strategies, stakeholders can become promoters of the local and often national bioeconomy development [16]. Regional strategies provide the opportunity to structure paths of coordinated actions and synergized regional initiatives while connecting regional activities with cross-regional, national, and international efforts. Strategies are understood in the EU as a multi-level governance structure, to allow the best possible development of the bioeconomy [24]. Moreover, the bioeconomy arising from the regional context has been found to be a key pillar as rural areas constitute the base of bio-based value chains [25]. Moreover, value chains developed within the regional limits—feedstock production, conversion, market, recovery, and disposal—are supporting competitiveness and regional value added, by keeping most of the value chain in the region, and therefore reducing the environmental impacts of globalized markets [26]. The understanding of regions and their role in the bioeconomy is expanding from the “feedstock production areas” to hot spots for innovation, inter and transdisciplinary cooperation, knowledge dissemination, and closer monitoring of the bioeconomy's contribution to sustainability and socio-economic transformations. Regional bioeconomy strategies address also context-related challenges [27]. In this matter, setting decentralized and highly technological solutions such as regional biorefineries, data-intensive development of the value chains for improved efficiency, and the specialized workforce to be attracted to the regions, as well as the daunting task of changing strongly consolidated fossil-based rural business models, are some of the current stakes. In addition, they also address the rising expectations of the bioeconomy, such as new momentum in the forestry sector, the transformation of value chains, and coupling with circularity principles/activities, among others. Contributing to solving the challenges requires a strong shift in cooperation at the regional level [27].

The experiences of the regions analyzed highlight the importance of participative approaches as key to the development of bioeconomy strategies, for which a key issue is the active engagement of a great diversity of stakeholders and the establishment of an inter-and cross-sectoral, as well as inter- and transdisciplinary cooperation in the region [28]. Stakeholders involved in the bioeconomy are diverse, starting with the value chain participants themselves (biomass producers, pre-conversion and conversion industries, market actors

such as distribution and retailing among others, users, recycling and logistics institutions), knowledge communities and innovators (research institutes, universities, technical parks, pilot and demonstration facilities), facilitators or influencing bodies such as policy makers and governmental representatives, lobbyists, investors, non-governmental organizations (NGOs), and the civil society as a whole. The stakeholders often share long-established value chains but are not completely connected [4,29]. They have particular interests and expectations for the bioeconomy and often participate in other networks (e.g., sectoral and industry associations). In order to increase a more effective implementation of the bioeconomy, stakeholders should be better connected with each other. The intrinsic characteristics of regions and socio-cultural understanding among local stakeholders can be the first step. The proximity among stakeholders in a specific geographical context has been found to generate positive effects to facilitate the dissemination of knowledge, engagement in innovation activities, and bottom-up initiatives [30]. The importance of proximity lies in the consolidation of stakeholders' networks, as explained by Porter [31], and boosts interaction and communication, while contributing to the coordination of strategic actions, according to Feldman [32]. Thus, frequent interaction facilitated by social networks established due to proximity and commonalities creates trust among stakeholders, which is key for long-lasting cooperation, innovation in industry, and policy development.

D'Adamo reviewed the topic of stakeholder engagement in the context of the bioeconomy, especially biomethane production [33], and came to the conclusion that it had not been discussed sufficiently in the literature and it would need to be further explored, especially because this aspect seems to be a decisive factor when looking at the implementation of energy community models.

In addition, according to [34], sustainability, motivation, and performance are strongly influenced by the role and values of stakeholders. He examined the literature in the sector of agri-food waste biomass in the context of multicriteria decision analysis (MCDA) and life cycle assessment (LCA) methodologies and came to the conclusion that stakeholders were not considered in most studies reviewed. Even if considered, mostly they were researchers and actors in the supply chain, whilst neighboring communities, legislative stakeholders, or workers were less prominent. Not only are several types of stakeholder groups missing in their entirety but also the selection method of the actors. In addition, the degree of integration of the participants was often limited to some specific steps or to the level of the final finding, instead of the whole process.

Other studies [35] analyzed different research projects and have found that participatory approaches in the bioeconomy are often limited to the provision of information.

There is a wide need for communication and coordination platforms to facilitate purposeful interactions among the diverse actors of the bioeconomy and build trust among stakeholders. Such platforms are, for example, clusters, which have been found to serve as bridge builders for actors with common needs [36] and important drivers in regional bioeconomy development [37]. Currently, bioeconomy clusters connect industry, R & D & I, and policy representatives in new sectors in development (e.g., green chemistry, bioplastics), as well as established sectors that evolve accordingly to arising bioeconomy opportunities, such as forestry, agriculture, and other specific feedstocks.

According to Szarka [38], who analyzed 32 regional bioeconomy clusters in Europe, in most of the cases, clusters were established via a regional or national cluster policy, which also gave financial support. The trend shows cross-innovation platforms and overarching clusters, connecting different fields of the bioeconomy. Other previously existing platforms are also being used, such as networks among knowledge holders (R & D, universities). Extending those networks to include other groups along the value chain as well as schools, citizen initiatives, and NGOs promotes the creation of community resilience to tackle local challenges and define a transition path towards a desired bioeconomy system [21,28,39]. New stakeholders' cooperation can be challenged to generate not only innovative technologies but also innovative organizational, logistical, and business structures and to create knowledge. The success of the bioeconomy calls for value chains to evolve into disruptive

ones (completely anew) or for existing ones to be reinvented by symbiosis and the use of circularity principles within sectors [40].

New and inclusive bioeconomy networks are established continuously, using new formats (e.g., hubs, councils, living labs) and tools (e.g., digital platforms, online match-making) and anchoring their development to already identified regional strengths, such as pairing their development to regional smart specialization strategies, thus “considering local specialization, challenges and opportunities” [16,19]. The regionally available biomass feedstock is a key resource in bio-based business models [37], and thus there is a high need for networks fostering regional initiatives that consider the geographical, natural, and cultural contexts, and the regional biomass availability, as well as supporting the supply of the necessities of local territories.

Summarizing, both stakeholder platforms and strategies are drivers for the bioeconomy implementation [41]. However, many countries in Europe still remain without such platforms. Based on this background, the goal of this research was to develop a step-by-step guideline to establish and consolidate regional bioeconomy hubs and to engage them to develop their strategies.

2. Methodology

The methodology consists of three main steps (Figure 1): the development of the guideline (Section 2.1), the application of the guideline (Section 2.2), and monitoring (Section 2.3).

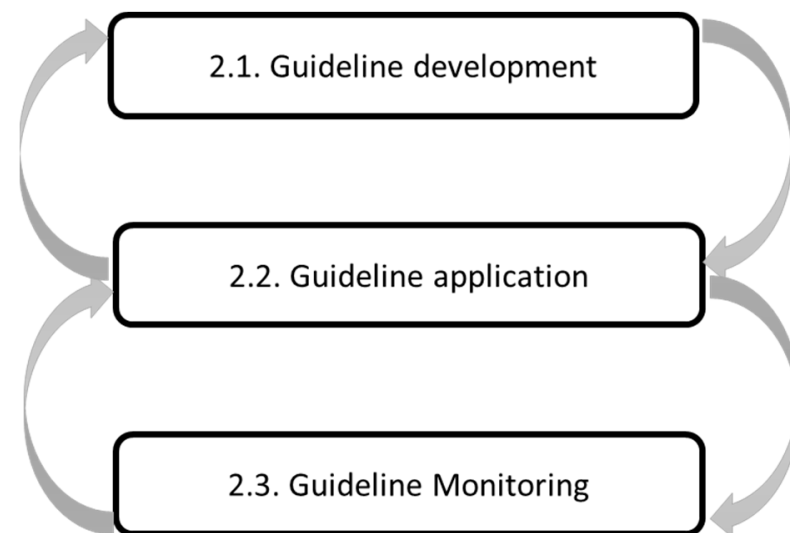


Figure 1. Main methodological steps.

The methodology applied includes research in the literature, questionnaires, expert interviews, a workshop, and indicator assessments. The developed guideline was applied in five Central and Eastern European (CEE) regions (see Figure 2) in the framework of the Horizon 2020 POWER4BIO project [42]. The resulting guideline can be a support tool for regional representatives, useful for top-down and bottom-up initiatives determined to develop regional bioeconomy visions, accompanied by focal bioeconomy priorities, coherent actions in strategic areas for the regions, and implementation planning.



Figure 2. Study area—Central and Eastern European (CEE) regions.

2.1. Guideline Development

The main steps to develop the guideline are presented in Figure 3.

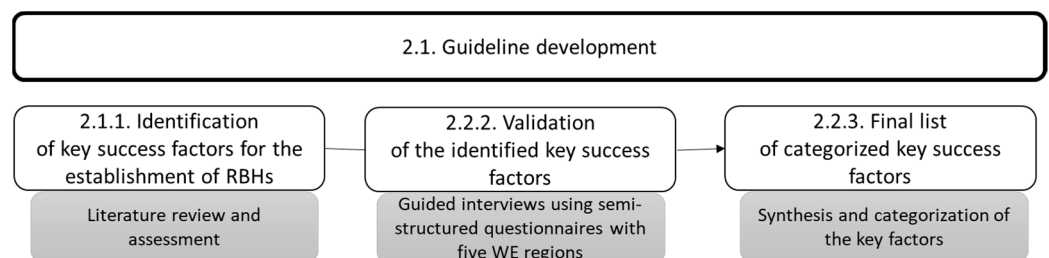


Figure 3. Steps to the guideline development for regional bioeconomy hubs and strategies.

At first, the definition of the Regional Bioeconomy Hubs (RBHs) was set as a dynamic system of diverse interconnected stakeholders (such as innovative start-ups, small, medium, and large enterprises, research and knowledge dissemination organizations, nonprofit organizations, public administration, and other institutions) that cooperate closely in order to develop a particular bioeconomy field. The RBH acts as a focal point for the stakeholders, promoting horizontal links (sectoral) and/or vertical links (value chain), improving communications, knowledge transfer, sharing experiences, and disseminating information, which in turn stimulate innovative activities and a better response to external effects and expectations. RBHs are characterized by a sustainable and flexible structure to implement commonly agreed objectives, preferably politically supported. The RBHs have as their main goal to foster a rich participatory approach to the co-creation of regional bioeconomy visions, cooperation, and support in the development of regional bioeconomy strategies and roadmaps.

2.1.1. Identification of Key Success Factors for the Establishment of RBHs—Literature Review and Assessment

Based on the definition and goals set for the RBHs, the literature review was focused on two themes: (i) identification and involvement of stakeholders in regional and national bioeconomies [24,28,43–45] and (ii) cooperation in social structures and existing platforms engaging stakeholders, such as open cooperative networks, and (bioeconomy) clusters [26,43–56]. The revision of EU case studies from national and regional contexts was used to identify practical approaches of bioeconomy networks (hubs and clusters) in related areas such as the (bio)chemical industry and agriculture. Available documentation on EU projects was also revised in relation to multi-actor approaches, the involvement of key stakeholders in bioeconomy activities, and their engagement in strategy development. From the literature review, an initial list of key factors relevant to the development of multi-actor networks was identified as a base for the guideline and further discussion with regional partners (results are presented in Section 4).

2.1.2. Validation of Identified Key Factors—Guided Interviews with Five Western European Regions

Guided interviews were designed and carried out with five Western European (WE) regions—Central Germany, Flanders, SPRING Cluster (representing 11 Italian regions), Andalucía, and Bavaria to validate the literature review findings and gain tacit knowledge of key factors. The selected WE regions have a research and enforcement trajectory in the bioeconomy and practical experience in the development of bioeconomy hubs or clusters and are frontrunners in the development of regional bioeconomy strategies. The guided interviews were a methodological approach to collecting knowledge about the creation, organization, and management of these stakeholder platforms, the lessons learned, barriers encountered, and recommendations from interviewees' own experiences. The semi-structured questionnaire used for these interviews is presented in File SA (Supplementary Material). Besides the questionnaires, interviews were conducted via telephone and teleconferencing with representatives from WE regions to learn about their experience and influence in the regional bioeconomy.

2.1.3. Final List of Key Success Factors—Synthesis and Categorization

Recommendations and knowledge collected through the previous two steps and a final list of success factors for the creation and management of bioeconomy hubs/clusters were synthesized and consolidated. Furthermore, the factors were categorized into six groups: hub definition and organization, involved groups of stakeholders, hub management, activities services and benefits, financial support, and external factors. The results were summarized into a step-by-step process with recommended actions, suggestions for responsible stakeholders, potential tools to aid the process, and examples in each step. A first version of the guideline was developed and focused on the set-up of the hubs (Chapter 1 in the guideline) and sent to all CEE regions for their application and feedback. Each other consecutive chapter of the guideline, namely stakeholder involvement (Chapter 2), development of a common regional bioeconomy vision (Chapter 3), and finally strategy and roadmap development (Chapter 4), followed the same process. The last chapter of the guideline (Chapter 4) linked the utilization of several other resources prepared within the project (e.g., analysis of policies supporting the bioeconomy in the EU [13] and a compendium of financial instruments, among others). The table of contents of the guideline is included in File SB (Supplementary Material).

2.2. Guideline Application

The guideline was applied by the following five CEE regions: Nitra (Slovakia), South Bohemia (Czech Republic), Mazovia (Poland), Southern Great Plain (Hungary), and Lviv (Ukraine). The summary of the application process with all recommendation steps is shown in Figure 4 and is detailed in the following sections.

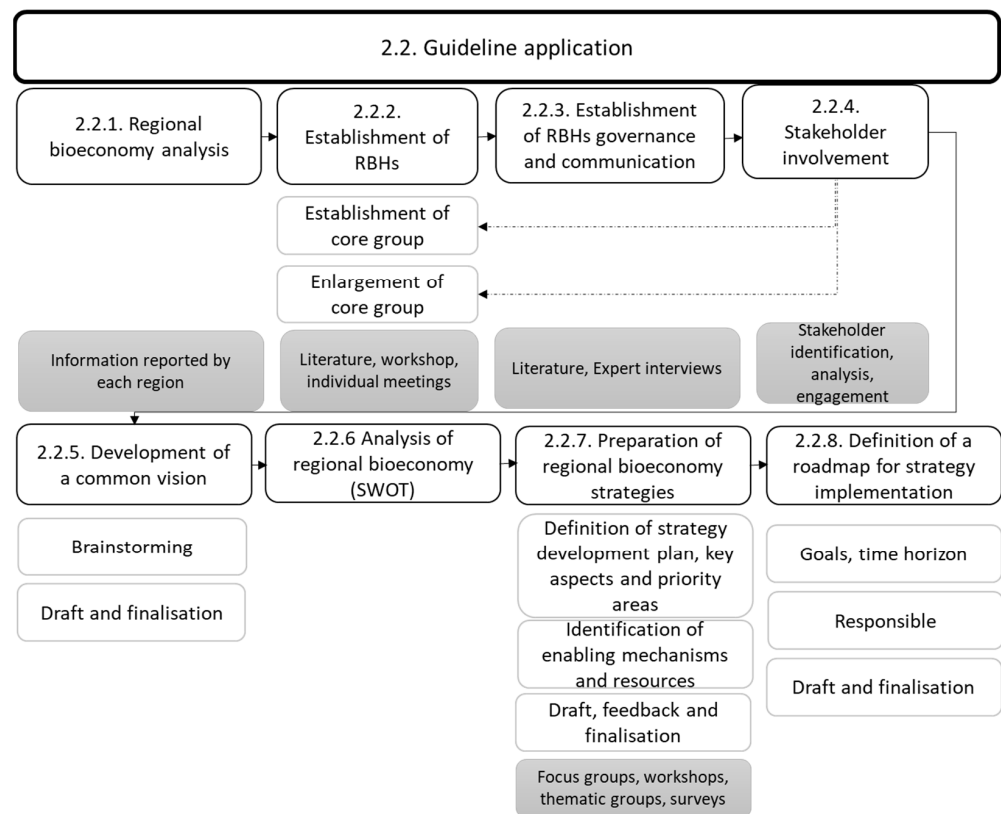


Figure 4. Methodological steps for the regional bioeconomy guideline application.

2.2.1. Regional Bioeconomy Analysis

First, the status of the regional bioeconomy of all five selected CEE regions was investigated. The following aspects were identified: the existence (or lack) of a widely understood definition of bioeconomy in the region and the existence of bioeconomy-related policies and regulatory instruments, as well as information on possible official working groups dedicated to bioeconomy issues. This informed shared knowledge about the status quo of the regions, as can be found in Section 3.2.1. This initial analysis was carried out by the regional representatives of each region, both CEE and WE regions, using a template for the collection of key information on the regional status quo that was developed within the project. The information was delivered by all regions at the beginning of 2019, including their references to consulted sources.

Finally, a workshop directed toward the identification of major challenges for the RBHs and proposals for their solution was carried out between regional representatives and other experts participating in the consortium. This provided a collective take on the major challenges faced at the regional level to reach strong stakeholder cooperation and brainstorming of potential solutions.

2.2.2. Establishment of RBHs

In order to consolidate an initial idea about the development of the regional bioeconomy and bring together a few committed stakeholders to sustain this process, the first recommended step in the guideline was the creation of a core group. This group shall aim at gathering highly engaged stakeholders to lead and sustain the initiative of a regional bioeconomy strategy. It should at least include representatives of policy, industry, and academic institutions as depicted in Figure 5, based on the triple-helix approach [57].

After the establishment of the core group, the guideline suggests that the RBH should be enlarged to use a multiplication effect by engaging stakeholders within their group of action (as seen in Figure 6). In this step, a gradual involvement of new interested stakeholders in the RBH shall be conducted. First, a workshop or individual meetings are

used to share the current status of the bioeconomy in the region and the initial concept for the set-up of the RBH. Then, the core group and the new integrated members can jointly start refining this concept and mapping together the key bioeconomy sectors in the regions and their relevance for regional activities and potential development. Furthermore, the stakeholders should be extended to citizens (represented by civil society organizations (CSOs)) and other representing institutions, resulting in a quadruple-helix approach. The multiplication effect constitutes a method of securing joint efforts from all core group members in identifying and engaging other key stakeholders.

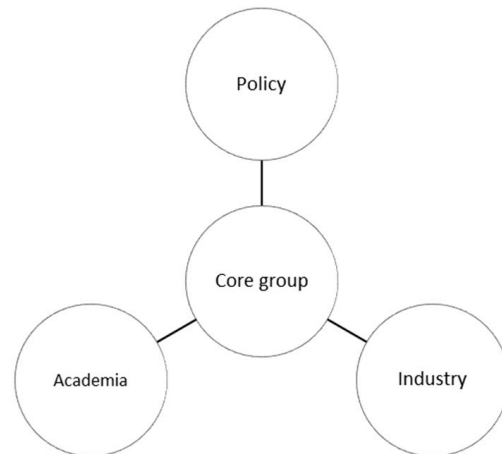


Figure 5. Recommended initial set-up for RBH's core group.

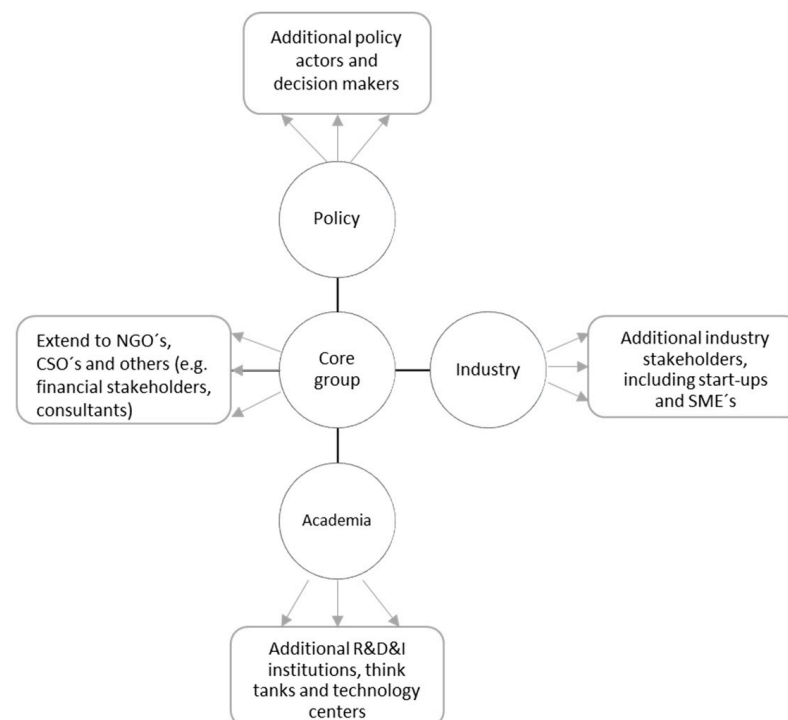


Figure 6. From RBH's core group to the extended stakeholders' group.

2.2.3. Definition of RBH's Governance

The main goal of this step is to define the governance and communication structure of the RBHs, the responsibilities, and information formats and flows. Two main bodies, namely a management team and an advisory board, should be established and a spokesperson selected. For later stages—such as the identification and development of key priority areas

in the bioeconomy strategy or the development of concrete projects—the definition of working groups was recommended.

2.2.4. Stakeholder Involvement—Identification, Analysis, and Engagement

This section of the guideline provides indications on the methods of identification, analysis, and engagement of stakeholders. It provides tools in a systematic manner considering the local conditions of relevant value chains. Finally, recommendations are provided for stakeholder engagement, which is understood as a transversal and iterative process through the strategy and roadmap development and implementation.

2.2.5. Development of a Common Vision

One chapter in the guideline has been dedicated to the development of a common vision at the regional level and marks the beginning of the strategy development. It highlights the essential aspects to consider while developing a regional bioeconomy vision that is shared among the regional stakeholders and backed up by decision makers (policy institutions). The guideline provides a definition of a vision and its key characteristics and recommendations for its preparation steps. It includes examples of well-defined visions and a guide to prepare and carry out a visioning workshop with an RBH's engaged stakeholders.

Preparation Steps Prior to the Workshop—Base Information

For the development of a vision, first of all, the RBHs should select the actors to invite to this discussion. Representatives of the previously identified bioeconomy sectors and potential enablers should be included. In the best case, all stakeholders to be invited will already be involved within the RBH. The preparation includes also a pre-analysis of the changing dynamics, e.g., political, economic, technological, and environmental factors that may affect the future development of the regional bioeconomy. This pre-analysis can be conducted among core group members using the tools suggested in the guideline.

Desired Futures—Brainstorming in the Visioning Workshop

During the visioning workshop, participants should be involved in complementing the pre-analysis and in the thematic of potential developments of the regional bioeconomy. Then, participants are invited to brainstorm possible developments of how their regional bioeconomy could look in the medium term, which can be conducted in groups and using a set of triggering questions.

Draft a Common Vision—Identifying Common Desired Futures

Within a workshop with stakeholders, objectives and ideas for the future of the region are collected in a brainstorming section, then summarized. This is followed by a “reality check”, examining the summarized results in terms of their implementation potential, possible conflicts, and trade-offs, in the form of group discussions. Next, participants use the results of group discussions to propose a phrasing of the regional bioeconomy vision. This sentence should denote—recommended in the present tense—an aspired future state of the regional bioeconomy. Finally, the RBH core group with its advisory board refines the vision and sends it to all for final approval.

2.2.6. Regional Bioeconomy Analysis—Strengths, Weaknesses, Opportunities, and Threats (SWOT)

The SWOT analysis of the potential of regional bioeconomy was carried out utilizing the Self-Assessment Test (SAT) tool of the European Commission (DG GROWTH), known as ESCSS-SAT (The ESCSS-SAT is currently not accessible on the DG Growth tools databases. For future references, the tool was consulted and utilized online here: https://single-market-economy.ec.europa.eu/tools-databases_en, accessed on 20 January 2020). It is referenced and recommended as an essential step to support the following sections in the guideline. The ESCSS-SAT focuses on sustainable chemical processes, and it assesses the

investment readiness in regions, utilizing two questionnaires: one focusing on the available biomass and the second one on waste. The regional representatives were responsible for filling out these questionnaires, in strong cooperation with other regional institutions due to the diversity of topics and information required. After submitting the questionnaire, the tool delivers a predetermined set of recommendations for each region and a spider graphic showing the marking of the region from 1 to 10 in each one of the main factors evaluated, in relation to the media from ten other random European regions that have responded voluntarily to the questionnaire. The spider diagram serves as a reference to indicate improvement potential in the regions. Based on the automatic results of the tool and other information delivered by RBHs in previous stages, the SWOT analysis was carried out for each one of the factors evaluated.

2.2.7. Preparation of Regional Bioeconomy Strategy Document

Having a commonly agreed vision and an analysis (SWOT) of the region is the basis to begin the development of the regional bioeconomy strategy. This process utilizes key information about the status of the regional bioeconomy and its potential, collected among RBH participants, as well as other resources recommended in the guideline, which have been made available to the regions (see the Bioeconomy Strategy Accelerator Toolkit (BSAT) from POWER4BIO project (The Bioeconomy Strategy Accelerator Toolkit (BSAT) is now being managed by the BIOEAST initiative. However, it is currently not accessible). It was recommended to carry out the strategy development process following a rich participatory process led by the RBHs, which at this state represents a quadruple-helix approach. The specificities of stakeholder engagement are particular to the region, the analysis and characterization of their stakeholders, and the involvement plan devised according to the strategy and roadmap definition (according to Section 2.2.4).

This final section of the guideline (Chapter 4) provides specific steps and examples from other EU regions to define a regional bioeconomy strategy based on the shared common bioeconomy vision (see recommended methodological steps in Figure 7). The strategies should consider the main regional assets and needs, encompassing growth opportunities in a sustainable manner and building on the cooperation and support of all key regional players. On the other hand, while the strategies respond to the valorization of local resources and generation of local opportunities for the regional economy, they also encompass major drivers of essential importance at the regional level; for instance, food and nutrition security, climate change and the transition towards sustainability, independence from fossil resources, rural development, new skills and employment, and social inclusion, among others.

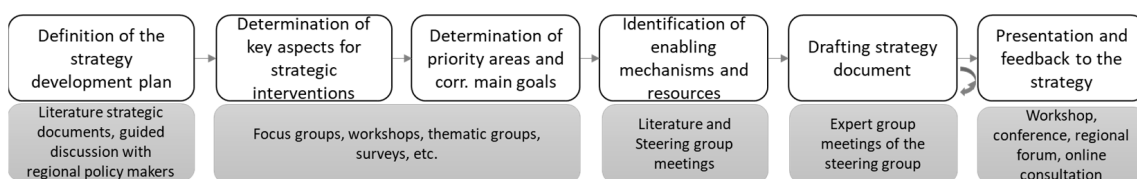


Figure 7. Methodological steps recommended for regional bioeconomy strategy development.

Definition of the Strategy Development Plan

The first recommended step is planning the roles and timespan for the strategy development, together with RBHs and policy decision makers. Above all, it is recommended to create a group to coordinate the preparation of the strategy (steering group), including RBH participants, i.e., the advisory group and policy makers from the regional administration. This group would manage the process to define the priority areas, objectives, and mechanisms to apply, based on a participatory process that involves key stakeholders from diverse sectors of interest, as well as the feedback process, assuring the strategy. This joint planning ensures policy support for the bottom-up RBH initiatives.

Determination of Key Aspects for Strategic Interventions

The key aspects that require strategic actions shall be determined based on the results of the regional analysis, learnings from the RBH establishment process, visioning workshop, and the SWOT analysis.

Determination of Priority Areas and Their Corresponding Main Goals

The main areas of priority and corresponding objectives are to be defined in a participative process, in the form of workshops or thematic working group meetings. These priority areas constitute the conceptual pillars of the strategy document.

Identification of Available Enabling Mechanisms and Resources

It is recommended to identify the mechanisms and resources available to the region in order to enable the strategic areas and their corresponding main objectives. This might include indispensable policy coordination, vital policy instruments, and available financial resources.

Drafting Strategy Document

Considering all the above aspects, the participants of the steering group should structure and draft the strategy document. It is recommended in the guideline to include an inter-institutional technical team and to consider all results derived from the participatory process and previous regional analysis for the draft.

Presentation and Feedback to the Strategy

The drafted strategy document should be made available for consultation with the regional institutions/administration involved in its development. After including the received feedback from the consultation process, the strategy is ready to be presented, disseminated, and enforced.

2.2.8. Definition of a Roadmap for the Strategy Implementation

Derivation of Specific Goals within Priority Areas and Corresponding Specific Actions

Following the agreed strategic priority areas and considering the necessary steps to be taken in order to reach the commonly defined regional bioeconomy vision, specific objectives and supporting specific actions should be drafted. This should take into consideration the available regional or regionally applicable (national) mechanisms in place and resources available, as identified during the strategy development (see Section 2.2.7).

Establishment of a Time Horizon and Modes of Monitoring for Each of the Planned Actions

For each planned action, a time horizon for its implementation should be defined. The steering group should define which actions should be implemented in the short, medium, or long term and what each of these time frames means in terms of years for the region. This will provide a clear distribution in terms of time and priority for each defined action.

Identification of Responsible Institutions for Implementation and Monitoring

It is essential to identify the responsible institutions for implementation and follow-up. Since bioeconomy issues require inter-institutional cooperation in the region, rounds of discussions between the steering group and regional government bodies should be held to agree on the potential implementing entities.

Drafting Roadmap Document, Presentation, and Feedback

The drafted roadmap document, being a complementary section of the strategy, should be equally made available for consultation with all institutions involved in its development, as well as collecting and considering the feedback from the stakeholders involved. After including the received feedback from the consultation process, the roadmap is ready to be presented, disseminated, and enforced.

2.3. Guideline Monitoring

In addition, the application of the guideline was monitored and evaluated, using periodic teleconferences with the regional representatives to assess its applicability and opportunities for improvement, based on the following questions: What was applicable from the guideline? What is missing? What could be improved? All sessions were protocolled for later revision and changes included in the guideline were decided appropriately.

3. Results

3.1. Guideline Development

Key Success Factors for the Creation of Hubs

The regional bioeconomy strategy guideline was built on the premise of supporting regional and bottom-up approaches, building from a concept of a sustainable bioeconomy and taking into consideration the strategic bioeconomy paths of each region. It is directed to facilitators of the strategy development process, which in several cases might be represented by a regional policy institution or an interdepartmental working group while in other cases might be the representatives of industrial associations or R & D institutions. In this context, priority was given to the creation of platforms for integration and cooperation between stakeholders in the region (i.e., RBHs). This is considered the basis for the subsequent phases in the development of the strategy. The results of the literature review (see Section 2.1.1) and validation with experts allowed a selection of success factors in the creation of these multi-actor platforms. The literature review yielded initially 46 factors related to the management of clusters, their tasks, links to be established among stakeholders, aspects related to their creation, as well as other external aspects contributing to their success. These factors were then organized into categories according to the similarity of their topics and avoiding repetition; some of the initial factors were merged. After the validation, the final list of success factors is found in Table 1.

Special emphasis was given to the following success factors, which were highlighted by all interviewed actors and furthermore reaffirmed by the CEE regions during the application process:

- Financial support, particularly during the establishment and first years of the RBH, to ensure the strong workload that is required when building a functional organizational structure, together with raising awareness and attracting the key actors that should be involved. EU projects and other public funding are some of the most important sources. For the particular case of clusters, membership fees were mentioned as one of the most important financing sources.
- Key motivated players and the hub manager. The existence of a facilitator(s) was described as crucial, but most importantly their ability to gather other actors. Additionally, the importance of the group that generates a first alliance in the RBH was highlighted, since those are the institutions and individuals that will set everything in motion.
- Involvement of relevant and diverse stakeholders, which is mainly represented by the triple-helix approach and preferably the quadruple-helix approach.
- Institutional capacities represented in available instruments and policies that allow the activities related to the bioeconomy, policy coherence, regulations, and intellectual property rights and that promote interactions, such as the public–private partnerships, which have been found to be a good practice to introduce important bioeconomy innovations and novel business models.

The structure of the guideline was then defined in four chapters. The list of success factors was used mainly for the first two chapters, which support the set-up of hubs and the integration of regional bioeconomy stakeholders. The final version follows the structure presented in File SB (Supplementary Material).

Table 1. Success factors for establishment of Regional Bioeconomy Hubs (RBH).

Category	Success Factors for RBH Establishment
Hub definition and organization	<ul style="list-style-type: none"> Well-defined Hub, incl. target group, needs, resources, and services. Common vision. Clear organizational structure (executive body, advisory board, and working groups). Structured organization of work: working groups and other definitions of responsibilities.
Involved stakeholders	<ul style="list-style-type: none"> Involvement of relevant stakeholders from a quadruple-helix context, creating close cooperation among them. Active and motivated members. Social capital: existent between actors invited to join or should be promoted as a precondition for the hub success.
Management	<ul style="list-style-type: none"> The qualities and skills of the person acting as manager of the hub. Clearly defined role and plan of the manager. Understanding the existing dynamics and relationships, teamwork. Assess the quality and further develop the linkages, especially amongst the different types of members. Promote awareness about the hub initiative.
Activities, services, benefits	<ul style="list-style-type: none"> Services and activities provided for the members and target groups. Support for stakeholders to identify and develop bioeconomy initiatives in the region. Serving as an interface between members and other institutions. Create links with other clusters inside and outside the region. Brand building: strengthen the attraction of investment, venture capital, and skilled workers.
Financial support/resources	<ul style="list-style-type: none"> Public financial support and regulations (eventually membership fees). Initial resources of the region.
External factors-regional ecosystem	<ul style="list-style-type: none"> Demand/Market conditions—demand for offered products and services—sophistication level of consumers. Existing economic environment. Institutional capacities (e.g., strong institutional presence; quality of infrastructure; existence of effective product and labor market regulations; property rights; industrial disputes; high levels of interaction among regional stakeholders; and local industrial embeddedness). Agile entrepreneurial community—highly educated workforce, access to university research, existence of start-up programs, good quality of life, and the free flow of information.

The received comments of each of the regions during the monitoring of applications were taken into account to refine the content and presentation of the guideline. The result is a flexible process with essential steps highlighted, and a specific selection of methods to be applied at each step, according to the needs and preferences of each user. The guide also includes best practices and examples of stakeholder involvement and co-creation of strategies. Hereafter are the results of the guideline application in each one of the CEE regions during 2019.

3.2. Guideline Application by CEE Regions

3.2.1. Regional Bioeconomy Analysis

In this section, a short description of the five CEE regions is provided with respect to their initial situation prior to the application of the guideline (2018–2019).

The Lviv region is one of Ukraine's most wooded regions, with forests covering 31.8 percent of its land area, making the forest sector one of the main pillars of the Lviv bioeconomy. As a result, the agricultural sector takes up 57.89% of the total area of 21,833 km². Lviv Region has a total population of 2,512,084 inhabitants and a gross domestic product (GDP) of EUR 7188 million [58]. According to the reports, timber (148.4 million m³), forestry waste (160.3 thousand m³), wood residues (50.4 thousand m³), post-consumer woods (123.8 thousand tons), straw (474.5 thousand tons or 169.3 thousand tons in oil equivalent) are among the regional biomasses available [59].

Mazovia region has a total area of 35,558 km² and had a population of 5,403,412 inhabitants in 2018. With a total GDP of EUR 111,183.83 million, the region holds a strong bioeconomy potential in its agriculture activities and agriculture residues [60]. The agricultural

sector accounts for 67.8% of regional land, while the forest sector contributes only 23.67%. Resources and residues from agricultural and forest activities, waste water treatment and sludge, municipal waste (biological fractions), and energy crops are the primary biomass resources considered by the region for the development of their bioeconomy, municipal waste accounting for the majority of the biomass which is 1,776,953.12 tons [60].

Nitra is a predominantly rural region with 339 rural municipalities (95.8%) and Slovakia's lowest regional urbanization rate (45.6%), with a GDP of EUR 10,009.4 million. It has a population of 676,672 inhabitants and covers an area of 6343.94 km². This region only has 15.3% forest area, and its economy is based mostly on two pillars: high agricultural production of wheat, rye, and vegetables, with a 73.2% agricultural area, and the presence of an automotive sector [61]. The majority of biomass in Slovakia's bioeconomy originates from municipal waste (314,739 tons), followed by crop residues (1237.28 tons), and agricultural crops (1108.27 tons) [62].

The South Bohemia region is one of the most forested regions in the Czech Republic, with forests covering 37.69% [63] and agriculture accounting for 41.36% [64] of regional land use. The overall population of the South Bohemian region is the lowest of the five areas, at 638,782. It also has a smaller total area than the other regions, at only 10,058 km² [65]. The regional GDP is EUR 9395 million (4.9% of national GDP) [66]. South Bohemia has a lot of potential for regional bioeconomy growth due to existing agricultural activities, agriculture biogas stations, forest residues, and unused municipal waste (bio-fractions). The technical potential of energy biomass in the South Bohemian region is mainly from dendromass, wood waste from the processing industry, straw (cereal and rapeseed), plant-based pellets (from various by-products/residual agricultural products), energy crops (deliberately grown crops) and bio-waste, which is a total of approximately 14–16 PJ/year [67].

With its total area of 18,339 km² [68], the Southern Great Plain region is the largest among the NUTS2 level statistical regions in Hungary, representing almost one-fifth of the country's total area. Southern Great Plain is the 3rd largest region regarding the population, which is 1.23 million inhabitants [69], and accounts for approximately 12% of the total population of Hungary. With a GDP of EUR 13,377 million (2019) [70], the region's share of the national GDP is 9%. The Southern Great Plain region is characterized mainly by agricultural landscapes and rural areas, with a strong focus on agriculture within industrial activities. Much of the total area is suitable for agricultural utilization, and 85% of its farming land is used for field crop production. In total, 12% [71] of the Hungarian forests are located in the Southern Great Plain. Since agriculture and forestry have a significant role in the economy of the region, utilization of agricultural residual biomass and forestry by-products is a key potential. Agricultural wastes and by-products (e.g., straw from cereals, sunflower, rapeseed; by-products of grape and wine production or industrial crops such as oil seeds and sugar beet; lignocellulosic biomass such as cuttings of wood, logs, woodchips, sawdust, bark, etc.) and their utilization into high-value-added bio-based products are essential for the Hungarian national bioeconomy as well. Approximately 600–800 thousand tonnes of agricultural and food industrial waste is produced in Hungary per year, approximately half of which is treated by material recovery. More than 92% of agricultural and food industrial waste is utilized by material or energy recovery, providing a good starting point for further developments in the bioeconomy [72].

A summary of the five regions' initial bioeconomy status is presented in Table 2, including the bioeconomy-related potential and the bioeconomy definition in the countries.

Table 2. Central and Eastern European (CEE) regions—Initial bioeconomy status (2018).

Region	Bioeconomy Potential	Bioeconomy Definition	Related Strategies
Lviv	Forest and wood sector Agro-food sector	No explicitly defined for the region. Understood as defined in the EU bioeconomy strategy (2018).	Action National Plan in reference to Renewable Energy for the period up to 2020 [73] Energy Strategy of Ukraine for the period up to 2035 “Safety, Energy Efficiency, Competitiveness” [74] Strategy of the Lviv region’s development for the period up to 2020 [75]
Mazovia	Agriculture and forestry industry Sustainable energy sector Chemical industry Waste management	Not a common definition adopted in the region.	Development Strategy of Mazowieckie Voivodeship 2030 [76] Rural Development Programme for 2014–2020 [77] and Waste Management Plan of the Mazowieckie Voivodeship [78].
Nitra	Agro-food and feed Agricultural and forest residues Energy crops Municipal waste (separation, composting)	The areas related to bioeconomy have been outlined by the Ministry of Agriculture and Rural Development of the SR and include agriculture, forestry, fisheries, food and feed production, renewable energy, the chemistry sector, and biotechnology.	RIS3 strategy (Slovakia)—domain Healthy food and healthy environment [79] National Action Plan for Energy from Renewable Energy Sources. Rural Development Programme of the SR (2014–2020) [80] Programme of Economic and Social Development of the Nitra region (2016–2022) [81] Long-term Regional Research Strategy Regional energy concept for the use of agricultural and forestry biomass (Nitra)
South Bohemia	Forest residues Feedstock from forest-based industries, Agricultural residues Bioenergy (Biogas) Biotechnology	Not a common definition adopted in the region.	National Action Plan for Renewable Energy [82] National Action Plan for Biomass [83] State Energy Concept of the Czech Republic [84] Concept of Sustainable Development (Sustainable Development) [85] Regional Appendix to National Research and Innovation Strategy (RIS3) [86] Development program of the South Bohemian Region 2014–2020 [87]
Southern Great Plain	Agriculture residues Forest residues Energy crops Industry by-products	Not a common definition adopted in the region.	Hungarian Renewable Energy Utilization Action Plan 2010–2020 [88] National Sustainable Development Strategy National Forestry Strategy Research and Innovation Strategy for Smart Specialization (2014–2020) for Southern Great Plain

3.2.2. Establishment of RBHs

Establishment of Core Group

For the definition of the core groups, two different processes were applied: relying on an existing structure (Mazovia, Nitra, and Lviv) and starting with a new structure (South Bohemia and Southern Great Plain).

The Forest Sector Council (FSC), founded in 2016, was the base structure used in Lviv for the RBH's core group. The FSC, created by the Lviv State Regional Administration and the Ukrainian National Forestry University includes the engagement of regional forest enterprises, local government representatives, and academia. A working group was initially created to coordinate the engagement of actors from the FSC as well as the food and agriculture sectors (external to the council).

The Mazovia region based the creation of its core group on the Mazovian Energy Efficiency Cluster, founded in 2011 by the Mazovian Energy Agency, a leading regional representative for the RBH establishment process. A founding group was created among cluster members while inviting other external bioeconomy experts in the region having an interest in taking part in the RBH and the subsequent development of a regional strategy.

Likewise, in the Nitra region, an initial core group was built upon the previously established Bioeconomy Cluster founded in 2015, with the participation of business stakeholders in the fields of agriculture and food processing, R & D actors, academia, regional and local governments as well as civil society.

The RBH in the region of South Bohemia was established completely anew, led by the University of South Bohemia. The bioeconomy as a topic was new to several actors in the region; however, a good understanding of all potentially contributing sectors to the regional bioeconomy and its possibilities for regional development was lacking. The creation of the core team took place through an initial stakeholder mapping and approaching potentially interested actors individually to explain the idea of the RBH. These individual talks were followed by the organization of a meeting and a survey prior to the meeting, applied to all invited experts, in order to identify areas of interest for the regional bioeconomy (e.g., key bioeconomy sectors, identification of bioeconomy concept) and willingness to cooperate with the RBH.

Although there were pre-existing stakeholder networks related to the bioeconomy in Southern Great Plain, the creation of a bioeconomy cluster as a cooperation platform had already been initialized before the POWER4BIO project, and it was decided to represent the RBH for this region. Utilizing a top-down approach, cooperation was reached first between the Ministry of Agriculture, the Hungarian Chamber of Agriculture, and Bay Zoltan Nonprofit Ltd., the regional representative in the project. Two workshops were organized to establish the aims and vision of the cluster, and also the Ministry of Innovation and Technology joined these events.

Enlarging the Core Group through Stakeholder Identification, Analysis, and Engagement

Core groups in the regions carried out diverse engagement activities to grow their RBHs, involving regional as well as national stakeholders that would later be crucial for strategy development. These engagement activities extended to stakeholders identified for their expertise, engagement in value chains of the most important regional sectors, or for their influence in enabling the strategy development and implementation process.

The core group in Lviv acted first on opening the spectrum of stakeholders to be engaged apart from those already represented by the FSC. Although the forest sector is of great importance for the economy in the region, from an initial stakeholder meeting (December 2018), the agriculture and the food sectors were identified as further relevant sectors. The identification and mobilization activities included national and local authorities, academia (universities specialized in forestry and agriculture), experts on project development and statistics, as well as civil society representatives and stakeholders from three main business sectors (industrial associations), namely forest, agriculture, and food industries, and a regional agency for sustainable development. Telephone calls, face-to-face meetings,

as well as the publication of a newsletter, were used as part of the engagement strategy to enlarge the core group and establish the RBH. A total of 44 stakeholders initialized the Lviv RBH in May 2019.

In Mazovia, the founding group conducted individual meetings with representatives of different sectors to mobilize interested stakeholders, such as research institutions, public administration, entrepreneurs, and civil society representatives. The initialization of the RBH in Mazovia took place with 16 stakeholders including policy makers, representatives of national, local, and sectoral agencies, research centers, universities and technology institutes, industry associations, and foundations representing agriculture and civil society. As part of internal coordination, the policy and industry representatives were mainly engaged in the core group of the hub, and the academia and research stakeholders mainly took part in the advisory group and as supporters of thematic working groups.

The Nitra region extended its core group, placing a focus on crosscutting and cross-sectoral cooperation between areas such as energy, waste and environment, information and communications technology (ICT), plastic industry, and engineering. The existing bioeconomy cluster had begun to mobilize towards the national level (during 2019), starting with the newly established “Platform for bioeconomy in Slovakia”, endorsed by the Ministry of Agriculture and the guiding aims of the BIOEAST Initiative to enlarge the activities, knowledge base, and collaborations that the cluster might facilitate, with actors outside of the Nitra region. Therefore, the RBH in Nitra was based upon the experience and networks of the Bioeconomy Cluster to boost the regional bioeconomy and facilitate activities with other relevant regional players such as the Nitra Regional Administration and representatives of the agriculture and food sectors as well as from the BIOEAST initiative. Due to the efforts towards the development of the National Bioeconomy in Slovakia by the time that Nitra’s RBH was being established, stakeholders of relevance for the national bioeconomy were also included, among them a group of “industry indirect partners” for the synergies between national and regional levels. This integration of cross-regional/national stakeholders in Nitra’s RBH responded also to the challenges of finding all supportive actors of Nitra’s relevant bioeconomy sectors, given the small size of the region and its interdependency with other regions.

South Bohemia utilized its initial mapping of stakeholders, complemented with the snow-balling technique [89], and conducted two meetings (March and June 2019) to consolidate the expansion of the core group and initialize the RBH. During the first meeting, stakeholders were familiarized with the topic and their willingness to cooperate in the regional bioeconomy development was explored. In the second meeting, the level of involvement and the governance structure components were discussed. The South Bohemian RBH was started with a core group including 10 members mostly from academic and entrepreneurial environments and about 25 non-core members. Several institutions of the agriculture, biogas, and innovation sectors did sign letters of Commitment for the RBH.

In Southern Great Plain, the engagement of stakeholders was established based on the networks of the representative partners of the region, which included public authorities and private sector institutions mainly. For the further engagement of stakeholders, two workshops were organized (March and April 2019) in which bioeconomy developments, the establishment of the RBH, its main aims, and the overall vision were discussed.

The composition of the RBHs by the end of 2019 is presented in Figure 8.

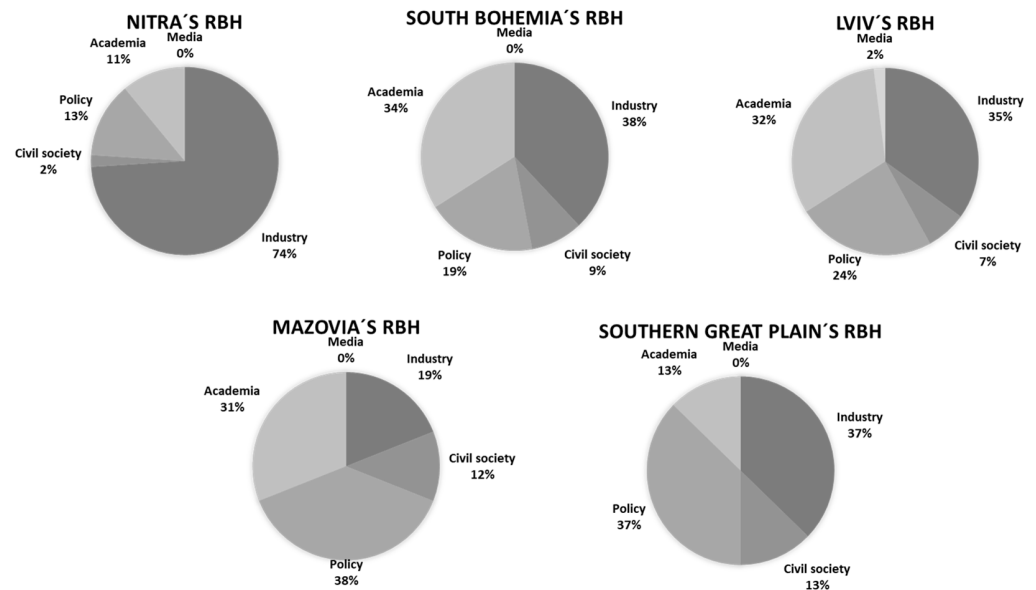


Figure 8. Stakeholder composition of RBHs in the five CEE regions (2019) (Own illustration).

3.2.3. RBH Governance and Communication

For the organization and coordination of the RBHs' activities, a governance structure was recommended to all the regions. This included well-defined responsibilities and communication protocols.

In Lviv, the organizational structure of the FSC was maintained to facilitate coordination, and the level of engagement of stakeholders among the established working groups was organized. In Mazovia, the RBH's organizational structure consisted of a management team as the main coordination body, an expert advisory board, and four working groups related to the key areas of interest, namely agricultural raw materials and their processing, forest raw materials and their processing, bio-waste and its treatment, and regional development. The Nitra region benefited from having the structure already in place from the Bioeconomy Cluster and existing communication protocols. In South Bohemia, after discussing among engaged stakeholders the desired degree of involvement, as well as organizational and content aspects of the hub, a core group with 10 members took the responsibility of organizing meetings and main communications. The core group members represented the following institutions: the cluster association of the "DanuBioValNet" project, the Institute of Circular Economy, the Technological Centre of the Academy of Sciences of the Czech Republic, and the Foundation of Bioeconomy Platform for the Czech Republic. Finally, no detailed information on the governance of the Southern Great Plain RBH is documented.

3.2.4. Stakeholder Involvement

The engagement of stakeholders continued as a transversal process during all the following steps, particularly during the visioning workshops and the development of the regional bioeconomy strategies and roadmaps. It was recommended to involve within the RBHs those actors identified as having high influence and/or influence. These could be identified, characterized, and engaged through the suggested methods in the guideline. However, joining the RBH did not generate exclusivity of participation. The RBH intended to be the central network for the participatory activities surrounding the strategy development while being open to additional participants and experts.

In Lviv, the forest sector was strongly involved in the definition of a vision and strategy development. This included the cluster for the woodworking industry, individual representatives of wood companies (e.g., wood furniture and packaging), as well as administrative institutions such as the regional forest department. In addition, regional administrations

took part in the process, such as representatives from the Lviv state administration, from the Department for Sustainable Development, Agricultural Production, Infrastructure, and Land Relations, and from the Commission of Ecology and Natural Resources. Experts from research and academia supported the expertise in regional resources (e.g., agriculture and food) and innovation.

The Mazovia region, as previously mentioned, had a strong involvement of regional governmental institutions and regional agencies, which was maintained for the visioning and strategy development. The regional government (provincial level) represented the areas of waste management, agriculture, and land development, as well as transversal topics, such as regional planning. The regional agencies included represented the attainment of green gas house emissions reduction and biomass producers as well as the energetic transition in the region. Finally, some municipalities interested in the process took part as well, bringing the topic of bioeconomy and strategic development to the local level. Other stakeholders outside of the government structures were the National Research Institute on Biological and Technical Development and companies related to waste management.

The Nitra region reached out from the beginning of its stakeholder engagement process towards regional and national levels. In the visioning workshop and strategy development process, Nitra included the participation of several experts on agriculture and food resources, maintaining as a focus the prioritization of land utilization for the production of food for human consumption. Among those experts, the Ministry for Agriculture and Rural Development, as well as two main research centers at the national level focused on agriculture and food, stand out. Industry played a big role in the process also, with representatives from national industrial clusters, among them the national bioeconomy cluster. Finally, representatives of the regional administration, business consultants, and a research center on agrobiotech also participated actively.

In South Bohemia, a varied pool of experts was summoned for the visioning workshop and strategy development. Representatives of academia with a focus on forest resources; experts on regional resources such as hemp and hay; industries and regional institutions dealing with waste sources and their valorization (e.g., landscape wastes, waste management), heating plants, the biogas association, and technical expertise in algal biotechnologies. Likewise, representatives of the regional administration and regional supporting institutions working on innovation, technology transfer, and innovative enterprise (RIS3) were part of the process. A clear need appeared for having an official body covering the RBH activities at the regional level—the members of the RBH decided to establish the South Bohemian Association for Bioeconomy (JSBE) in 2020. This Association serves as a part of the regional RIS3 Strategy as a Regional Innovation Platform for Bioeconomy and Circular Economy.

Finally, in Southern Great Plain, stakeholders involved in the visioning process were mainly from the national administration. Among them are the main founders of the RBH, the Hungarian Ministry of Agriculture, the Chamber of Agriculture, the Ministry for Innovation and Technology, and Bay Zoltan Nonprofit Ltd. (a research center). Other participants represented regional development interests, however, from a top-level perspective, such as the European Committee of the Regions (CoR) and the European Network for Rural Development. Two companies involved in innovative agriculture activities, the valorization of agriculture residues, and one more research center attended this visioning process. The strategy development process did not include a participatory process, since the regional strategy could not be prepared. More information can be found in Section 3.2.7.

3.2.5. Visions of the RBHs and Bioeconomy Regions

In the Lviv region, the visioning workshop served to discuss the potential bioeconomy areas for the region as well as the current challenges in their development and ways to tackle these challenges, utilizing a situational analysis. The stakeholders reaffirmed the importance of the three main sectors for the regional bioeconomy, with the forest sector being the leading one, followed by the agricultural sector and the food industry. Currently,

these sectors are embedded in a linear type of economy and several bottlenecks hinder their redirection to circular and sustainable resource use. In particular, poor environmental awareness results in the underestimation of primary and secondary (waste and by-products) raw material values for the regional economy. Additionally, as the circular economy implies a shift in business as usual, it puts the spotlight on the lack of knowledge, technology, and financial tools to reinvent the economy as well as the shortage of highly qualified employees for newly arising economic activities. In light of this discussion, the stakeholders of the visioning workshop prioritized human capital development together with policy support mechanisms for innovation in order to foster Lviv's regional bioeconomy. Finally, as for the specific support needs, the participants would expect the project to provide them with examples of funding mechanisms for the RBH and guidance regarding applicable funding tools for regional initiatives within the Bioeconomy Strategy. The vision was formulated as follows in the visioning workshop in Lviv:

“Competitiveness strengthening for the bioeconomy in the Lviv region”

A SWOT analysis was used during the visioning workshop in the Mazovia region, combined with the driver-mapping tool recommended in the guideline in order to explore the dynamics of change that might influence the development of the bioeconomy in the region. Recognized strengths include the availability of biomass and waste resources, combined with highly skilled personnel in those areas. The increasing energy demand, social interest in climate protection, and growing demand for bio-based products are some of the most representative opportunities for bioeconomy development. Attention was given to the identified weaknesses, such as the lack of organizational structure of the bioeconomy sector, limited implementation of flagship initiatives, and the lack of an incentive system. It was concluded in the group that Mazovia had a strategic position for the development of its regional bioeconomy. Finally, the visioning workshop also served for the analysis of the most pressing challenges of the regional bioeconomy. Waste management was one of the central themes of the workshops and was defined as the focus of the regional bioeconomy. Thus, the priority areas of the bioeconomy in Mazovia were defined as the utilization of waste from plants, animal production, and food processing, as well as wood residues, municipal waste (bio-fractions), and sewage sludge. Additionally, new value chains from agricultural biomass were discussed. The development of the bioeconomy in these areas “aims at increasing the competitiveness of the economy through the management of by-products and waste from production, as well as maximizing the value added from the biomass unit”. To this end, two factors were defined as crucial: first, a state-of-the-art analysis of the existing environmental, economic, and social capacities of the bioeconomy and, second, the screening of the relevant regional, national, and EU legislation. It was also defined as equally relevant to identify potential gaps that could hinder the strategy development. The Mazovia regional bioeconomy vision has been defined with the following statements:

“Mazovia will become a region:

- *with a significant share of the use of biomass in the development of a circular economy,*
- *developing in accordance with the principles of sustainable development,*
- *in which innovative bioeconomy technologies and associated industries will be developed, enabling the bioeconomy's efficiency to be increased,*
- *economically competitive, with an environmentally conscious society”.*

During the workshop in the Nitra region, the participants discussed the drivers of the regional bioeconomy, utilizing the driver-mapping tool recommended in the guideline, according to their importance (high, medium, and low) and level of impact (high, medium, and low). The drivers resulting in high importance and a high impact for Nitra's bioeconomy activities are the National Agricultural Strategy, sufficient investment in research, an interdisciplinary approach to raw material management, and changes in customers' behavior. Drivers with lower importance and high impact are biochar and tax policy. Finally, the

automotive industry, bio-textiles, social agriculture, and education are considered drivers with lower importance and lower impact. Regarding the specific needs, the participants mentioned cross-visits between partner regions as well as assistance with improving the formal structure of the RBH Nitra and defining the financing mechanisms for the hub. The formulated vision for Nitra is:

“The RBH Nitra in cooperation with BIOEAST and Bioeconomy Cluster will:

- *Stimulate the creation of appropriate conditions (of the whole regional ecosystem) for the development of bioeconomy in Nitra region,*
- *Offer access to actual knowledge, information and best practices from different parts of the EU,*
- *Circulate the best practices, which are utilizable in the Nitra region”.*
- *“Nitra-the Region with a Flavor of Bioeconomy”.*

During the visioning workshop in South Bohemia, the participants discussed the gaps in the socio-economic cycle relevant to the bioeconomy strategy and analyzed the potential of the regional bioeconomy by means of a SWOT analysis within focus groups (groups of interest: forestry, agriculture, wastes, non-traditional sources) and a brief evaluation of cluster potential. It was highlighted that the bioeconomy exceeds the regional level and requires state support. The region faces a non-existent market for bioeconomy products. One of the reasons, apart from underdeveloped markets and lack of information about bioeconomy as such, is the existing subsidies for fossil-based products. In addition, the instability of legislation also influences the development of the bioeconomy. Addressing the gaps can be achieved through regulations, education, production processes, and a circular economy approach. Thus, regarding regulations, the participants proposed the cancellation of direct and indirect subsidies for fossil energy sources at the national level, the introduction of the mandatory returnable packaging ordinance, and an increase in quality standards for products (e.g., food, cosmetics) as well as the natural environment (water, air). Yet, the regulation should go hand-in-hand with enforcement mechanisms (e.g., sanctions) for non-compliers. The educational perspective includes the introduction of the bioeconomy as a school subject in the framework of environmental and economic education in secondary schools and universities (social sciences, biology, and ecology) and the establishment of a regional consultancy body for bioeconomy activities. Technological innovation is another key factor to bring improvements in production processes while assuring competitiveness and marketable products. As the focus of the regional bioeconomy is placed on closing the cycle, the participants also discussed waste and end-of-life management as part of the regional strategy. Finally, the specific support for South Bohemian RBH was the visit of experts from more advanced bioeconomy regions to their workshops. In such cases, the foreign experts shared their experience in developing the RBH, attracting stakeholders and preparing conditions for bioeconomy development. The preliminary version of the regional bioeconomy vision in South Bohemia has been defined with the following statements:

“Closing of the ecological cycle containing water, soil and climate at landscape scale. An effort to build value chains on traditional resources and branches and link them with a new high-value added-sustainable technology. Emphasis on the linkages of value chains of all branches of regional bioeconomy-agriculture, forestry, waste management and non-traditional sources”.

The visioning workshop in Southern Great Plain drew attention to priority actions. The participants agreed on the need for a comprehensive and understandable definition of bioeconomy that would serve as a baseline for stakeholders' involvement. Another required action to foster participants' engagement in RBH is the gathering and demonstration of the already existing bioeconomy-related good practices across various sectors in both Hungary and Europe. For this reason, the RBH should provide relevant training and educational visits, which would correspond to the interests and requests of sector-specific stakeholder groups. Informative sessions and newsletters with sector-specific messages were also

regarded as a tool for forging the RBH network and providing a common understanding of the opportunities, benefits, and challenges in the regional bioeconomy. The need for synergies was another topic brought up to the table during the workshop. The participants referred both to the synergies between experts, for example, the cooperation with the Hungarian Chamber of Agriculture, and those related to existing policies. Thus, the elaboration of the regional bioeconomy strategy should be developed in synergy with other relevant regional and national documents. Additionally, the workshop participants came up with the innovative idea to create and put at the disposal of all RBH stakeholders a joint expert database that could enhance knowledge transfer and cooperation. The regional bioeconomy vision in Southern Great Plain has been defined with the following statements:

“to become a national leader in the regional bioeconomy development in Hungary by elaborating the regional bioeconomy strategy and through a collaborative approach between the most important relevant parties”.

3.2.6. Regional Bioeconomy Analysis—SWOT

The SWOT analysis focused on the following eight key factors (KF), with an individual SWOT analysis per factor for each CEE region.

- KF1. Availability and use of resources
- KF2. Infrastructure and industrial factors
- KF3. Research and innovation
- KF4. Market/Economic aspects
- KF5. Transition towards bioeconomy
- KF6. Public and institutional support/Governance/Policy frameworks
- KF7. Funding
- KF8. Social and environmental aspects

This approach allowed for detailed consideration of each factor at the regional level, utilized for the identification of focal points—areas of action—during the strategy development. A summary of the findings can be found in File SC (Supplementary Material).

3.2.7. Regional Bioeconomy Strategies

Utilizing the methodology provided in Chapter 4 of the guideline, CEE regions prepared their regional bioeconomy strategies. Collected knowledge from the literature review, experience, and tacit knowledge from WE regions regarding their bioeconomy strategy development allowed for step-by-step recommendations. In this section, a summary of the bioeconomy strategies in each region is presented. For a comprehensive description, please consult the POWER4BIO report on five new bioeconomy strategies in the CEE regions [90].

In general, the development of the bioeconomy strategy in the Lviv region is the Smart Specialization Strategy and goes hand-in-hand with the development of the Lviv Regional Strategy for 2021–2027, elaborated in December 2020. The Lviv Regional Strategy acts as an umbrella for various regional programs. In the Lviv region, the strategy development process was led by Lviv Regional State Administration and the Ukrainian National Forestry University as coordinators of the Lviv RBH. Other contributing institutions/stakeholders to the final regional bioeconomy strategy and roadmap were the Forest Sector Council, the Lviv Regional Forestry Administration, the Agency for Sustainable Development “FORZA” (NGO), and the “Bioeconomy Cluster” Association. The elaborated bioeconomy strategy has significant importance for the Lviv region of Ukraine since based on this strategy it was agreed to admit the strategic theme of bioeconomy as a Smart Specialization of the Lviv region. It is expected to be fully elaborated in the future.

The region of Mazovia holds great potential for the development of its bioeconomy, especially for the development of rural areas, strengthening local specializations, and diversifying economic activity. Agricultural and forest residues and resources, wastewater treatment and sludge, municipal waste, and energy crops are the main biomass resources considered by the region for the development of its bioeconomy. They are enhancing

the connection and symbiosis of the chemical and waste management industries with agriculture. The strategy development of the Mazovia was led by the Mazovia Energy Agency (MAE) together with the Mazowieckie Voivodeship regional administration and with the participation of the RBH and stakeholders. The MAE directly developed the strategy. The established guidelines allowed a focus on the most important aspects when developing a bioeconomy strategy and gathering a well-selected group of experts as an advisory group. The importance of the document is significant, as it sets future directions for the development of the bioeconomy in Mazovia. It identifies the greatest potential to be used and indicates priority areas.

The proposed framework for the development of the bioeconomy in the Nitra Region focuses on the possibilities for increasing the efficiency of agriculture and the development of food production in the Slovak Republic to significantly reduce its dependence on imports. The vision, objectives, and strategic actions for the bioeconomy in the Nitra region were included in the Strategy Paper of the Programme of Economic Development and Social Development (PHRSR) of the Nitra Self-Governing Region (NSK) until 2030. This process was led by the Slovak University of Agriculture (SUA) and supported by representatives of the Nitra Self-governing Region. The SUA is an official partner of the regional government regarding the preparation of development plans. Another supporting entity was the National Bioeconomy cluster. The strategy document is considered to be very important because the defined priorities are implemented into concrete calls for individual projects, which are going to be financed from the regional budget.

The region of South Bohemia holds great potential for the development of a regional bioeconomy mainly based on existing agricultural activities, agriculture biogas stations, biotechnology valorization of agriculture and forest residues, and unused municipal waste (bio-fractions). The Development Program of the South Bohemian Region 2014–2020 and 2021–2027, considers key the further development of facilities to process biologically degradable materials and the further development of biotechnological research. In October 2019, the RBH in South Bohemia held a meeting with its engaged stakeholders to discuss the opportunities for bioeconomy strategy, as well as the legislative status of the RBH itself. (The RBH was changed to South Bohemian Association for Bioeconomy (JSBE), established in 2020, which has legal status. The legal status is important for the RBH in order to participate in tenders and projects). The core group and the RBH members (South Bohemian Association for Bioeconomy) agreed to continue working on the regional bioeconomy strategy, which is currently at the visioning stage. In addition, the region of South Bohemia indicated that a stand-alone strategy would not be possible during the development of this project. However, in South Bohemia, efforts have been directed toward including the bioeconomy within other regional strategies, such as the regional innovation strategy and other national strategic plans, as the National Agriculture strategy. The possibility to have an influence on regional strategic documents was enabled thanks to the new function of the South Bohemian Association for Bioeconomy, which serves as a Regional Innovation Platform for Bioeconomy and Circular Economy in the regional RIS3 Strategy. The strategy has relevance in terms of presenting key priorities and opportunities lying in bio-based developments.

The idea of bioeconomy strategy development for the Southern Great Plain arose in 2016 as a result of the cooperation between the Ministry of Agriculture of Hungary and the Hungarian Chamber of Agriculture in the BIOEAST initiative. However, only the national bioeconomy strategy is under development, and no regional strategies are planned. In particular, the region of Southern Great Plain communicated not having the possibility of setting up the strategy at a regional level, given that in Hungary strategies can be generated at the national and county level only. As for the regional level, in the absence of a regional bioeconomy strategy, Bay Zoltan Nonprofit Ltd. as the Hungarian partner in the POWER4BIO project had a recommendatory role and generated recommendations for a bioeconomy strategy with a regional focus, included in a material entitled “Bioeconomy in Southern Great Plain region, Hungary – Regional strategy recommendation”.

This document was delivered to the organizers of the national strategy development for consideration as a summary of the regional potential and strengths.

3.2.8. Roadmaps

Of the five CEE regions, Mazovia and Lviv concluded their roadmap creation with the finalization of the POWER4BIO project (March 2021). The Nitra region was close to finalizing the process, and the South Bohemia region continued to strengthen the RBH structure and raise awareness of the importance of a regional bioeconomy strategy, and at the end of the project was in the visioning phase. The regions analyzed the financial and policy mechanisms available to implement the strategic objectives of the strategy and planned their roadmaps accordingly. For a comprehensive description of the roadmaps developed, please refer to the POWER4BIO report on implementation plans [91].

The Lviv region defined within its strategy the following components as focus areas: (1) resource support for the bioeconomy; (2) waste management; (3) competitiveness; (4) public–private partnerships; (5) cooperation; (6) knowledge and education, and (7) knowledge dissemination. For each of these components, an implementation time frame and responsible institutions in charge were defined, as well as detailed actions to implement.

Mazovia directed actions in its roadmap towards technologies and value chains with potential for the region, such as the production of sugar from lignocellulosic biomass (hydrolysis), bioconversion of organic side-streams by the black soldier fly, lipid and protein for feed, mushroom production on coffee grounds, renewable hydrogen via thermolysis of biomass, bio-coal production via hydrothermal carbonization (HTC) of sewage sludge, and production of 1,4-butanediol (1,4-BDO) from sugar by fermentation. These were framed within the main strategic goals defined in the strategy, with specific planned actions per goal and a timeframe for their development. The consultation on the roadmap took place at the end of 2020.

Key priorities of the strategy in Nitra and on which the roadmap concentrates are as follows: (1) innovative, sustainable, and competitive economy; (2) sustainable regional agri-food complex and in particular the processing and distribution chain; (3) environment, ecosystem services, and green infrastructure; (4) smart energy, transport, and technical infrastructure, while reinforcing debt recovery in those areas. The implementation of roadmap actions is grounded on cross-sectoral measures and the interconnection between towns and municipalities in the region.

As previously explained, Southern Great Plain did not generate a strategy and roadmap but a recommendation document to the national government, in order to highlight the key priorities and goals of the region and suggest potential activities for their realization. Key areas pointed up in the recommendation for the development of bioeconomy in the region are (1) knowledge sharing and transfer, (2) development and innovation, and (3) rural development. Actions recommended paired the key findings in the SWOT analysis, starting by enlarging the base of knowledge (e.g., detailed knowledge of the availability of resources and existing practices), related to supportive institutions and accompanying actions to strengthen innovation, such as supporting cluster activities, networking, awareness raising, and innovation. The recommendation also included the linking of the bioeconomy to other agendas and programs of relevance, such as the R & D & I framework.

4. Revisiting the Hubs

After finalizing the project, we revisited all established CEE RBHs and asked them to give a review of the current state of the hubs. The RBHs updated information on the current thematic focus and their stakeholder composition, as well as the key opportunities and challenges they were currently experiencing. A summary of the updated status is described in Table 3.

Table 3. Updated status of the Hubs.

Region	Engagement Activities	Thematic Focus	Stakeholder Composition	Further Issues
Lviv	<ul style="list-style-type: none"> Organization of the promotional events Dissemination of knowledge about bioeconomy Supporting the relocation from the occupied Ukrainian territory for the enterprises of the forest sector 	<p>More focus on the bioenergy issues compared to material use because of the problems with availability of the fossil fuel resources from the Russian Federation. The use of wooden and agricultural waste for energetic use is in focus. The Hub is active in discussing the current issues and influencing them through support and encouragement of private investment.</p>	<ul style="list-style-type: none"> Number of institutes: 23 Number of members: 42 <p>Member list: NGO "Association of Woodworkers and Loggers of the Lviv region" Association "Cluster "Woodworking industry" LLC "Kimak" LLC «Markom» LLC «Vitmar» LLC "Firm "Modus" LLC "Firm "Modus" LLC "Ukrprofpatlet" LLC «EIMO;» PE "Lviv-PAK" FF "Savka" Farmhouse "Romalin" LLC "Graphen" LLC"Graphen" Lviv Regional Forestry Administration NGO "Forza" Lviv Regional State Administration The Main Department of Statistics in the Lviv region Ukrainian National Forestry University Lviv National Agrarian University Ukrainian Academy of Sciences University "Lviv Polytechnic" Newspaper "Woodworker"</p>	<ul style="list-style-type: none"> Key opportunities: Bioenergy development because of the high cost of natural gas from Russia; Circular economy development and waste management development with the aim of saving forest resources and resource efficiency enhancement. Key challenges: There are some obstacles in the Lviv regional Hub that are related to the Russian-Ukrainian war. The main obstacle is limited funding (since the main part of it should cover military issues) Further: Lviv region Hub development in the direction of the Smart Specialization as an important part of the EU strategy

Table 3. Cont.

Region	Engagement Activities	Thematic Focus	Stakeholder Composition	Further Issues
Mazovia	<ul style="list-style-type: none"> Obtaining a grant for the development of RBH Organization of promotional events Dissemination of knowledge about the development of bioeconomy 	<p>Agriculture: Rational use of agricultural production space and maintenance of the production potential of soils and waters; Production of raw materials with the desired quantitative and qualitative parameters expected by consumers and industry; Limiting or eliminating threats to the natural environment and concern for the preservation of biodiversity; Improving the quality and availability of consultancy services and activities for integration and transformation in the agri-processing sector, as well as the effectiveness of the use of funds from the Common Agricultural Policy or the European Regional Development Fund.</p> <p>Waste management: Municipal waste, including food waste and other biodegradable waste; Post-consumer waste; Sewage sludge</p> <p>Sustainable energy: reduction in the negative impact of the economy on the natural environment, social progress, and economic growth.</p>	<ul style="list-style-type: none"> Number of institutes: 15 Number of members: 20 Member list: <p>Institute of Rural Development and Agriculture, Department of Waste Management, Emission and Integrated Permits of the Marshal's Office of the Mazowieckie Voivodeship Department of Agriculture and Rural Development of the Marshal's Office of the Mazowieckie Voivodeship EIT Food Poland Foundation for biosequestration Foundation for the Development of Polish Agriculture Institute of Technology and Life Sciences, Warsaw KEZO Research Center PAN Mazovia Energy Agency Mazovian Office for Regional Planning, Siedlce Branch POLBIOM Polish Chamber of Biomass Public Utility Company in Płońsk Sp. z o.o. Commune Office Liw Engineering Department of the University of Technology and Economics</p>	<ul style="list-style-type: none"> Key opportunities: Mazovia focuses on deepening the network of contacts of institutions operating in the field of bioeconomy and creating joint initiatives Key challenges: increasing the quality of life; preventing food waste; reducing the mass of mixed municipal waste in favor of the mass of waste collected selectively; reducing the mass of waste sent for storage; increasing the mass of recovered secondary raw materials from municipal waste and waste obtained in the recycling process; construction of new biogas plants; construction and expansion of a composting plant for green waste and other bio-waste. Ultimately ensuring the production of a product with fertilizing properties or plant conditioners from green waste and other bio-waste; introducing the principles of the circular economy. Supporting the development of the ecological industry and eco-innovation; further development of energy production from renewable sources; ensuring permanent and sustainable development and preserving the high values of the environment; development of an ecologically aware society. Further: Open access for the general public.

Table 3. Cont.

Region	Engagement Activities	Thematic Focus	Stakeholder Composition	Further Issues
Nitra	<ul style="list-style-type: none"> Establishing the Innovation Platform for Bioeconomy within the SUA Creative Centre Approved project submitted in December 2019 within the Integrated Regional Operational Programme (Priority axis: Mobilization of creative potential in regions). Establishing The Virtual Bioeconomy Library. 	Support green and sustainable entrepreneurship in sectors of the creative industry (design, architecture, and marketing) via programs and events of the business incubator and accelerator. Virtual Library provides interesting articles, information, project outputs, and materials on various topics in the field of bioeconomy.	<ul style="list-style-type: none"> Number of institutes: 5 Number of members: 35 Member list: <p>Slovak University of Agriculture in Nitra (including EIT Food Hub) The Nitra Self-governing Region The Bioeconomy cluster-31 members (https://bioeconomy.sk/en/membership/members/, accessed on 6 November 2020) The National Agriculture and Food Centre, the Slovak Business Agency (regional center)</p> <ul style="list-style-type: none"> Further: 34 participants in calls and projects (SMEs, start-ups) <p>Young and starting entrepreneurs, existing entrepreneurs in creative industry sectors, university graduates, and persons with entrepreneurial intentions from the Nitra region.</p>	<ul style="list-style-type: none"> Key opportunities: continuing in strengthening cooperation among BEC, SUA, and other stakeholders Key challenges: interconnection and sharing sources with the Innovation platform for BE within the Creative Centre and offering complex information about projects, training, and other activities in the field of BE; establishing living labs and demo-sites; establishing seed and proof-of-concept funding mechanisms at the regional level Further: We are closely cooperating with the Platform for Bioeconomy of the Czech Republic and BIOEAST HUB CZ. In December 2022, the Slovak University of Agriculture in Nitra signed the MoU about joining the Network of Bioeconomy Universities in the BIOEAST macro-region BIOEAST UniNet. <p>Small, but very successful and interesting initiative (innovation vouchers) led by the Bioeconomy cluster in cooperation with the SUA in Nitra and the Regional business center of the Slovak Business Agency. The innovation vouchers scheme was promoted to representatives of regional government as a best practice example.</p>
South Bohemia	<ul style="list-style-type: none"> Regular meetings of the (JSBE) twice a year. Annual Bioeconomy Course at the University of South Bohemia. Cooperation with the Bioeconomy Platform of the Czech Republic. 	<ul style="list-style-type: none"> Networking Education Fundraising Removal of administrative, legislative, and economic barriers 	<ul style="list-style-type: none"> Number of institutes: 13 Number of members: 24 Member list: <p>Faculty of Economics University of South Bohemia The National Cluster Association (NCA) Technology Transfer Office - Biology Centre of Czech Academy of Sciences Member of the Czech House of Representatives independent expert" Calla—Association for the Preservation of the Environment CzechGlobe—Global Change Research Institute of the Czech Academy of Sciences</p>	<ul style="list-style-type: none"> Key opportunities: deepening of networking and cooperation in the framework of existing members. Focusing on cooperation at the national level (e.g., Bioeconomy Platform of the Czech Republic). commenting on the South Bohemian Region's RIS3 strategy. Key challenges: In accordance with the results of the POWER4BIO project, continue to identify, change and possibly remove legislative, financial, and bureaucratic barriers Further: participation in other research and application projects, participation in the development of a national bioeconomy strategy, and creation of a national bioeconomy hub. <p>Registration of the legal form of the RBH as South Bohemian Association for Bioeconomy. Support for the bioeconomy is still very cautious both at the regional and national level</p>

Table 3. Cont.

Region	Engagement Activities	Thematic Focus	Stakeholder Composition	Further Issues
Southern Great Plain	<ul style="list-style-type: none"> Helping SMEs to be involved in funding programs (both nationally and EU financed) for bioeconomy-related projects Informing the members of the Hungarian Bioeconomy Cluster as well as the experts' network about bioeconomy-related events and knowledge transfer opportunities Involving different stakeholders in the development processes of bioeconomy-related strategies, for example, the development of the National Circular Economy Strategy in 2022, supported under the Structural Reform Support Programme (SRSP) 	<ul style="list-style-type: none"> Bio-based fertilizers, soil conditioners, and plant biostimulants that can reduce chemical outputs in farming practices and ensure nutrient recycling from bio-based wastes Utilization of sewage sludge to substitute inorganic fertilizers Composts to improve soil fertility and enhance soil biodiversity, boosting regional composting initiatives and activities Novel supplementary feeds: microalgae, insects as a protein source, extraction of high added value protein from by-products Small-scale biorefineries are essential in the regional bioeconomy, especially in rural areas Innovative bioenergy solutions, with special regard to small-scale local energetic utilization of bio-based by-products and wastes Separate collection of bio-based wastes Horizontal activities, such as business development support and awareness raising. 	<ul style="list-style-type: none"> Number of members: 9 members in the Hungarian Bioeconomy Cluster Member list: Agrogeo Ltd, Arundo Bioenergy Ltd, Bay Zoltan Nonprofit Ltd, BSF Systems Ltd, Jozsef Galamb Agricultural Vocational School, Lavina Foundation, Pilze Nagy Ltd, Research Centre for Natural Sciences, University of Pannonia Further: <p>The farmers' associations have to get a more prominent role in bioeconomy developments; SMEs, research organizations in the field of agriculture, and vocational education institutions remain the most important in stakeholder networks; The Ministry of Agriculture is the main stakeholder in policy matters since the Ministry of Technology and Industry was dissolved in November 2022.</p>	<ul style="list-style-type: none"> Key opportunities: great potential in biomass from agriculture and food industry (Hungary's value added in the agricultural sector is outperforming the rest of the EU: value added in the agricultural sector as a percent of GDP is twice as high as in the EU.) Key challenges: the most important challenge remains the same as it was in 2018— lack of supporting policy background, including the lack of a national bioeconomy strategy and no governmental body designated to be responsible for bioeconomy developments; low labor productivity of the Hungarian agri-food sector in the European context

The Hungarian Bioeconomy Cluster that represents the RBH for the Southern Great Plain region supports its members in getting funded by national and EU funds—there are several ongoing R & D projects in the field of bioeconomy, implemented with the participation of cluster members (e.g., WATERAGRI, MarginUp!).

To continue the valuable work started in the POWER4BIO project for CEE regional bioeconomy development, Bay Zoltan Nonprofit Ltd. is closely cooperating with the Hungarian Ministry of Agriculture and other country representatives of the BIOEAST initiative in the Interreg Central project BIOECO-UP, involving also members of the Hungarian Bioeconomy Cluster. Since biomass valorization and the importance of rural development cooperation for the development of national bioeconomies are greatly emphasized in the recently adopted Common Agricultural Policies (CAPs), the timing of the BIOECO-UP project is perfect to support the alignment of CEE countries' own bioeconomy measures and bio-based value chains with their CAPs implemented in the period 2023–2027.

5. Discussion

The establishment of the RBHs in the five CEE partner regions has revealed the core aspects of the process. While regional and contextual differences play an important role, it is still possible to identify common dynamics when it comes to the mobilization and engagement of stakeholders. Moreover, it allowed us to summarize key challenges faced by the regions to implement multi-actor platforms that will strengthen the bioeconomy in their regions.

To begin with, the concept of the bioeconomy and how it is understood in rural contexts, or even the fact that as a concept it had to be first defined in the region, was one of the first findings in the creation of the RBHs. Additionally, identifying how to begin discussing the concept of "bioeconomy" with different stakeholder groups is essential [92]. For instance, it is radically different to build a bioeconomy concept with the region's political actors than with farmers' associations. The experiences gathered among all 10 regions participating in the research indicate that the dissemination of bioeconomy initiatives and good practices in the regions at the European level helps regional stakeholders to grasp the meaning of bioeconomy. It is only after this step of understanding and interpretation that regional actors undertake the task of defining the bioeconomy for their own region: What does the bioeconomy look like now and what should it look like? What are the sectors that present great potential, and which is the desired direction?

For this purpose, the RBHs play a central role in supporting the understanding of the bioeconomy as a concept and the creation of a shared vision for the regional bioeconomy. In the processes experimented with the CEE regions, the time constraints imposed by the project timelines only allowed for one visioning workshop. However, the construction of this vision at the regional level involves several exchanges for its refinement and consolidation, to first identify the information that is available on the status of the bioeconomy in the region, to integrate the interests of various stakeholders, and to clear the vision of conflicting and non-compatible interests. These exchanges among bioeconomy stakeholders in the RBHs support also the understanding of specific characteristics and established structures among isolated disciplines or sectors, allowing for the discovery of potential integration or collaborations. Understanding the way in which other sectors work, their necessities, and potential synergies deepens the understanding of the regional bioeconomy [93,94].

While the need to connect regional stakeholders interested in the various areas of the bioeconomy was latent in all regions, and those stakeholders involved could appreciate the benefits of the creation of the RBHs, the motivation to participate and engage is sometimes difficult to instill. During the set-up of RBHs and also during later stages, the motivation of stakeholders was found to be the key to achieving an active stakeholder platform. In some regions, the low interest of some political actors and the limited understanding of the (direct or indirect) benefits of the bioeconomy to the different stakeholder groups challenged the formation and engagement of the RBHs. Some regions reported on the shortage of specialized human resourcing supporting the strategy process. Information on the status

quo of the regional bioeconomy is key to enabling the identification of areas of interest and possible benefits of the stakeholders. The status quo includes not only information on relevant sectors of the bioeconomy and value chains but also on various scattered initiatives. These initiatives should not only include economic activities but also research projects, existing clusters, and linkages between actors as well as citizen and education initiatives [95]. All of this should be the responsibility of the RBH management team, together with the RBH stakeholders. Good examples to start a discussion about the status quo and future goals are the Smart Specialization Strategies and regional development programs, with already identified priorities in the region.

In addition to motivating stakeholders, it is important to facilitate their participation [96]. We argued in Section 1 for the benefit of using existing networks as a base for the RBHs. However, it is crucial that these base networks do not decide alone from the outset on the development of the RBHs with a sectoral preference, but rather that they leverage an organic development of the platform. They should allow this new RBH to connect other networks and to represent the diversity of active sectors in the region and nascent initiatives. In this way, the RBH becomes the connection point of several regional networks, clusters, and actors (that are currently not connected). This even allows established networks to meet other stakeholders (companies, NGOs, research groups, entrepreneurs, etc.) that were not previously identified.

Although these RBHs serve to strengthen links between actors, their coordination role must be defined on a case-by-case basis. Some RBHs' main roles might lie in the dissemination of information and linking initiatives, while others may be actively involved in project development, or even provide advisory services regarding available financing options or joint development of projects. This should be directly connected to the way in which each RBH is founded, the team that integrates it, the resources it has to carry out these possible functions, and finally the agreements reached with all the members of the hub. The current status of engagement activities is presented in Table 3.

Besides linking key stakeholders in an RBH, it is recommended that they promote exchange among hub participants for specific purposes, e.g., for the preparation of new projects/living labs/creation of new support institutions in the region or taking an active role in knowledge dissemination. Hubs are a node for different disciplines, promoting knowledge and transdisciplinary exchange and connecting regional actors also with cross-regional initiatives (with surrounding regions) and other macro-regional ones (e.g., BIOEAST). Thus, the RBH can contribute to the development of innovative environments in the region. This, in turn, depends on the structural components of the region that facilitate these environments, such as the existence of universities, technology parks, active industrial development, demonstration facilities, financial support options, and plans and programs for bioeconomy advancement. The experiences with all of the CEE regions showed that although the process of RBH creation takes time, the steps of the guideline were valuable in supporting each of the stages for this creation. Furthermore, it is recommended to plan in future activities to accompany the regions for a longer term, including the implementation of the strategy and monitoring the robustness, success, and challenges of the implementation. On the other hand, with active support and contribution, the exchange among them could be fostered, which would be fruitful for mutual learning and collaboration.

6. Conclusions

The role of stakeholders in the bioeconomy, specifically in the development of strategic issues, was discussed in the Introduction. It is important to identify and involve all relevant stakeholders of the regional bioeconomy, to engage them, and through their active participation throughout the whole process develop regional bioeconomy strategies. We, therefore, developed a guideline for the creation of such multi-level Hubs, considering the quadruple-helix concept, and for the creation of regional bioeconomy strategies. The developed guideline was continuously and immediately tested, validated, and improved together with the five CEE regions in the POWER4BIO project, and resulted in a flexible

guideline with real examples. It was invaluable to include engaged regional representatives with an explicit interest in developing their regional bioeconomy and in establishing regional bioeconomy hubs as platforms for stakeholder participation. All representatives played a key role in providing information about their regions and facilitating the analysis and mobilization of their stakeholders for the implementation of the guideline and the creation of the RBHs.

Common between all regions was the adaptability of the guideline to their specific regional cases. Each CEE region found different sections helpful and applicable to the specific stage in which they were situated at the moment of application. For some of them, the outline of workshops to raise initial awareness of their regional bioeconomy and to motivate active support for the creation of the RBH was useful. For others, it was helpful to identify missing or disaggregated information in the region.

During the feedback, it was noted how each region was looking for specific advice for their strategic bioeconomy areas or strong value chains. However, the guideline was purposely built as a scheme that could be applied independently of the particular conditions of the region. The outlined steps and methods to implement each step are given in the form of recommendations, highlighting the importance of the results in each step instead of the methods used.

The feedback from regional representatives led us to include a multitude of tools that can be used in each of the defined steps and to indicate when, how, and by whom they should be used. This makes it possible for any region with an interest in exploring the development of a regional bioeconomy (or regional initiative) to make use of this guideline, which proposes some basic steps for the creation of an RBH and presents examples of how other regions set up their own platforms (hubs, clusters). We not only noted the importance of showing examples of organizational, financial, and governance aspects of the hub, but also thematic examples of regional bioeconomy initiatives that can be inspirational for those using the guideline. Although, the latter examples should be updated in future versions, given the fast development of the bioeconomy at the regional level and active dissemination efforts at the EU level. Finally, the guideline also provides methods for implementing each of the steps, including for example detailed instructions for organizing a first approach with actors interested in the bioeconomy and for assessing the complementary nature of different stakeholders that may be invited to the RBH. Other methods included help to facilitate the identification of the status quo of the region with instructions for use in the case of a regional bioeconomy and with a multi-actor approach. These include a SWOT analysis, surveys with integrated RBH stakeholders, driver maps, and the problem tree method. While the guide was developed with the intention of establishing RBHs that would exclusively support the development of regional bioeconomy strategies, it also contains examples and methods that can be used even in initiatives that are not aimed at strategy development. In this case, the recommendation is to clearly define the goals and areas of action of the RBH, thus, giving clarity to the actors who would like to join the hub. The guideline can be applied in the future to other regions at different stages in terms of bioeconomy hubs and strategies. The significance of the strategies is high in all CEE regions, as presented in Section 3.2.7. The regional strategies and strategy recommendations can support the establishment of the strategic theme of the bioeconomy at the regional level, sets future directions for the development of the bioeconomy, identifies the greatest potential to be used, indicates priority areas, and presents opportunities lying in bio-based developments.

Finally, the importance of platforms that integrate actors interested in the bioeconomy was noted. As well as giving leadership to these actors to build spaces that allow them to first discuss the complexity of the bioeconomy as a concept, as an economic activity, and the interrelationships that it generates between regional ecosystems, policy and regional programs, economic sectors, and activities already established in the various disciplines that are expressed in the region. Above all, we emphasize the importance of giving the baton to the regional actors, allowing them to decide on their own hub and how they want

to strengthen their regional framework (economic, digital, environmental, for innovation) that supports the bioeconomy from their region.

Supplementary Materials: The following supporting information can be downloaded at: <https://www.mdpi.com/article/10.3390/su15086967/s1>, File SA: Semi-structured interviews' questionnaire; File SB: Table of content of the guideline "Regional Bioeconomy Hubs for regional bioeconomy strategies"; File SC: Results of the SWOT analysis in CEE regions.

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