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Governance Strategies for Sustainable Circular Bioeconomy Development in Europe: Insights and Typologies

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Abstract: This study examines governance strategies that facilitate sustainable regional circular bioeconomy development, culminating in a typology which enables the classification of regional government good practices supporting circular bioeconomy deployment in diverse regions within Europe. Data on regional circular bioeconomy governance models were collected through desk research and a survey, resulting in a compilation of 61 circular bioeconomy governance models. From this compilation, 20 case studies were identified and further explored to develop a typology of regional circular bioeconomy governance strategies in the EU-27. Findings reveal a strong regional commitment to expanding bioeconomies; however, managing conflicting sustainability goals remains a challenge. This paper provides a comprehensive overview of successful governance models and practices, offering valuable insights for policymakers to support the co-development and replication of effective circular bioeconomy strategies across diverse European regions.

Keywords: circular economy; bioeconomy; innovation; sustainability; governance; typology

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1. Introduction

The bioeconomy concept revolves around utilizing biological principles and processes to substitute fossil-based materials with bio-based alternatives, fostering innovative and sustainable resource utilization [1]. This approach offers opportunities for sustainability, aligning with several United Nations Sustainable Development Goals (SDGs) and necessitating governance structures and models to ensure the development of sustainable bio-based transformations, especially when aligned with a circular economy strategy that seeks to narrow or close loops and eliminate waste [2].

In general terms, "governance" encompasses systems of control and regulation, involving state intervention and rules governing private actors' interactions such as markets, associations, and actor networks like clusters, including at the regional level [3]. The literature presents various governance forms that structure actor interactions, market

dynamics, interest groups, and negotiation processes for informal rules. Governance embodies three dimensions: (i) a substantial dimension, determining governance rules; (ii) a procedural dimension, describing how rules are developed; and (iii) a structural dimension, outlining rulemaking institutions, implementation, enforcement, and conflict resolution mechanisms [1].

For a sustainable circular bioeconomy, governance serves two pivotal functions [3]. Firstly, it plays a safeguarding role, necessitating explicit measures to ensure economic, social, and ecological sustainability through appropriate governance approaches [4]. A robust governance framework is vital for guiding the transition from a linear, fossil-based economy to a circular bioeconomy structure. Secondly, governance facilitates an enabling function by ensuring fair competitive conditions for circular bioeconomy processes and products, thus enabling efficient decision-making regarding alternative technologies and resources that are essential for this transition [3]. Governmental governance models encounter significant challenges in promoting the transition to a circular bioeconomy while ensuring effective sustainability assurance. For example, information problems, stemming from uncertainties about the economic, environmental, and social impacts of diverse bioeconomy value chains, pose a substantial obstacle [5]. Disclosing conflicting goals and engaging in prioritization discussions are essential steps toward establishing a sustainable circular bioeconomy [3].

1.1. Regional Circular Bioeconomy Governance

The European Commission and numerous Member States advocate promotion of a robust circular bioeconomy to underpin the implementation of Europe's Green Deal and the goal of achieving climate neutrality by 2050. In addition to the benefits accruing at the national and European levels, the significance of regional participation and the advantages for European regions are key considerations. Regions, and regional governance, play a pivotal role in advancing the European circular bioeconomy by facilitating the establishment of innovative value chains. They are well placed to identify locally available feedstocks from various sources, such as agriculture, agri-food industries, forestry, and residual material streams. These feedstocks can catalyze and scale up circular bioeconomy development. Furthermore, regions can attract investments in local demonstration or flagship projects, leveraging funds such as the European Structural and Investment Funds (ESIFs) and the European Agricultural Fund for Rural Development (EAFRD), thereby fostering local job creation, regional economic growth, and opportunities in the regional primary production sectors [6]. Additionally, regions possess a nuanced understanding of their territorial needs and synergies, encompassing urban, coastal, and rural areas.

A report from the Bio-Based Industry Consortium (BIC) in 2017 [6] underscored the emergence of bioeconomy regions across Europe, emphasizing the potential for bioeconomy development in these regions. Various initiatives have been launched to bolster regional bioeconomy development. One such initiative is the Model Demonstrator Regions for Sustainable Chemical Production, established in 2016, which is aimed at encouraging investment in sustainable chemicals production in Europe. This is supported by a self-assessment tool (SAT) to gauge regions' readiness levels. Another initiative, the BIC's Regions bioeconomy platform, provides a digital platform fostering collaboration between regions and industry to create local value chains and facilitate access to finance. Taking a transregional perspective, the Vanguard Bioeconomy Pilot Initiative endeavors to support the deployment of high technology readiness level (TRL) technologies through the establishment of transregional value chains. The pace of regional circular bioeconomy development, and associated governance models and practices, varies across regions. Many European regions have integrated circular bioeconomy-related priorities into their research and innovation strategies for smart specialization [7], while the Bioeconomy Stakeholder Manifesto [8] highlights the potential for the circular bioeconomy to revitalize rural regions. The development of regional circular bioeconomy strategies has been explored in various studies, including the BioStep project, which investigated four regional case studies [9]. Recent efforts by the European Union's (EU) Joint Research Centre (JRC) have focused on

mapping regional bioeconomy strategies across Europe, revealing an acceleration in their deployment since the updated EU Bioeconomy Strategy in 2018. In total, 194 regions in the EU-27 have strategic frameworks for the bioeconomy in place or in progress, with a total of 359 bioeconomy-relevant strategies at the regional level in the EU [10].

1.2. The European Bioeconomy Strategy Development

Originally adopted in 2012 and revised in 2018, the 2018 EU Bioeconomy Strategy offers a cohesive bioeconomy framework that spans multiple sectors and policies, facilitating the creation of synergies, addressing trade-offs, and delivering sustainability across multiple policy and sectoral objectives.

The initial delineation of bioeconomy strategies on a European scale was outlined in the 2018 EU Action Plan for the Bioeconomy Strategy [11]. Within this report, the analysis of 210 territorial units revealed that the majority (207) integrated bioeconomy-related elements into their research and innovation agendas. Subsequently, the EU JRC has been monitoring the advancement of EU member states in crafting and executing policies directed toward bioeconomy development. The final report of a recent study conducted by the European Commission's Knowledge Centre for Bioeconomy offers an in-depth analysis and mapping of strategies pertaining to the bioeconomy across regions within the EU-27, providing current insights into existing bioeconomy regulatory frameworks, or those under development as of November 2021 [10].

1.3. Bioeconomy Strategy Development in EU Regions

Currently, there are 194 regions acknowledged within the EU-27 that have either already implemented, or are in the process of adopting, a bioeconomy strategy [10]. Table 1 describes the regional implementation of bioeconomy strategies in the EU-27. Italy leads, with the highest count of regions featuring bioeconomy-related strategies, trailed by Sweden, France, Spain, Finland, and Poland. These six nations actively advocate for bioeconomy development through strategic plans at the regional level. Conversely, data indicate that six EU Member States lack strategies pertinent to the bioeconomy, namely Bulgaria, Cyprus, Estonia, Luxembourg, Malta, and Slovenia, although closer examination reveals otherwise. To specify, Bulgaria indeed possesses a regional bioeconomy model. Additionally, Luxembourg, Cyprus, and Malta have national strategies relevant to the bioeconomy. These three countries are considered as entire regions at the European Nomenclature of Territorial Units for Statistics (NUTS) levels 1 and 2; thus, the national strategies are therefore also regional strategies.

Figure 1 also illustrates EU regions with bioeconomy strategies. Spain and Portugal commonly integrate the bioeconomy within circular economy strategies, while Finland incorporates it within Regional Development Plans and Smart Specialization Strategies (S3s). In Poland, the bioeconomy appears in either Regional Development Plans or Research and Innovation (R&I) strategies. Lastly, in Hungary, the bioeconomy is recognized within territorial development plans [10]. The diverse socio-economic, political, cultural, and ecological context of the nations that engaged in regional bioeconomy strategy planning (as described in Table 1 and Figure 1) highlights the relevance and value of circular bioeconomy development across regions facing different challenges and with varying development opportunities available to them [12].

Despite the advancements and efforts of the EU regions, the issue of a lack of measurement and monitoring of bioeconomy contributions keeps re-emerging [13]. This drawback is reinforced by the lack of harmonization of bioeconomy standards and the data supporting them, necessitating the creation of a facilitated policy environment. In reality, harmonization of sustainability measurement for the circular bioeconomy may not be possible [14], but harmonization of the methodology for both the public and private sector seems possible. To accomplish this milestone, the creation of a unified typology of regional circular bioeconomy governance models is a pivotal stepping stone.

Table 1. EU-27 Regions with Bioeconomy-related Strategies (Source: [10]).

Country	Regions with Published Strategic Frameworks	Regions with Strategic Frameworks under Development	Pre-Dominant NUTS Level of Strategic Frameworks per Country	Total Number of Regions per Country
Austria	8	-	NUTS2	9
Belgium	3	-	NUTS1	3
Bulgaria	-	-	-	-
Cyprus	-	-	-	-
Czech Republic	11	-	NUTS3	14
	13	-	NUTS1	17
Denmark	4	-	NUTS2	5
Estonia	-	-	-	-
Germany				
Spain	14	3	NUTS2	20
Croatia	16	-	NUTS3	19
Finland				
France	18	-	NUTS1	18
Greece	2	-	NUTS2	13
	1	-	NUTS3	21
Hungary	10	-	NUTS3	20
Ireland	7	-	NUTS3	8
Italy	19	2	NUTS2	21
Latvia	2	-	NUTS3	6
Lithuania	1	-	NUTS3	10
Luxembourg	-	-	-	-
Malta	-	-	-	-
Netherlands	5	-	NUTS1	5
Poland	15	1	NUTS2	17
Portugal	7	-	NUTS2	8
Romania	7	-	NUTS2	8
Slovakia	5	-	NUTS3	8
Slovenia	-	-	-	-
Sweden	16	4	NUTS3	21

The objective of this study was to analyze and contextualize potential types of regional circular bioeconomy governance models in Europe. To achieve this goal, an overarching approach was implemented, consisting of several key steps. Initially, an extensive literature review was conducted to gather relevant information and insights. Subsequently, a comprehensive data collection survey was carried out to gather empirical data on existing regional circular bioeconomy governance models. From the collected data, a careful selection of case studies was made to represent diverse examples of regional circular bioeconomy governance across Europe. These case studies were then subjected to typology analysis, aiming to categorize and understand the different regional circular bioeconomy governance models in play. The results of this analysis provide valuable insights into the landscape of regional circular bioeconomy governance in Europe. The typology developed served as a foundation for the classification of a list of good circular bioeconomy governance practices of regional governments. These practices aim to support local operators and innovation developers, through appropriate business models and social measures, thus highlighting the practical implications of the identified regional circular bioeconomy governance models.

The paper provides an overview of regional circular bioeconomy governance strategies and models and governance practices within the EU-27, along with a typology of regional circular bioeconomy governance models derived from a sample of 20 case studies that were carefully selected to represent all aforementioned regions and for which data collected were deemed accurate and complete.

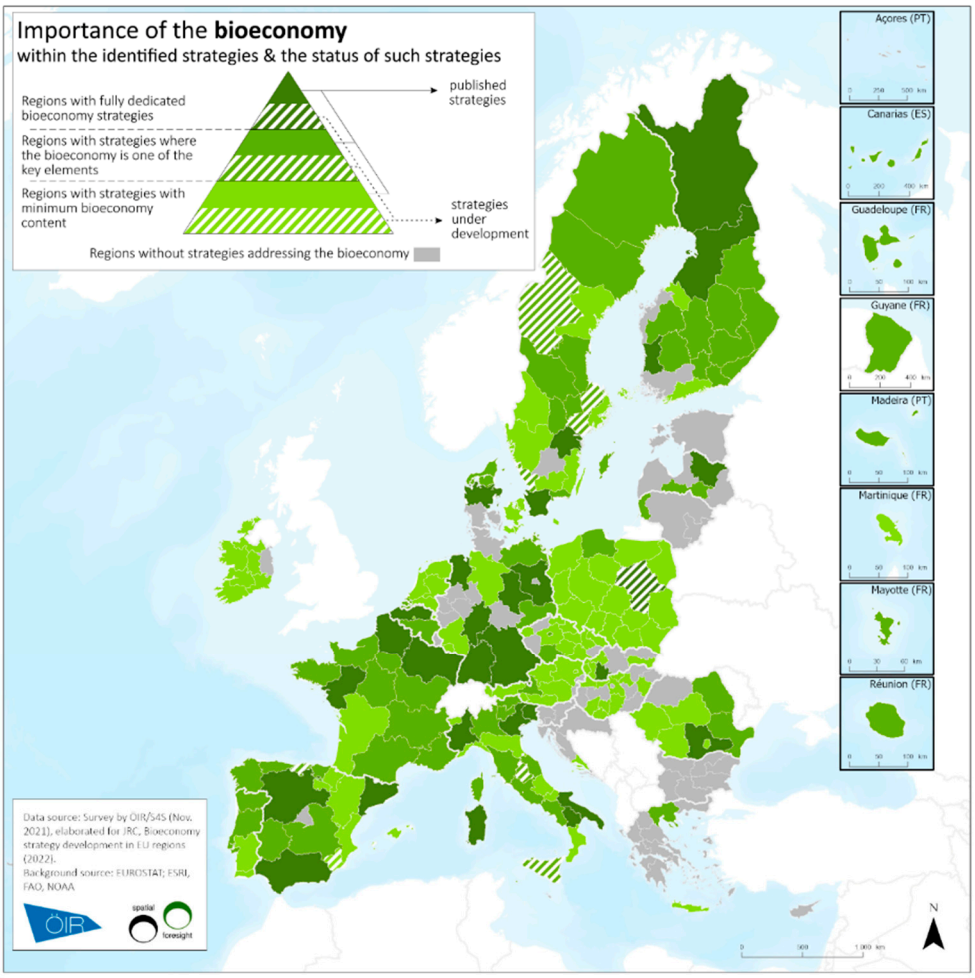

Figure 1. EU regions with bioeconomy strategies (Source: [8]).

2. Materials and Methods

2.1. Development of a Typology of Circular Bioeconomy Governance Models in European Regions

The term "governance model" primarily refers to a system of control and regulatory mechanisms encompassing state intervention and regulations governing the interactions among private entities such as markets, associations, and clusters [3]. Across Europe and globally, various governance models are evident in the realm of the circular bioeconomy. These models serve two vital functions for fostering a sustainable, circular bioeconomy: an enabling function and a safeguarding (constraining) function. Dietz et al. [1] have delineated a taxonomy of political support measures (enabling governance) as the primary governance challenge, and regulatory tools (constraining governance) as the secondary governance challenge, thereby distinguishing between the two fundamental political challenges in establishing an effective governance framework for a sustainable bioeconomy. The typology of circular bioeconomy governance models shown in this paper is built upon this theoretical framework, further elaborating on its structure.

Dietz et al. [1] identified four distinct bio-based transformation paths: (1) substituting fossil fuels with bio-based raw materials; (2) enhancing productivity in bio-based primary sectors; (3) improving efficiency in biomass utilization; and (4) generating value and enhancing processes through the application of biological principles, independent of large-scale biomass production. Path dependencies have been underscored as the primary obstacles to the effective realization of the circular bioeconomy. The subsequent table (Table 2) offers a comprehensive summary of these four bio-based transformation paths.

Table 2. Bio-Based Transformation Paths (Source: [1]).

Path No.	Bio-Based Transformation
Transformation Path 1	Substitution of fossil fuels with bio-based raw materials
Transformation Path 2	Boosting primary sector productivity
Transformation Path 3	New and more efficient biomass uses
Transformation Path 4	Value creation and addition through the application of biological principles and process separate from large-scale biomass production

The primary objective of a circular bioeconomy governance model is to establish equitable competitive conditions for bioeconomy processes and products, facilitating effective choices among alternative technologies and biogenic and non-biogenic resources in markets [3]. The governance model's enabling function delineates how political strategies can bolster the emergence of the circular bioeconomy through suitable policy measures. The establishment of a sustainable circular bioeconomy necessitates a robust governance model. Dietz et al. [1] distinguish three enabling governance mechanisms (Table 3):

Table 3. Enabling Governance Mechanisms (Source: [1]).

	Enabling Governance Mechanisms
1.	Bio-based research and development (R&D) strategy
2.	Enhancing the competitiveness of bio-based products through subsidies
3.	Implementing awareness-raising campaigns to increase societal participation in bio-based transformation, including more responsible and sustainable consumption

A significant governance challenge arises in effectively managing conflicting objectives associated with promoting the circular bioeconomy and achieving the SDGs, constituting a key challenge for circular bioeconomy governance [1]. Hence, a crucial aspect of governance models involves maintaining a well-balanced focus that steers political and economic actors toward a sustainable, bio-based, and cyclically managed economy, facilitating a more efficient and environmentally compatible utilization of biological materials than in the past. The sustainability element of circular bioeconomy governance models is thus facilitated by clear objectives across the three sustainability pillars: societal, environmental, and economic objectives. Table 4 illustrates the potential opportunities and risks of bioeconomy transformation.

Table 4. Risks and Opportunities of Bioeconomic Transformation (Source: [1]).

Sustainability Dimension	Opportunities	Risks
Food Security (SDG2)	Increase via higher yields and new production methods	Reduction due to food price increases
Poverty/Inequality (SDG10)	Reduce via transfer of technology and leapfrogging	Increase via exclusion from technical progress
Natural Resources (SDG 7, 14, 15)	Conserve by improving production methods	Degrade/Loss through inefficient production and overuse
Health (SDG3)	Improved through new and refined forms of therapy	Risk/Damage through improper use of risky technologies
Climate Change (SDG13)	Mitigate through emissions reductions	Exacerbate through direct indirect land use change

Managing conflicts in goals and effectively addressing conflicting objectives represent the second governance challenge, known as constraining governance. These encompass issues such as global equity concerns, water scarcity, land degradation, and land use change.

The typology takes account of innovation governance strategies as described by the triple helix, quadruple helix, and penta helix models. The triple helix model of innovation

emphasizes collaboration between specific institutional domains, namely government, industry, and universities [15]. The quadruple helix model extends this to include civil society organizations (CSOs) representing local communities, while the penta helix model expands stakeholder engagement further to incorporate representatives from the financial sector (penta helix), which can enhance the effectiveness of implementing regional circular bioeconomy initiatives. Financial institutions have distinct criteria and programs that need to be taken into account during the process to ensure that circular bioeconomy governance models receive the necessary support [16]. The journey toward a circular bioeconomy involves intricate dynamics arising from the interplay of economic, technological, institutional, cultural, and ecological factors across various levels [17], and governance strategies that engage appropriate stakeholders for the regional context are therefore critical for regional circular bioeconomy development.

The analysis employs the following definition of a circular bioeconomy strategy: "A circular bioeconomy strategy encompasses the regulatory frameworks utilized by official authorities to articulate methods for achieving policy goals and objectives. It encompasses strategies, action plans, roadmaps, and resource management plans that advocate for the advancement of bio-based value chains within a sustainable and circular bioeconomy context". In this analysis, models not officially part of a bioeconomy strategy were also considered.

Data on regional bioeconomy models were collected through a literature review conducted via desk research and data acquisition. Desk research relied on online documents and other available sources. The literature review also explored potential assessment methods and evidence regarding the effectiveness and robustness of existing governance schemes in the EU, resulting in the development of a typology of governance models. A dataset comprising 61 models was compiled in an MS Excel spreadsheet for further analysis, with 20 model case studies selected for further examination. To complete this step, a data collection template was developed to collect data about circular bioeconomy governance models. This is described in simplified form in Appendix A (Table A1). The models were compiled with the assistance of local subject matter experts in each region to ensure representation of case studies spanning across the EU and covering the most diverse array of governance models possible for which accurate and complete data were available. The complete list of models is available as a Supplementary Materials file (Table S1).

The research aimed to identify circular bioeconomy models in the regions of EU-27 and EU-Associated countries, with a focus on active, planned, and recently completed models. While primarily targeting the regional level, some national models were included, particularly for small countries or in cases where regional models were unavailable.

Out of the initial 61 models collected, several were excluded due to incomplete or missing data. Additionally, models lacking mention of support measures and those at the national level, except for small countries, were eliminated, as the analysis primarily focuses on the sub-national, regional level.

2.2. Collection of Good Governance Policies for Supporting Local Stakeholders towards Bioeconomy Implementation

For effective regional circular bioeconomy governance implementation, it is important to identify individual policies, practices, and activities which regional governance bodies can support to deliver practical implementation of the circular bioeconomy on the ground with the local stakeholders. Such policies are diverse and could include business model supports (e.g., support in developing sustainable business models, financing support, incubators for new start-ups), regional policy supports for bio-based practitioners (e.g., incentives for practitioners, or bio-based procurement programmes), technical supports (e.g., accessing R&D, pilot facilities and scale up, product testing), collaboration supports (e.g., support in networking/matchmaking), education, skills, and knowledge-sharing supports and support for social innovations. This step of the research focused on identifying and analyzing an inventory of "good practice" examples of such regional

circular bioeconomy governance practices which have been implemented across diverse European regions and territories.

Previous research into suitable regional policies to support bio-based business models has characterized the existing policies in place for supporting a bio-based economy [18]. The following types of bioeconomy policy instruments were identified by Elbersen et al. [18] and have also been used to classify and analyze good practices in this study.

- Fiscal and financial instruments
- Regulatory instruments
- Information and advisory instruments
- Networking, collaboration, and joint planning instruments
- Voluntary instruments
- Other instruments

To assess which practices constitute good practices for inclusion within the inventory, it was first necessary to define the term "good practice" based on the literature and previous studies. This approach has previously been used as a first step to cataloguing good practices [19]. Various organizations have offered their interpretations as to what criteria lead to a practice being defined as "good". The United Nations Food and Agriculture Organization (FAO) [20] defines a good practice as a practice this is not only good but also "has been proven to work well and produce good results, and it is therefore recommended as a model. It is a successful experience, which has been tested and validated, in the broad sense, which has been repeated and deserves to be shared so that a greater number of people can adopt it".

The European Network for Rural Development (ENRD) [21] outlines that "good practice" refers to strategies, programmes, projects, procedures, management, and implementation practices that should be at least:

- Implemented with positive results.
- Successful, (innovative), tested and validated: it contributes to the improved performance of an entrepreneurship/farm/organization and this contribution is recognized.
- Transferable: it can be adopted in and adapted to other contexts.
- Several commonalities exist within these definitions including:
- Demonstrating positive results.
- Has been tested and validated.
- Has been or can be transferred and/or replicated.

A data collection template was subsequently developed to collect bioeconomy good governance practices. This is described in simplified form in Appendix A (Table A2). The focus of the template was to collect a detailed description of the practice with useful information for regional governance stakeholders to understand and repeat the practices, and to assess the suitability of the practices for inclusion as circular bioeconomy good governance practices. The template has several components, including identifier information, geographical location and context, practice description, driver, territorial context, and type of practice. The template also includes questions related to defined criteria for good practice as described above, including:

- Implemented and demonstrating positive results—the template asks for contribution of the practice to environmental, social, and economic impacts.
- Has been tested and validated—the template asks for the nature of beneficiaries, level of uptake, and the duration for which the practice has been in operation.
- Has been or can be transferred and/or replicated—the template seeks to understand whether the practice can be replicated in other settings/jurisdictions and to understand if there are barriers to regional deployment.

The template provided a common framework for collection of good practices for regional circular bioeconomy governance.

To ensure a broad coverage of good practices, to promote learnings from different jurisdictions of Europe, and to also allocate the collection between different research collab-

orators with regional circular bioeconomy expertise, it was decided to distribute European countries into different regional clusters for good practice sourcing. The breakdown was as follows:

- Balkan Cluster (Greece, Cyprus, Bulgaria, Albania, Serbia, Montenegro, Romania, North Macedonia, Croatia, Bosnia, Slovenia)
- Central Europe Cluster (Germany, Austria, Switzerland, Netherlands, Denmark, Poland)
- Eastern Europe Cluster (Slovakia, Czech Republic, Hungary, Ukraine, Estonia, Latvia, Lithuania, Moldova)
- Mediterranean Cluster (Spain, Portugal, Italy, Malta)
- North-West Europe Cluster (Ireland, UK, Sweden, Norway, Finland, Iceland)
- Western Europe Cluster (Belgium, France, Luxembourg)

Two strategies were employed to identify good practices in these regions. Firstly, regional governance structures identified in Section 2.1 were investigated to see if these were associated with certain good practices during their implementation. Secondly, a literature review, including searches of white and grey literature, a review of circular bioeconomy governance research projects, e.g., the EU CORDIS database, and consultation within the authors' own networks were undertaken to identify relevant practices fulfilling the circular bioeconomy good governance practice criteria. The practices primarily focus on regional level initiatives; however, in certain cases, e.g., where a practice had a major impact and could be transferred to other regions/at the national level (e.g., the Italian Ban on Plastic Bags, or the Netherlands' Green Deal), or where a programme is operating nationally but benefits regional stakeholders (e.g., the LEADER programme), these have been included within the inventory.

The typology developed as part of the work described in Section 2.1 was applied to the final list, in order to categorize the compendium of regional government initiatives supporting local operators and innovation developers through appropriate business models and social measures, characterize the diversity of regional circular bioeconomy good governance practices in European regions, and identify regional strengths and vulnerabilities. The resulting analysis with the final list of circular bioeconomy good governance practices is available in the Supplementary Materials file (Table S2). Descriptive statistics were calculated for the analyzed practices and typology categories using MS Excel, on a regional basis (based on the regional clusters listed above) and a categorical basis (based on the typology categories).

3. Results

Our findings affirm previous research indicating that numerous European regions have committed to advancing their bioeconomies, with local governments offering extensive political backing to realize this objective. The regional circular bioeconomy governance model typology developed in this research delineated four bio-based transformation paths and identified two primary governance functions: enabling governance and constraining governance. Currently, European regions are actively engaged in addressing the challenge of enabling governance for circular bioeconomy development. However, our analysis reveals that managing conflicting goals (constraining governance) has not received sufficient attention.

3.1. Results from the Collection of Circular Bioeconomy Governance Strategies and the Development of a Typology of Circular Bioeconomy Governance Models

The results of the study provide a comprehensive insight into regional circular bioeconomy governance strategies and models within the EU-27. Through an examination of 20 circular bioeconomy case studies, a typology of regional bioeconomy governance models was developed, delineated along 10 dimensions. This typology not only offers an overview of the diverse approaches adopted by regions but also identifies key patterns and classifications within the governance landscape. Notably, the typology distinguishes between four bio-based transformation paths, each representing distinct trajectories toward a circular

bioeconomy: fossil fuel substitution (TP1), boosting primary sector productivity (TP2), new and more efficient biomass uses (TP3), and low-bulk and high-value applications (TP4). Furthermore, it delineates two primary governance functions: enabling governance (EG), which facilitates and promotes bioeconomy initiatives, and constraining governance (CG), which sets boundaries and regulations to ensure sustainable practices. These findings contribute significantly to understanding the complexity of regional bioeconomy governance and offer valuable insights for policymakers and stakeholders aiming to foster sustainable circular bioeconomy development.

The format of a typology matrix was selected since there is great diversity in the circular bioeconomy governance models across the EU regarding several identified crucial parameters, as discussed earlier in this paper. The identified circular bioeconomy governance types are presented in the typology matrix (Table 5) below:

Table 5. Typology Matrix.

Transformation Path	TP1: Fossil Fuel Substitution TP2: Boosting Primary Sector Productivity TP3: New and More Efficient Biomass Uses TP4: Low-bulk and High-value Applications
Enabling Governance Mechanisms	EG1: Bio-based R&D Strategy EG2: Enhancing the Competitiveness or Bio-based Products through Subsidies EG3: Implementing Awareness-raising Campaigns to Increase Societal Participation
Constraining Governance	CG0: No-goal Conflicts Explicitly Considered CG1: Global Equity/Regional Equity Concerns CG2: Water Scarcity CG3: Land Degradation CG4: Land Use Change
Helix Model	Penta-helix: Business, Knowledge, Administration, Society, Capital Quadruple-helix: Business, Knowledge, Administration, Society Triple-helix: Business, Knowledge, Administration
Driver Measures	DM1: Economic Measures (Price, Taxation or Subsidies) DM2: Regulatory Measures DM3: Information and Support
Territorial Aspects	Rural Urban Coastal Multiple
Focus	F1: Energy F2: Material Use F3: Waste Prevention F4: Recycling F5: Food & Feed
Type of Model	Public Private Mixed
Transition Process	Top-down
	Bottom-up
Decision-making	Ad Hoc/Voluntary Agreements
	Legally Binding/Legislative Decision-making
Voting Mechanisms	One Member—One Vote OR Votes Proportional to Population
	Minority Members Have More than One Vote
Dispute Resolution Processes	Transparent and Accountable Process
	No Formal Process

3.1.1. Transformation Paths

Data collected from the 20 governance models suggests that most of them primarily aligned with TP3: "new and more efficient biomass uses" (65%), with TP2: "boosting primary sector productivity" closely following at 60%. The other two transformation paths were less prevalent in the sample of case studies. Transformation Path 4: "low-bulk and high-value applications", i.e., value creation and addition through the application of biological principles and processes, separate from large-scale biomass production, was found in 30% of the sample, while TP1: "fossil fuel substitution", i.e., substitution of fossil fuels with bio-based raw materials, was present in 25% of the sample.

3.1.2. Enabling Governance Mechanisms

The enabling governance mechanisms employed in the 20 selected regional circular bioeconomy governance models were examined, accounting for instances where more than one enabling governance mechanism is applicable when clarity is lacking. This analysis revealed that the primary mechanism used was "bio-based research and development (R&D) strategy", evident in 60% of the regional circular bioeconomy governance models. The second most commonly used enabling governance mechanism, "enhancing the competitiveness of bio-based products through subsidies", was present in 40% of the governance models. Lastly, the third enabling governance mechanism, "implementing awareness-raising campaigns to increase societal participation" in bio-based transformation, including fostering more responsible and sustainable consumption, was observed in 25% of the regional circular bioeconomy governance models.

3.1.3. Constraining Governance Mechanisms

Only a minority of circular bioeconomy governance models acknowledged the potential adverse effects of bio-based transformations on other objectives, such as the SDGs. Furthermore, how regions handle these conflicting objectives remains uncertain. In most of the 20 case studies of regional circular bioeconomy governance models (11 out of 20), no conflict with SDGs resulting from bio-based transformations were explicitly recognized or directly addressed. For the remaining nine governance models where conflicts with SDGs were explicitly acknowledged, the most prevalent concerns included land use change and equity, followed by water scarcity and land degradation. Analysis of the 20 case studies of regional circular bioeconomy governance models reveals that not all models incorporated all three sustainability pillars (economic, environmental and social) with clear objectives. While all 20 governance models encompassed economic objectives, 19 included environmental objectives, and 18 incorporated social objectives. Moreover, the specific, targeted objectives across the three sustainability pillars primarily prioritized economic objectives, followed by environmental objectives and then social objectives, indicating a lack of a balanced sustainability approach.

3.1.4. Helix Models

Financial organizations were identified as key actors in just two of the case studies. Consequently, the incorporation of capital markets into regional circular bioeconomy governance models remains at an early stage. Further integration of financial organizations utilizing the penta-helix approach is essential to guarantee the effective implementation and functioning of regional circular bioeconomy governance models.

3.1.5. Transition Process

The predominant transition governance approach was top-down, accounting for 75% of the cases, while only 5 out of the 20 case studies (25%) adopted a bottom-up approach.

3.1.6. Territorial Aspects of the Governance Models

In terms of the local dimension within regional circular bioeconomy governance models, the majority (12 out of 20) exhibited multiple territorial aspects, with rural aspects

represented in 5 out of 20 cases, and urban aspects in 3 out of 20 cases. The local characteristics and dimensions of a region are likely influential for the efficacy of regional circular bioeconomy governance models. Given that most of the 20 case studies highlighted multiple territorial aspects, a deeper analysis of these aspects is not warranted.

3.1.7. Decision-making, Voting Mechanisms and Dispute Resolution Processes

The effectiveness of regional circular bioeconomy governance models relies heavily on decision-making and voting mechanisms. Among the 20 cases reviewed, only 7 acknowledge the presence of a decision-making mechanism, typically administered by a committee or working group. Voting rights are typically held by members of key actors or municipalities, with no clear specification regarding the weight of these votes, such as adherence to the one member, one vote principle. Notably, the number of voting members in these seven cases tends to be relatively small, streamlining the decision-making process. However, it remains unclear whether decision-making occurs through consensus, if decisions carry legal weight, or if decision-making authority is established by legislation. Interestingly, in the majority of cases (13 out of 20), there was no mention of decision-making or dispute resolution processes, suggesting that if such mechanisms exist, they are not publicly disclosed.

3.1.8. Driver Measures

Driver measures play a crucial role, differentiating between regulatory measures and economic measures like price incentives, taxation, or subsidies. The case studies of circular bioeconomy governance models revealed that subsidies or similar economic incentives were prevalent in most instances (14 out of 20). Regulatory measures were found in two governance models, while in four governance models there was no information available about any driver measures.

3.2. Results from Collection of Good Governance Policies for Supporting Local Stakeholders toward Bioeconomy Implementation

A total of 86 practices were initially identified in the screening of regional circular bioeconomy good governance practices. Following closer examination of alignment with the definition of good practice outlined in Section 2.2, 75 of the initial 86 were selected for inclusion within the best practices inventory (Supplementary Materials file: Table S2). The shortlisted good governance practices were widely distributed across Europe and the different regional jurisdictions described in Section 2. Within the regional clusters, the distribution of shortlisted practices was as follows:

- Balkan regional cluster: 12 good governance practices
- Central Europe regional cluster: 7 good governance practices
- Eastern Europe regional cluster: 8 good governance practices
- Mediterranean regional cluster: 12 good governance practices
- North-West Europe regional cluster: 24 good governance practices
- Western Europe regional cluster: 12 good governance practices

The list of all practices examined, and the policy instrument type they are associated with, is available in Supplementary Materials (Table S2).

3.2.1. Regional Circular Bioeconomy Good Governance Practices as Policy Instruments

The shortlisted regional circular bioeconomy good governance practices are associated with the following policy instruments: fiscal and financial instruments (24), regulatory instruments (7), information and advisory instruments (15), networking, collaboration, and joint planning instruments (20), voluntary instruments (3), other instruments (6). Table 6 displays the proportion of shortlisted good practices per instrument category. However, as previously noted, there is potential for overlapping categories of instruments across multiple categories [18]. Many of the shortlisted regional circular bioeconomy good governance practices straddle multiple instruments. For example, some accelerator

programmes, such as BioVale's Innovation BioCamp, provide advisory services, while at the same time providing networking opportunities and, potentially, access to finance and investment.

Table 6. Number and Proportion of Good Governance Practices per Policy Instrument Category.

Policy Instrument Categories	Number	Proportion of Total (n = 75)
Fiscal and financial instruments	24	32%
Regulatory instruments	7	9%
Information and advisory instruments	15	20%
Networking, collaboration, and joint planning instruments	20	27%
Voluntary instruments	3	4%
Other	6	8%
Total	75	-

3.2.2. Territorial Context of Regional Circular Bioeconomy Good Governance Practices

There was a wide distribution of territorial deployment locations among the shortlisted good practices (Table 7). Many of the practices could be deployed in multiple territorial contexts (47%), while some are more oriented toward a rural (24%), urban (16%), or coastal (11%) setting, with a smaller number (1%) described as peri-urban or mountainous/uplands.

Table 7. Number and Proportion of Good Practices per Deployment Location.

Deployment Location of Good Practices	Number	Proportion of Total (n = 75)
Coastal	8	11%
Urban	12	16%
Rural	18	24%
Peri-urban	1	1%
Mountainous/Uplands	1	1%
Multiple	35	47%
Total	75	-

3.3. Findings from Application of Typology to Good Practices

The inventory of good practices was further analyzed by applying the typology of circular bioeconomy governance models to the practices. Each regional circular bioeconomy good governance practice was examined to see which categories of the governance model typology were applicable to the practice, and which sub-category within those categories applied to the practice. Certain categories within the matrix applied more closely to the regional circular bioeconomy governance structures which were examined in the development of the typology than to the shortlisted good governance practices outlined. This was the case for the categories: "decision making", "voting mechanisms" and "dispute resolution". These were therefore excluded from the analysis of good practices. Figure 2 describes the good governance practices that were aligned with each typology category and sub-category, as a proportion of the total number of shortlisted practices (n = 75). Figure 3 describes the good governance practices within each regional cluster that were aligned with each typology category and sub-category, as a proportion of the number of good governance practices shortlisted from each regional cluster (see Section 3.2).

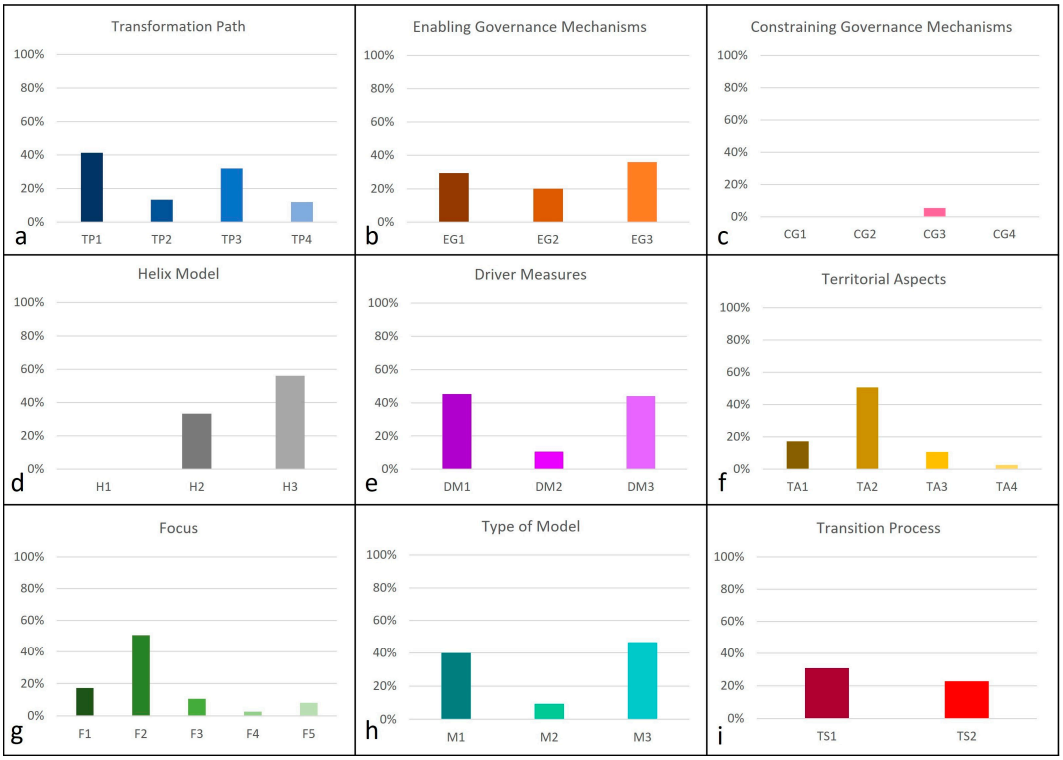

Figure 2. Proportion of practices that were aligned with each category (n = 75; for full description of X axis labels see "typology matrix" Table 5).

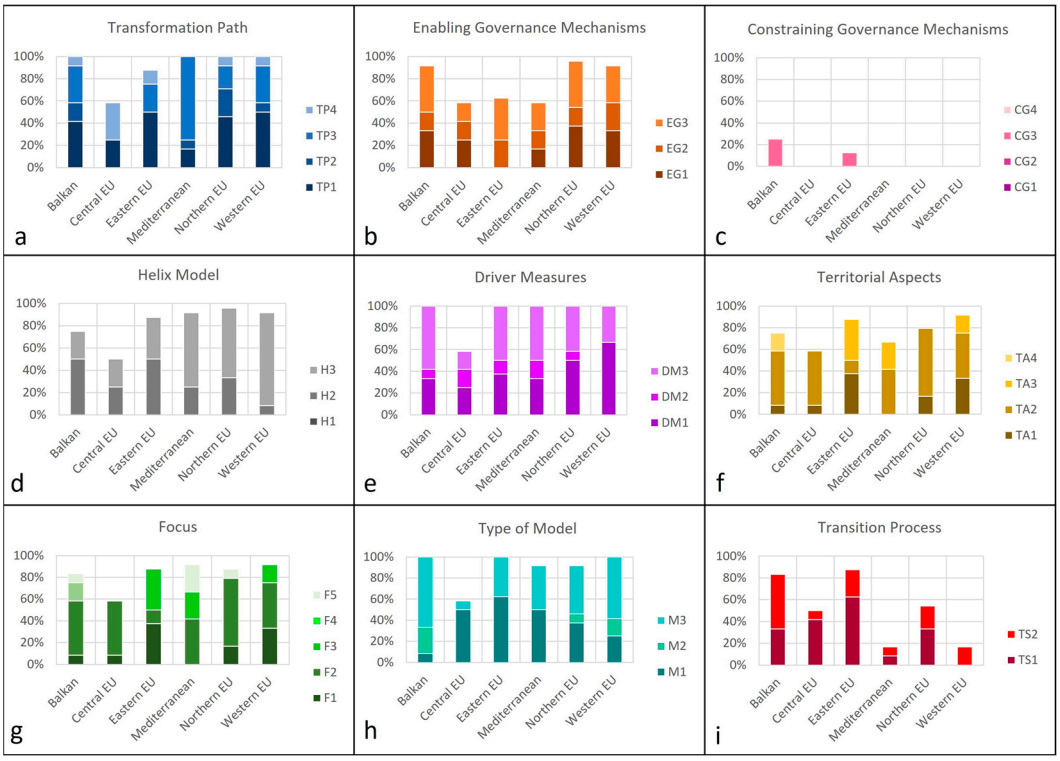

Figure 3. Proportion of practices within each regional cluster that were aligned with each category (Balkan cluster n = 12; Central Europe cluster n = 7; Eastern Europe cluster n = 8; Mediterranean cluster n = 12; North-West Europe cluster n = 24; Western Europe cluster n = 12; for full description of legend labels see "typology matrix" Table 5).

3.3.1. Transformation Paths Applied to Good Governance Practices

The transformation path (TP) is described by Dietz et al. [1] as the root cause of hurdles in the successful implementation of the circular bioeconomy. Of the regional circular bioeconomy good governance practices which aligned to one of the transformation paths, the greatest proportion aligned most closely with TP1 "substitution of fossil fuels with bio-based raw materials" (40%), followed by TP3 "new and more efficient biomass uses" (30%), TP2 "boosting primary sector productivity" (13%) and TP4 "low bulk and high value applications", i.e., value creation and addition through the application of biological principles and processes separate from large-scale biomass production (12%).

3.3.2. Enabling Governance Mechanisms Applied to Good Governance Practices

Regarding enabling governance, 38% aligned most closely with enabling government option 3, (EG3) "implementing awareness-raising campaigns to increase societal participation in bio-based transformation", including more responsible and sustainable consumption. Similarly, 35% were aligned with EG1 "bio-based research and development (R&D) strategy". The remaining 27% aligned with EG2 "enhancing the competitiveness of bio-based products through subsidies". This indicates that the practices exhibit a good balance between the various enabling government functions.

3.3.3. Constraining Governance Mechanisms Applied to Good Governance Practices

There was a noticeable lack of practices describing constraining governance characteristics or potential negative impacts from their activities. However, a small number of practices identified in the Balkan (25%) and Eastern Europe (13%) clusters were found to be aligned with constraining government 3 (CG3) relating to land degradation, accounting for 5% of all shortlisted good practices. These identified good practices were associated with circular bioeconomy activities, which help to restore contaminated land and support regenerative agriculture.

3.3.4. Helix Models Applied to Good Governance Practices

The majority (56%) of good governance practices were triple-helix collaborations (H3), combining business and knowledge with administration. The remaining 33% also brought society on board, (quadruple-helix collaborations: H2) in initiatives such as education, knowledge and awareness-raising, community activities, and social enterprises. This was particularly the case in the Balkan and Eastern Europe clusters, where half of the shortlisted practices were classified as quadruple-helix collaborations. Examples of penta-helix collaborations (H1) were less obvious, and none of the shortlisted practices were identified as penta-helix, i.e., involving private investors or financial institutions.

3.3.5. Transition Process Applied to Good Governance Practices

The typology matrix distinguishes between two main transition governance approaches. The first (TS1) is a more traditional top-down governance strategy, focusing on the shorter-term economic opportunities and incremental innovation that keep the overall structure of existing industries intact [17]. The second (TS2) is a bottom-up approach that facilitates regional clusters and promotes radical innovation through cooperation between vested players and frontrunners that are co-creating a longer-term vision that informs the short-term actions. There is a slightly higher level of TS1 approach in the analysis of good practices compared with TS2 (31% vs. 23%). However, the bottom-up approach is more prevalent than the top-down approach in the Balkan (TS1: 33%, TS2: 50%) and Western Europe clusters (TS1: 0%, TS2: 17%).

3.3.6. Territorial Aspects Applied to Good Governance Practices

Looking at the territorial setting of these practices, based on the typology options, almost half of the practices (47%) could fit across multiple territorial contexts, with the

other remaining practices dedicated specifically to rural (24%), urban (16%), or coastal (10%) settings.

3.3.7. Driver Measures Applied to Good Governance Practices

Considering the driver measure of the best practices, we find that the majority of these are either related to DM3 (44%) "information and support" or DM1 (45%) "economic measures (price, taxation, or subsidies)", the latter being more prevalent in the North-West and Western Europe clusters. Only a relatively small number related most closely to DM2 "regulatory measures" (11%), most of which were found in the Central and Eastern Europe and Mediterranean clusters.

3.3.8. Foci of Regional Circular Bioeconomy Good Governance Practices

When analyzing the foci of the practices, it seems that the largest proportion of practices link most closely with F2: material use (51%), with a smaller proportion aligned with F1: energy (17%), F3: waste prevention (11%), F5: food and feed (8%) and F4: recycling (3%). There was substantial regional variation in the foci of practices. Examining applications within regional clusters, a material use focus was most prevalent in the North-West Europe cluster (63%) and least prevalent in the Eastern Europe cluster (13%). The focus on energy was more pronounced in the Eastern Europe and Western Europe clusters (38% and 33%, respectively). The focus on waste prevention was also more pronounced in these regions (38% and 25%, respectively) and the Mediterranean cluster (17%) than elsewhere (no practices aligning with waste prevention in the other clusters). The food and feed focus were more pronounced in the Mediterranean cluster (28%) than the other regions (<10%), while a focus on recycling was only identified among practices from the Balkan cluster (17%).

3.3.9. Implementation Strategy of Regional Circular Bioeconomy Good Governance Practices

Considering the type of strategy used to implement the practice, the vast majority were either public initiatives (40%), or public–private collaborations (47%), with a small amount (9%) that can be identified as private. This emphasizes that regional and national government is playing a significant role in the development of initiatives to support regional circular bioeconomy development, but also that the private sector is engaging and seeing the commercial benefit of many of these developments. Public–private collaborations were more prevalent among practices from the Balkan and North-West and Western Europe clusters (67%, 46% and 48% of practices, respectively). Private implementation strategies were also more prevalent among practices in these regional clusters (25%, 8% and 17%, respectively) than in the other clusters analyzed (none of the practices identified were implemented solely by private organizations).

4. Discussion and Conclusions

This paper delves into the governance strategies and models driving regional circular bioeconomy development in the EU-27, presenting a typology derived from 20 case studies. It underscores the significant commitment of various regions to sustainably advance their bioeconomies. Strong political support is evident from this analysis of circular bioeconomy models and practices in action. However, while enabling governance receives considerable attention, the analysis reveals a gap in managing conflicting goals (constraining governance) both among the regional governance models and governance practices (policy instruments) examined. Generally, the regions tended to address the second fundamental challenge of developing a sustainable circular bioeconomy (constraining governance) to a considerably lesser extent than the first challenge (enabling governance), aligning with previous findings by Dietz et al. [1]. This poses a challenge to sustainable circular bioeconomy development and the need to account for conflicting goals in both the development of circular bioeconomy strategies and deployment of circular bioeconomy policy instruments [22].

The regional circular bioeconomy governance model typology developed in this research offers valuable insights into the diversity of approaches adopted by regions and identifies key patterns in regional circular bioeconomy governance functions. The typology developed aids in categorizing regional circular bioeconomy governance approaches and identifying areas for improvement, particularly in addressing conflicting goals and enhancing stakeholder collaboration. It distinguishes between four bio-based transformation paths and delineates enabling and constraining governance functions, based on the framework proposed by Dietz et al. [1]. This research demonstrates that these bioeconomy transformation paths and governance strategies are applicable to the circular bioeconomy as well as the broader conceptualization of bio-based economies (as applied by Dietz et al. [1]) and applicable at the regional level as well as the national level (as analyzed in the research of Dietz et al. [1]). This understanding contributes to a nuanced evaluation of regional circular bioeconomy governance, aiding policymakers and stakeholders in fostering sustainable regional development underpinned by a circular bio-based transition.

The application of the typology to the classification of regional circular bioeconomy good governance practices assists with the characterization of existing good governance practices deployed in European contexts, and demonstrates the applicability of the typology to policy instruments in practice. Examination of territorial aspects of the shortlisted good governance practices, for example, is useful for regional governments to understand the types of practices which may be used to stimulate different territories within a particular region and account for territorial aspects of sustainable circular bioeconomy development, as well as value chain dimensions [23].

The results highlight that most regional circular bioeconomy governance models primarily aligned with the transformation path focused on new and efficient biomass uses, indicating a shift towards innovative biomass utilization. Enabling governance mechanisms, particularly bio-based R&D strategies and subsidies for bio-based products, play pivotal roles in supporting bioeconomy initiatives. However, there is a need for increased attention to constraining governance mechanisms, especially in addressing potential adverse effects on sustainable development goals. The analysis reveals a predominance of triple-helix collaboration involving business, knowledge, and administration, with emerging instances of quadruple-helix models involving societal engagement. However, the incorporation of capital stakeholders (penta-helix) remains limited, highlighting a potential area for further development in circular bioeconomy governance. Clearly, this is an important factor, as a circular bioeconomy requires significant investment and scaling requires the participation of private investors, investment banks, etc. [16]. The European Circular Bioeconomy Fund and initiatives of the Nordic Investment Bank supporting investment in bioeconomy scale-up, among others, show that there is a growing interest from the capital stakeholders, and significant further potential for development of penta-helix models.

Key findings emphasize the need for a balanced approach to circular bioeconomy governance, encompassing both enabling and constraining mechanisms to ensure sustainable circular bioeconomy development. Moreover, there is a call for greater engagement of capital stakeholders and increased awareness of potential negative impacts on sustainable development goals. Overall, the study contributes to advancing understanding of regional bioeconomy governance, facilitating knowledge transfer and replication of successful governance models across Europe. Regional development sits within a broader framework of national and international social, economic, political, and ecological influences, e.g., national and international policies and regulations, and socio-ecological and market dynamics [24,25]. Dietz et al. [24] describe major national and international barriers to sustainable bioeconomy development, for example a "lack of policy coordination and harmonization" at the national level, and a lack of "binding international laws and regulations" at the international level. However, the social and material nature of a circular bioeconomy transition also benefits from a regional perspective and regional cooperation in circular bioeconomy governance planning and practice [25]. In this sense, regional and inter-regional

approaches can facilitate circular bioeconomy development that is appropriate to the local and regional context, even while national and international obstacles persist.

The regional circular bioeconomy governance model typology and inventory of good governance practices presented and analyzed in this paper provide valuable knowledge for regional policy actors and stakeholders regarding circular bioeconomy development. By leveraging the good governance practices and insights from case studies, policymakers and stakeholders can better support the co-development of regional circular bioeconomy governance models and structures for their own regions, fostering sustainable and inclusive growth. Further research will assess the application of the governance model typology and good practice inventory as regional circular bioeconomy co-creation supports in diverse European regional contexts, and support further regional good-practice-sharing. Monitoring and evaluation of these pilot cases and good governance practice sharing processes will provide the basis for a regional circular bioeconomy model and good-governance-practice replication guidelines, and harmonization of a circular bioeconomy sustainability evaluation methodology. These developments can support regions to realize greater agency in their circular bioeconomy transition, toward a fair and just transition, especially in the context of managing conflicting goals (constraining governance).

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/su16125140/s1, Table S1. Good Bioeconomy governance models data collection; Table S2. Good governance practice data collection.

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Appendix A

Table A1. Bioeconomy governance models data collection template.

Database Fields		
Field	**Expected info**	**Expected Format**
Bioeconomy governance model or strategy name	Name of the bioeconomy governance model identified	Short text (5–10 words)
Organization name	Name of the responsible organization or authority that has implemented or oversees the governance model	Short text (5–10 words)

Table A1. *Cont.*

Database Fields		
Field	**Expected info**	**Expected Format**
Website	Link to Website	A web link
Region/Geographical Scale	Country/region/locality where the practice has been implemented	Short text (5–10 words)
Year	Year that the good practice was implemented within the specific region	A number
Stage of implementation	Level of the deployment of good practice of the bioeconomy governance model	Short text (50 words max.)
Executive summary	Descriptive and short summary of the selected governance model	Short text (50 words max.)
Bioeconomy Governance Model Description	Longer description of the bioeconomy governance model	Long text (200 words max.)
Territorial aspects of the governance model	Urban, peri-urban, rural, coastal, multiple, others	Short text (50 words max.)
Statutory level	Is it statutory and if so for which organizations	Long text (200 words max.)
Model's sectors and value chains	Focus of model's sectors and value chains: Bioenergy, Biomaterials, Food & Feed	Long text (200 words max.)
Sector of governance model	Sector (agriculture, chemical industry, livestock, etc.)	Short text (50 words max.)
Societal objectives	Focus of societal objectives: Food security, Sustainability, Climate change, Employment and economic development, Dependence on non-renewables	Long text (200 words max.)
Environmental objectives	Focus of environmental objectives: Food security, Sustainability, Climate change, Employment and economic development, Dependence on non-renewables	Long text (200 words max.)
Economic objectives	Focus of economic objectives: Food security, Sustainability, Climate change, Employment and economic development, Dependence on non-renewables	Long text (200 words max.)
Resources to be used	Focus of resources to be used: Land, Water, Labor, Waste/Byproducts	Long text (200 words max.)
Driving forces of model/strategy	Driving forces of model/strategy: Technological innovation, Demographics & consumer preferences, Market organization, Climate change and environment	Long text (200 words max.)
Type of strategy	Type of strategy (public, private, mixed)	Short text (5–10 words)
Key actors	Key actors for the bioeconomy governance model in the region (e.g., Bioeconomy cluster, DIH, etc.), i.e., who participates in a collaboration scheme related to regional bioeconomy (i.e., public bodies, farmers, clusters, etc).	Short text (50 words max.)
Decision-making and voting mechanism	Describe the decision-making process in the circular bioeconomy governance model and the voting mechanism	Long text (200 words max.)
Dispute resolution processes	Describe the dispute resolution process between the circular bioeconomy governance model actors	Long text (200 words max.)

Table A1. *Cont.*

Database Fields		
Field	**Expected info**	**Expected Format**
Synergies with other regions and governance models	Synergies with other regions and/or national governance models	Long text (200 words max.)
Synergies with other objectives & strategies in the region	Synergies with other objectives & strategies in the region (e.g., SDGs, circular economy)	Long text (200 words max.)
Circular economy and development	Aspects related to circular economy and circular regional development	Long text (200 words max.)
Support measures/tools	Support measures/tools: Bio-based R&D strategy to promote investments in technological innovations, Enhance competitiveness of bio-based products through subsidies, Implement awareness-raising campaigns to increase societal participation, Industrial location policies, Legal frameworks, State-supported training of the labor force, Strategic international research collaborations, Foreign direct investment	Long text (200 words max.)
Potential conflicting goals of bioeconomy governance model	Potential conflicting goals of bioeconomy governance model raised and/or addressed linked to sustainable development: Social equity, Water scarcity, Land degradation, Land use change	Long text (200 words max.)
Transition process	Transition process: Top-down (keeps existing overall industry structure) or Bottom-up (promotes radical innovation)	Long text (200 words max.)
Monitoring	Monitoring and reporting mechanisms in place	Long text (200 words max.)
Regional aspects that affect bioeconomy governance models	Natural, geographical, economic, social, political aspects of the region that affect the governance model	Long text (200 words max.)
Relevant sources	Please add here any web link or other literature that you used to collect the information	Bullets points

Table A2. Good governance practice data collection template.

Database Fields		
Field	**Expected info**	**Expected Format**
Num	A numeration field for data management	A number
Good practice name	Name of the good governance practice identified	Short text (5–10 words)
Country/Region	Country/region/locality where the practice has been implemented	Short text (1–2 words)
Year Implemented	Year that the good practice was implemented within the specific region	A number

Table A2. *Cont.*

Database Fields		
Field	**Expected info**	**Expected Format**
Problem Statement	Context of the deployment of good practice (Example: does the good practice help to resolve a barrier, or initiation action to support local operators?)	Short text (50 words max.)
Executive summary	Descriptive and short summary of the selected good practice	Short text (50–100 words max.)
Type of practice	Term which best describe the model of practice e.g., social innovation, public procurement model, educational model, incentive model, non-financial business support, other	Drop Down List
Good Governance Practice Description	Longer Description of the Good Practice:	Long text (200–250 words max.)
	What were the main drivers?	
	What were the ambitions of the practice?	
	What barriers were needed to be overcome?	
	What was the enabling potential of implementation?	
	Was it developed through a project (FP, Interreg, EIP Agri, BBI_CBE JU etc.)?	
	Was it part of or a governmental measure?	
	Who was the promoter of the practice?	
Deployment Setting	Urban, semi-urban, rural, coastal, multiple, others	Drop Down List
Replication potential	Has it been transferred or is it transferrable to other regions or sectors, if not, is there potential to transfer to replicate	Short text (1–20 words)
Regional deployment considerations	Important deployment barriers for other regions, if any	Short text (1–20 words)
Stakeholders/Beneficiaries	Choose from the drop down list the type of stakeholder that is supported by the good practice	Drop Down List
Level of Uptake	Number of stakeholders availing or subscribing to the good practices	Drop Down List
Is the practice currently in operation?	Is the practice currently in operation within the region?	Short text (1–5 words)
Number of years that the measure has been operational in the region	How long since its introduction has the practice been in operation within the region?	A Number
Environmental Impact	Environmental impact or benefits resulting from implementation of good practice, if relevant	Short text (20–40 words)
Social Impact	Social impact or benefits resulting from implementation of good practice, if relevant	Short text (20–40 words)
Economic Impact	Economic impact or benefits resulting from implementation of good practice, if relevant	Short text (20–40 words)

Table A2. *Cont.*

Database Fields		
Field	**Expected info**	**Expected Format**
Organization name	Name of the responsible organization or authority that has implemented or oversees the good practice	Short text
Typology of circular bioeconomy governance model	Which type of circular bioeconomy governance model does this fall in, according to the typologies defined in the governance models section	Short text (5–10 words)
Contact	Contact person for the organization	Short text
Link (mandatory)	Link to the detailed info of about the good practice	A web link

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