PRIMED

D3.1 Circular Business Model Navigator

Handbook

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DISCLAMER

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The Circular Business Model Navigator

1. What is the Circular Business Model Navigator (CBMN)?

The CBMN is a tool which should help start-ups/founders/businesses/etc. to develop circular business models in the bioeconomy. The idea and development of the tool are inspired by already existing business model development tools, such as the St. Gallen Business Model Navigator. These tools are established ways to rethink and redesign current business models (BM) and are frequently used by any kind of firms. Therefore, adding up on the idea of the St. Gallen Business Model Navigator, the CBMN's specific focus lays on circularity within the bioeconomic context, since this topic holds several opacities. The CBMN helps to understand which components are relevant for a circular business model in the bioeconomy. Thereby, designing and implementing a circular business model for the bioeconomy (CBMB) will become easier and more tangible.

1.1. How can the CBMN support start-ups/businesses in the bioeconomy?

The CBMN helps to design, implement and establish CBMB. Therefore, start-ups and firms get a better overview about the topics and components their BM should address. Potentially the most relevant topics that need to be tackled are represented by our identified clusters, which are: „Requirements for Local Impact and Sustainability", „Foundational Resources for Business Development", „Market Competitiveness and Scalability", „Quality Assurance and Regulatory Compliance", „Bio-based Product and Process Innovation", „Flexible and Scalable Bio-Based Production Models", „Optimizing Value Chains for Ecological and Economic Benefit", „Collaborative Ecosystem Development", „Network & Knowledge Integration", „Multi-Stakeholder Collaboration & Open Innovation". By which the highest importance is allocated to the cluster „Bio-based Product and Process Innovation". By gaining this understanding, start-ups and firms can directly address these topics and try to tackle them from scratch.

1.2. What data is used for the CBMN? And how was it collected?

This CBMN is the result of a Group Concept Mapping (GCM) study (Block et al., 2023; Monteiro Moretti et al., 2023; Trochim, 1989) that systematically identified and validated the key components of circular business models within the bioeconomy sector. The five stages of this process are explained in the following.

Project Preparation:

The first stage (project preparation) involved the selection of participants for the idea generation phase. Participants were carefully chosen to represent key stakeholders within the LLabs countries and regions (ALCARRÀS BIOPRODUCTS (ALC), LLab1, Spain; CeNTI, LLab2, Portugal; FILSE, LLab3, Italy; Irish Bioeconomy Foundation (IBF), LLab4, Ireland; VTT, LLab5, Finland), including shareholders and other relevant actors in the bioeconomy sector. Additionally, a focus prompt was developed to guide the idea generation process. The focus prompt, „The most relevant component for a circular business model in the bioeconomy is…," was presented to participants during workshops and idea generation sessions. Participants were instructed to complete the statement based on their own perceptions and insights, thereby generating a comprehensive set of potential components for circular business models.

Data Collection:

In the second stage, data were collected through group discussions with the selected stakeholders in the bioeconomy sector. This included 33 participants from five LLabs of the PRIMED project operating within the bioeconomy sector. The initial data sample holds 103 statements answering the given focus prompt. The objective of this phase was to capture a broad range of potential components relevant to circular business models

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in the bioeconomy. Participants were asked to provide statements that reflected key aspects, challenges, and opportunities associated with circular business models in the bioeconomy.

Data Cleaning:

Following the initial data collection phase, in the third step, a rigorous screening and refinement process was undertaken. A total of 103 statements were initially collected. To enhance clarity and relevance, the dataset was systematically reviewed and reduced to 53 statements. The reduction process was based on the elimination of redundant or ambiguous statements, ensuring that the remaining statements were distinct and representative of critical components of circular business models.

Expert Sorting and Rating:

In the fourth step, the refined dataset of 53 statements was distributed to a panel of experts in the bioeconomy sector. These experts were asked to engage in two specific tasks:

Sorting: The experts were instructed to sort the statements based on their thematic similarity, identifying clusters of statements that addressed similar aspects of circular business models in the bioeconomy.

Rating: Experts were also asked to rate the statements in terms of their perceived importance for successful implementation and operation of circular business models. This rating exercise provided a quantitative assessment of the relative significance of each statement.

Data Analysis and Cluster Mapping:

In the fifth step, the sorted and rated data were analyzed by means of cluster mapping. This analysis generated visual representations that illustrated the relationships between the components identified in the dataset. The resulting cluster maps provided insights into:

The grouping of components based on thematic similarity, allowing for the identification of core clusters that represent fundamental aspects of circular business models in the bioeconomy.

The importance ratings of individual components, highlighting those that are perceived as critical to the successful creation and capture of value in circular business models.

The outputs of this analytical process serve as a foundational framework for the Circular Business Model Navigator (CBMN), enabling start-ups to identify, design, and implement effective circular business models tailored to the bioeconomy sector.

1.3. Results of the GCM Approach

This section provides the results of the GCM so far. Firstly, we will provide the collected statements/most relevant components for a CBMB which refer to the main components of the Business Model Canvas by Osterwalder in Table 1. Table 1 also shows the number of the statement, which relates to the dot-numbers in the Point Map (Figure 1). Afterwards we will provide the cluster map (Figure 2), the respective cluster statistics and descriptions (Table 2 - Table 23). Following by a brief conclusion on how to proceed with the collected results for the CBMN.

1.3.1. Statements/Components

The following 53 statements were identified (after data cleaning) and mapped to the respective component(s) of the Business Model Canvas by Osterwalder:

Table 1: Matching of the identified CBMB-components to the Business Model Canvas by Osterwalder

Statement ID	Identified CBMB-related characteristic per component	Business Model Component by Osterwalder

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1	to adress local needs.	Key Activities, Channels, Customer Segments
2	value for municipalities.	Value Proposition, Customer Segments
3	to ensure social value.	Value Proposition
4	to design reusable products.	Key Activities, Value Proposition
5	to inform the end user about a product that has both: high value and does not harm the environment.	Key Activities, Value Proposition, Customer Relationships, Customer Segments
6	biobased raw materials with performance at least as good as the fossil based options.	Key Resources, Value Proposition
7	to generate new bio-based products that are alternatives to the current fossil option.	Value Proposition
8	to ensure competitiveness on the market.	Cost Structure
9	to offer competitive product prices.	Value Proposition, Cost Structure
10	to produce/scale-up new bio-based products.	Key Activities, Key Resources
11	creating new revenue streams for primary sector activities.	Key Activities
12	to understand the bottlenecks at each step of the value chain.	Key Activities
13	a modular production process according to availability and request.	Key Activities
14	resource efficiency.	Key Activities, Cost Structure
15	to ensure ecological value.	Value Proposition
16	a cooperation with education.	Key Partners
17	a cooperation with municipalities.	Key Partners, Key Activities
18	a cooperation with other companies.	Key Partners
19	a cooperation with researchers.	Key Partners
20	a cooperation with the government.	Key Partners
21	a player to connect partners along the value chain.	Key Partners, Key Activities
22	synergies between stakeholders.	Key Partners
23	the connection of previously distant industries.	Key Partners, Key Activities, Key Resources
24	to align and coordinate producers and downstream processing partners in a joint ecosystem.	Key Partners, Customer Relationships
25	collaborative value-creation among partners with different expertise.	Key Partners
26	collaborative innovation.	Key Partners
27	the organized value creation along the partners.	Key Partners, Key Activities
28	to have involvement and buy in from biomass producers.	Key Partners, Cost Structure
29	to share knowledge across sectors.	Key Partners, Key Activities, Key Resources
30	to share best practices.	Key Partners, Key Activities
31	the internal quaility control through testing of the final product.	Key Partners, Key Activities
32	the external quality control through product certification.	Key Partners, Value Proposition

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33	to meet regulatory requirements necessary for production.	Key Activities
34	a replicable process model.	Key Activities
35	a tested and confirmed innovative production process.	Key Activities, Key Resources
36	an established and simple logistical infrastructure.	Key Partners, Key Activities, Channels
37	reverse logistic.	Key Partners, Key Activities, Customer Relationships
38	a circular supply chain.	Key Partners, Key Activities
39	a cooperation with logistic partners.	Key Partners
40	to adress local markets.	Value Proposition, Channels, Customer Segments
41	to adress international markets.	Key Partners, Channels
42	transparency throughout the supply chain.	Key Partners, Key Activities, Value Proposition
43	tracebility of raw materials.	Key Resources, Value Proposition
44	knowledge about side streams.	Key Activities
45	to solve a waste problem at the producer level.	Key Activities, Value Proposition
46	to benefit from side streams from other processes.	Key Partners, Key Resources
47	to produce side streams instead of waste.	Key Activities, Value Proposition
48	the valorization of waste streams.	Key Activities, Key Resources
49	financial support from investors.	Key Partners, Cost Structure, Revenue Streams
50	human capital.	Key Resources, Cost Structure
51	sufficient starting capital.	Key Partners, Cost Structure, Revenue Streams
52	a cost efficient production process.	Cost Structure
53	to ensure economic viability.	Cost Structure, Revenue Streams

The identified statements in Table 1 were sorted and rated by the participants. Based on the sorting and the multidimensional scaling with the sorting data, the following point map was generated:

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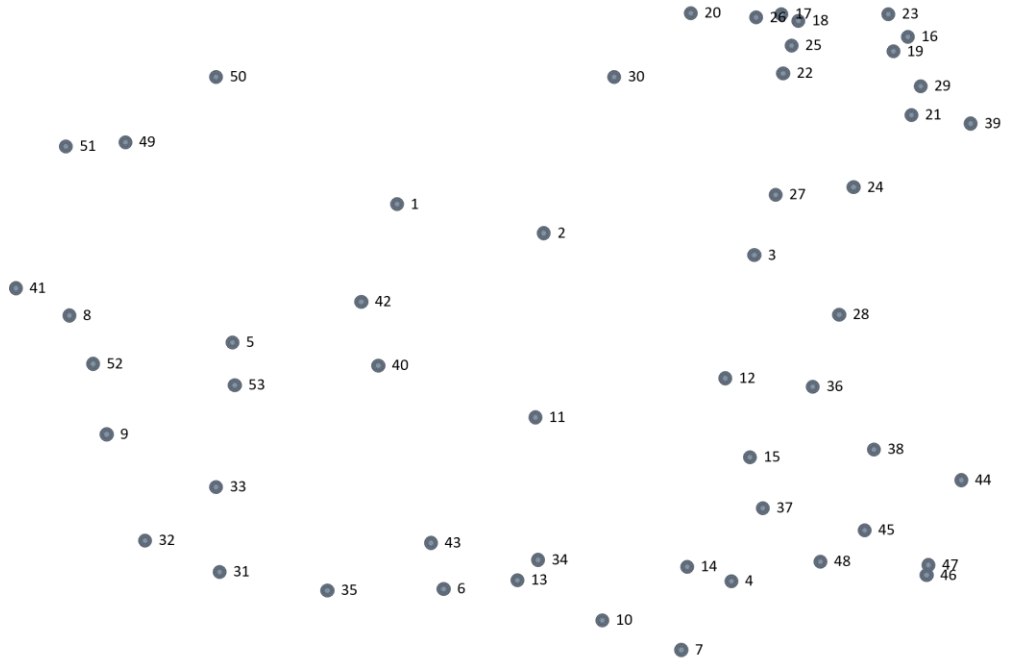

Figure 1: Point Map of the sorted statements

The point map serves as the first indicator and the basis for the following cluster map. In the following, the generated clusters will be explained in detail.

Cluster 1: Requirements for Local Impact and Sustainability (Average Importance: 3.91)

This cluster highlights the importance of addressing local needs and markets, ensuring economic viability, and providing transparent information about products that are both high-value and environmentally friendly. „To ensure economic viability“ received the highest rating (4.75), indicating its critical importance to the participants. „Value for municipalities“ (2.81) was rated lowest within this cluster, suggesting it's seen as less impactful compared to other factors.

Table 2: Composition of cluster one

Statement ID	Statement on most relevant component for a CBMB	Average rating value
1	„to adress local needs.“	3.63
2	„value for municipalities.“	2.81
5	„to inform the end user about a product that has both: high value and does not harm the environment. „	4.38
40	„to adress local markets.“	3.69
42	„transparency throughout the supply chain.“	4.19
53	„to ensure economic viability.“	4.75

Table 3: Descriptive statistics of cluster one

Average	3.906
Median	3.938
Variance	0.389
Standard deviation	0.624
Minimum	2.813
Maximum	4.75
Count	6

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Cluster 2: Foundational Resources for Business Development (Average Importance: 4.27)

As one of the highest-rated clusters, this emphasizes the essential role of sufficient starting capital, financial support from investors, and human capital. All statements within this cluster received high and very consistent ratings (above 4.19), underscoring their perceived necessity for any business development.

Table 4: Composition of cluster two

Statement ID	Statement on most relevant component for a CBMB	Average rating value
49	„financial support from investors.“	4.31
50	„human capital.“	4.19
51	„sufficient starting capital.“	4.31

Table 5: Descriptive statistics of cluster two

Average	4.271
Median	4.313
Variance	0.003
Standard deviation	0.059
Minimum	4.188
Maximum	4.313
Count	3

Cluster 3: Market Competitiveness and Scalability (Average Importance: 4.20)

This cluster focuses on strategic market positioning, including offering competitive product prices, ensuring overall market competitiveness, and establishing cost-efficient production processes. The high rating for „a cost efficient production process“ (4.69) indicates its critical role. Interestingly, „to address international markets“ received a comparatively lower rating (3.50) within this cluster, suggesting that while important, it might be seen as secondary to immediate cost and price competitiveness.

Table 6: Composition of cluster three

Statement ID	Statement on most relevant component for a CBMB	Average rating value
8	„to ensure competitiveness on the market.“	4.31
9	„to offer competitive product prices.“	4.31
41	„to adress international markets.“	3.5
52	„a cost efficient production process.“	4.69

Table 7: Descriptive statistics of cluster three

Average	4.203
Median	4.313
Variance	0.188
Standard deviation	0.434
Minimum	3.5
Maximum	4.688
Count	4

Cluster 4: Quality Assurance and Regulatory Compliance (Average Importance: 3.98)

This cluster stresses the importance of ensuring product and process integrity through internal and external quality control (e.g., certification) and meeting regulatory requirements. „To meet regulatory requirements necessary for production“ was rated highest (4.56), reflecting the critical nature of compliance in these industries.

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Table 8: Composition of cluster four

Statement ID	Statement on most relevant component for a CBMB	Average rating value
31	„the internal quaility control through testing of the final product.“	3.94
32	„the external quality control through product certification.“	3.44
33	„to meet regulatory requirements necessary for production.“	4.56

Table 9: Descriptive statistics of cluster four

Average	3.979
Median	3.938
Variance	0.212
Standard deviation	0.46
Minimum	3.438
Maximum	4.563
Count	3

Cluster 5: Bio-based Product and Process Innovation (Average Importance: 4.39)

This is the highest-rated cluster, underscoring the absolute priority given to developing new bio-based products that serve as alternatives to fossil options, designing reusable products, and ensuring resource efficiency. „To generate new bio-based products that are alternatives to the current fossil option“ and „resource efficiency“ both received very high ratings (4.69 and 4.63 respectively), highlighting the strong drive towards sustainable innovation.

Table 10: Composition of cluster five

Statement ID	Statement on most relevant component for a CBMB	Average rating value
4	„to design reusable products.“	3.94
7	„to generate new bio-based products that are alternatives to the current fossil option.“	4.69
10	„to produce/scale-up new bio-based products.“	4.31
14	„resource efficiency.“	4.63

Table 11: Descriptive statistics of cluster five

Average	4.391
Median	4.469
Variance	0.089
Standard deviation	0.298
Minimum	3.938
Maximum	4.688
Count	4

Cluster 6: Flexible and Scalable Bio-Based Production Models (Average Importance: 4.21)

This cluster emphasizes the practical aspects of production, including the need for bio-based raw materials with comparable performance to fossil options, modular and replicable production processes, and traceability of raw materials. This indicates a strong focus on operational excellence and industrial readiness for bio-based solutions.

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Table 12: Composition of cluster six

Statement ID	Statement on most relevant component for a CBMB	Average rating value
6	„bio-based raw materials with performance at least as good as the fossil based options.“	4.63
13	„a modular production process according to availability and request.“	3.69
34	„a replicable process model.“	4.38
35	„a tested and confirmed innovative production process.“	4.38
43	„tracebility of raw materials.“	4

Table 13: Descriptive statistics of cluster six

Average	4.213
Median	4.375
Variance	0.109
Standard deviation	0.33
Minimum	3.688
Maximum	4.625
Count	5

Cluster 7: Project Value at Local Level (Average Importance: 4.06)

This cluster, while somewhat overlapping with „Requirements for Local Impact and Sustainability“, specifically highlights creating new revenue streams for primary sector activities, understanding value chain bottlenecks, ensuring ecological value, and developing established logistical infrastructure including reverse logistics. „To understand the bottlenecks at each step of the value chain“ was highly rated (4.31), pointing to a recognition of operational challenges.

Table 14: Composition of cluster seven

Statement ID	Statement on most relevant component for a CBMB	Average rating value
11	„creating new revenue streams for primary sector activities.“	4.13
12	„to understand the bottlenecks at each step of the value chain.“	4.31
15	„to ensure ecological value.“	4.13
36	„an established and simple logistical infrastructure.“	4.19
37	„reverse logistic.“	3.56

Table 15: Descriptive statistics of cluster seven

Average	4.063
Median	4.125
Variance	0.067
Standard deviation	0.259
Minimum	3.563
Maximum	4.313
Count	5

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Cluster 8: Optimizing Value Chains for Ecological and Economic Benefit (Average Importance: 4.25)

This cluster underscores the strong commitment to circularity and waste valorization. Key statements include creating a circular supply chain, valorizing waste streams, and gaining knowledge about side streams. The high ratings for „to produce side streams instead of waste“ (4.44) and „the valorization of waste streams“ (4.56) clearly indicate the strategic importance of turning waste into value.

Table 16: Composition of cluster eight

Statement ID	Statement on most relevant component for a CBMB	Average rating value
38	„a circular supply chain.“	4.19
44	„knowledge about side streams.“	4
45	„to solve a waste problem at the producer level.“	4.06
46	„to benefit from side streams from other processes“	4.25
47	„to produce side streams instead of waste.“	4.44
48	„the valorization of waste streams.“	4.56

Table 17: Descriptive statistics of cluster eight

Average	4.25
Median	4.219
Variance	0.039
Standard deviation	0.198
Minimum	4
Maximum	4.563
Count	6

Cluster 9: Collaborative Ecosystem Development (Average Importance: 4.03)

This cluster emphasizes the importance of social value and active involvement and coordination of partners (especially biomass producers) within a joint ecosystem to facilitate organized value creation. Participants highly value the structured collaboration needed for effective ecosystem function.

Table 18: Composition of cluster nine

Statement ID	Statement on most relevant component for a CBMB	Average rating value
3	„to ensure social value.“	3.75
24	„to align and coordinate producers and downstream processing partners in a joint ecosystem.“	4.25
27	„the organized value creation along the partners.“	4.13
28	„to have involvement and buy in from biomass producers.“	4

Table 19: Descriptive statistics of cluster nine

Average	4.031
Median	4.063
Variance	0.034
Standard deviation	0.185
Minimum	3.75
Maximum	4.25
Count	4

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Cluster 10: Network & Knowledge Integration (Average Importance: 3.61)

This cluster, with the lowest average rating, focuses on cooperation with education and researchers, connecting diverse industries, sharing knowledge across sectors, and collaborating with logistic partners. While important, these „connection“ activities appear to be perceived as slightly less critical than direct production or market-oriented aspects.

Table 20: Composition of cluster ten

Statement ID	Statement on most relevant component for a CBMB	Average rating value
16	„a cooperation with education.“	3.44
19	„a cooperation with researchers.“	3.88
21	„a player to connect partners along the value chain.“	3.88
23	„the connection of previously distant industries.“	3.44
29	„to share knowledge across sectors.“	3.53
39	„a cooperation with logistic partners.“	3.5

Table 21: Descriptive statistics of cluster ten

Average	3.61
Median	3.517
Variance	0.036
Standard deviation	0.191
Minimum	3.438
Maximum	3.875
Count	6

Cluster 11: Multi-Stakeholder Collaboration & Open Innovation (Average Importance: 4.03)

This cluster broadly covers cooperation with various entities (municipalities, companies, government) to achieve synergies, collaborative value creation, and open innovation, including sharing best practices. The high rating for „synergies between stakeholders“ (4.44) suggests a strong belief in the power of diverse partnerships.

Table 22: Composition of cluster eleven

Statement ID	Statement on most relevant component for a CBMB	Average rating value
17	„a cooperation with municipalities.“	3.31
18	„a cooperation with other companies.“	4.13
20	„a cooperation with the government. „	3.69
22	„synergies between stakeholders.“	4.44
25	„collaborative value-creation among partners with different expertise.“	4.31
26	„collaborative innovation.“	4.38
30	„to share best practices.“	3.94

Table 23: Descriptive statistics of cluster eleven

Average	4.027
Median	4.125
Variance	0.145
Standard deviation	0.381
Minimum	3.313
Maximum	4.438
Count	7

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Overall Conclusion

The GCM results reveal a strong consensus among participants regarding the critical importance of innovation in bio-based products and processes, ensuring market competitiveness and efficiency, and optimizing value chains for circularity and waste valorization. While foundational resources are acknowledged as crucial, the focus heavily leans towards practical implementation and strategic collaboration across the value chain to realize the full potential of the circular bioeconomy. Aspects of network and knowledge integration, though valuable, appear to be seen as slightly less immediately critical than core business and circularity drivers.

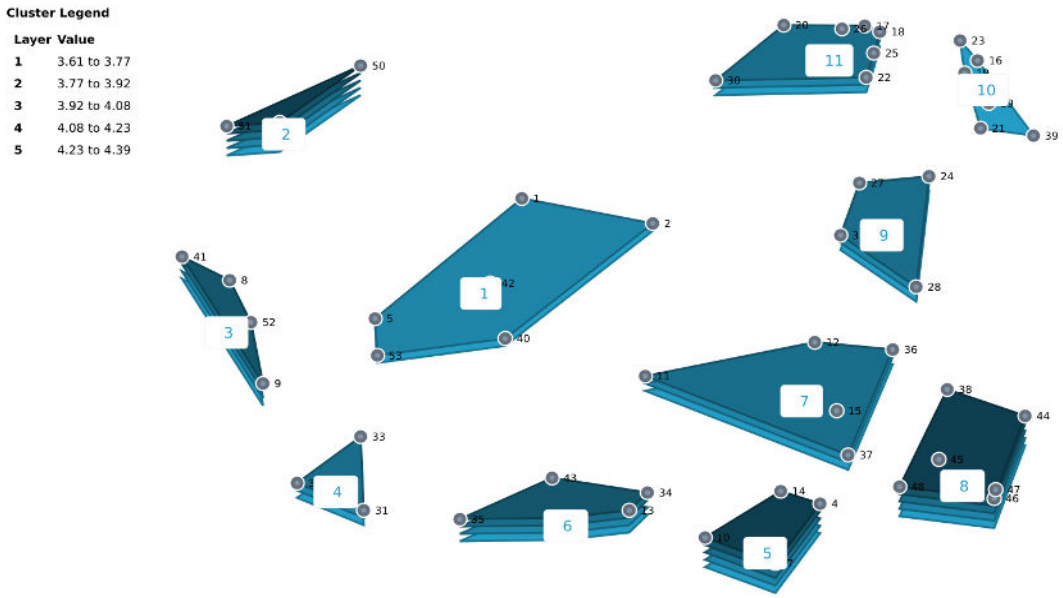

Figure 2: Cluster Map based on the Point Map in Figure 1

Given the strong fit of the data as indicated by the low stress value (0.24) - which underscores a reliable representation of the similarity matrices and reflects how each cluster or single criterion is related to each other - we are confident that this provides an excellent data foundation for the development of circular business models in the bioeconomy. In the next steps, we will first showcase how the generated and already known data are interconnected (Figure 3) , to then leverage this data to propose specific business models categorized into (1) bio-based products, (2) bio-based processes, and (3) new (bio-based) services.

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2. Illustration of the data connection/interdependencies of the CBMN

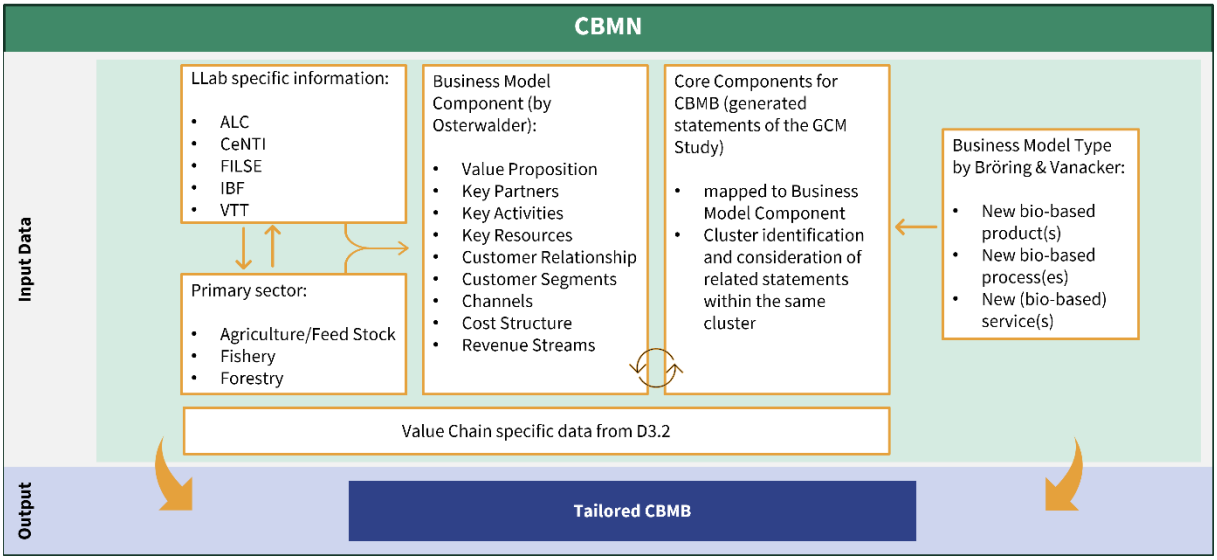

*Figure 3: Illustration of the used data and its connection within the CBMN**

*the value chain specific data from D3.2 will be implemented in the upcoming periods since this data is also generated within the third WP and cannot be used yet.

Further information about the database for the PRIMED CBMN can be found in the appendix.

3. The CBMN in the context of PRIMED and the related LLabs

To initially generate possible business models for the bioeconomy, we used the collected data of the GCM-study and the other WPs of PRIMED. We focused on classify the possible CBMB into the three business model types by Bröring & Vanacker, 2022. For the generation of the CBMB, we used a structured, data-driven approach to generate tailored CBMB. For the generation, we used the following data:

Primary Sector Data

The CBMN considers PRIMED related primary sectors to tailor the CBMB as fitting as possible. The PRIMED related primary sectors are:

- Agriculture & Feedstock
- Fishery
- Forestry

Business Model Components by Osterwalder

The CBMN uses the standard Business Model Canvas (BMC) framework to structure the CBMB. The data are assigned to the following components to get a better overview and understanding:

- Key Partners
- Key Activities
- Key Resources
- Value Proposition
- Customer Relationships

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- Channels
- Customer Segments
- Cost Structure
- Revenue Streams

GCM-generated Statements and Clustering

Based on the GCM, we use a combination of the generated statements on most relevant components for a CBMB and their specific clusters. This provides knowledge on which components belong together and needs to be addressed simultaneously.

Business Model Type Classification by Bröring & Vanacker, 2022:

Based on the combined inputs, the CBMN categorizes each CBMB into the following type(s):

- New bio-based product
- New bio-based process
- New (bio-based) service

This classification supports strategic direction and guides further development or prototyping.

Living Lab (LLAB) Contextualization

Finally, CBMN uses LLAB-specific background data (for further information please see here: https://primed-project.eu/the-project/), including:

- Current processes and products
- Existing business ideas and targeted markets
- Technological constraints or opportunities (will be implemented and respected even more, when the technology characterisation and risk-analysis (T3.1; NAKED, SINTEF) is finalized)

This enables adaptive configuration, where generated CBMBs are customized to each LLAB's environment.

1.4. Possible CBMB for PRIMED LLabs

The following CBMB for PRIMED LLabs should be seen as possible options to think about given the status-quo of the data we can access at the moment (30.06.2025). They were generated by extensive brainstorming and the help of AI. It is important to note, that they are not mandatory to realize and might change – regarding to the additional data we will gain in the future. But for now, the proposed CBMB should showcase the wide range of CBMB that could be possibly accomplished.

1.4.1. Bio-Lab: ALCARRÀS BIOPRODUCTS (ALC), LLab1

Carbon Farming & Soil Health Consultancy

Classification: New (bio-based) service

Description: Position ALC as experts in sustainable manure management and soil health. Offer consultancy services to other farms on optimizing manure application for carbon sequestration and soil improvement, thereby „ensuring ecological value“ (Value Proposition, Cluster 7) and helping farmers „solve a waste problem at the producer level“ (Key Activities, Cluster 8) while generating new income streams. This leverages ALC's deep understanding of their primary sector's waste and its benefits.

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- Connection to Data: Moves beyond product creation to service, focusing on „resource efficiency“ (Key Activities, Cluster 5 = Bio-based Product and Process Innovation) and „to ensure ecological value“ (Value Proposition, Cluster 7 = Project Value at Local Level), which are direct benefits of their current operations, now offered as a service.

Advanced Nutrient Recovery & Bio-Fertilizer Sales as a Service

Classification: New (Bio-based) Service (with a focus on new bio-based products as output of the service)

Description: Beyond producing basic fertilizer, ALC could develop and offer advanced nutrient recovery services to other farms, creating highly specialized, tailored bio-fertilizer products (e.g., concentrated nitrogen, phosphorus, or micronutrient solutions) from animal manure. This leverages „resource efficiency“ (Key Activities, Cluster 5 = Bio-based Product and Process Innovation) and „creating new revenue streams for primary sector activities“ (Key Activities, Cluster 7= Project Value at Local Level). It addresses „local needs“ (Value Proposition, Cluster 1 = Requirements for Local Impact and Sustainability) by providing high-quality, sustainable alternatives to chemical fertilizers.

- Connection to Data: Directly builds on ALC's existing process, expanding the „valorization of waste streams“ (Key Activities, Cluster 8 = Optimizing Value Chains for Ecological and Economic Benefit) to a more refined product with higher value and new revenue streams for ALC.

1.4.2. Bio-Silica Lab: CeNTI, LLab2

Waste-to-Value Technology Licensing & Consultancy

Classification: New (bio-based) service

Description: Beyond producing bio-silica, CeNTI could license its proprietary „tested and confirmed innovative production process“ (Key Activities, Cluster 6 = Flexible and Scalable Bio-Based Production Models) for converting agricultural waste into bio-silica to other companies globally. They could also offer consultancy services on setting up similar „cost efficient production process“ (Cost Structure, Cluster 3 = Market Competitiveness and Scalability) plants, effectively becoming a technology provider for circular economy solutions.

- Connection to Data: Leverages „a replicable process model“ (Key Activities, Cluster 6 = Flexible and Scalable Bio-Based Production Models) and „a tested and confirmed innovative production process“ (Key Activities, Cluster 6 = Flexible and Scalable Bio-Based Production Models) to create new revenue streams through technology transfer and consultancy, based on their expertise in waste valorization.

High-Purity Bio-Silica for Advanced Applications

Classification: New bio-based product

Description: Focus on refining the bio-silica production process to achieve extremely high purity levels suitable for specialized, high-value applications in automotive, textiles and construction industries, among other sectors. What needs to be understood is the limitation through regulations in this context. Especially for construction industry – as it is a new field.

- Connection to Data: Leverages the idea of a new bio-based product from the existing process, focusing on performance („bio-based raw materials with performance at least as good as the fossil based options“ - Key Resources, Cluster 6 = Flexible and Scalable Bio-Based Production Models) and „quality assurance and regulatory compliance“ (Cluster 4 = Quality Assurance and Regulatory Compliance).

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1.4.3. Liguria Bio-Lab: FILSE, LLab3

Integrated Bio-Valorization Hub for High-Value Marine & Agri-Waste Products

Classification: New (bio-based) Service (enabling new biobased products and processes)

Description: FILSE, as the Liguria Bio-Lab, would establish and operate an Integrated Bio-Valorization Hub. This hub would function as a central facilitator and orchestrator within the Ligurian bioeconomy, specifically targeting the valorization of „fishing and fish-industry side-streams“ and „food-waste or/and agri-waste“ (Feedstocks). The core service offered by this hub would be to connect and coordinate „biomass producers“ (e.g., fishermen, food processors, farmers) with „downstream processing partners“ and research entities (Key Partner - Cluster 9: Collaborative Ecosystem Development).

Leveraging „biomass pre-treatment, bioconversion tech and biodegradable films technologies“ (Technology), FILSE's hub would enable the transformation of these side-streams into „high-value added end-products“ such as. This directly addresses the „valorization of waste streams“ (Key Activities - Cluster 8: Optimizing Value Chains for Ecological and Economic Benefit) and the creation of „new bio-based products that are alternatives to the current fossil option“ (Value Proposition - Cluster 5: Biobased Product and Process Innovation)

The hub would also focus on understanding and overcoming „bottlenecks at each step of the value chain“ (Key Activities - Cluster 7: Project Value at Local Level), ensuring „resource efficiency“ (Key Activities - Cluster 5) in the conversion processes. FILSE's role as a connector, fostering „synergies between stakeholders and the „connection of previously distant industries“ (Key Partner - Cluster 11: Multi-Stakeholder Collaboration & Open Innovation), would be paramount. This includes active „cooperation with education and researchers“ (Key Partner - Cluster 10: Network & Knowledge Integration) to capitalize on new research and innovation, and partnerships with „municipalities and the government“ (Key Partner - Cluster 11) to build public-private partnerships and ensure „value for municipalities“ and „social value“ (Value Proposition - Cluster 1: Requirements for Local Impact and Sustainability; Cluster 9: Collaborative Ecosystem Development) within the regional context.

1.4.4. BioEire Lab: Irish Bioeconomy Foundation (IBF), LLab4

Bio-char Enhanced Bio-Materials for Construction

Classification: New bio-based product

Description: Collaborate with construction companies to integrate bio-char as a component in novel bio-based construction materials (e.g., bio-concrete, insulation panels). This is a direct application of „new bio-based products that are alternatives to the current fossil option“ (Value Proposition, Cluster 5 = Bio-based Product and Process Innovation) and creates „synergies between stakeholders“ (Key Partner, Cluster 11 = Multi-Stakeholder Collaboration & Open Innovation) from previously distant industries (forestry and construction).

- Connection to Data: Connects „the valorization of waste streams“ (Key Activities, Cluster 8 = Optimizing Value Chains for Ecological and Economic Benefit) with the creation of „new bio-based products“ (Possible Business Model), specifically targeting „the connection of previously distant industries“ (Key Partner, Cluster 10 = Network & Knowledge Integration).

Community-Based Bio-char Production & Local Application

Classification: New bio-based process / New (bio-based) service (in terms of setting up the process for others)

Description: Establish small-scale, decentralized bio-char production units in partnership with local forest communities or landowners, allowing them to convert their own forestry waste into bio-char for local soil enrichment or energy use. IBF would provide the technology, training, and quality control. This promotes „involvement and buy in from biomass producers“ (Key Partner, Cluster 9 = Collaborative Ecosystem

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Development) and „to adress local needs“ (Value Proposition, Cluster 1 = Requirements for Local Impact and Sustainability), ensuring „project value at local level“ (Cluster 7 = Project Value at Local Level).

- Connection to Data: Emphasizes „to have involvement and buy in from biomass producers“ (Key Partner, Cluster 9 = Collaborative Ecosystem Development) and „to ensure social value“ (Value Proposition, Cluster 9 = Collaborative Ecosystem Development) by decentralizing the production and promoting local use of the bio-product.

1.4.5. CellFactory Lab: VTT, LLab5

Upcycled Food Ingredient Development & Licensing

Classification: New bio-based product / New (bio-based) service (licensing)

Description: Focus on developing new, high-value food ingredients from food waste or agricultural side streams (e.g., fruit pomace, vegetable trimmings, spent grains from brewing). VTT could then license these „new bio-based products“ (Possible Business Model) and their „cost efficient production process“ (Cost Structure, Cluster 3 = Market Competitiveness and Scalability) to food manufacturers, ensuring „resource efficiency“ (Key Activities, Cluster 5 = Bio-based Product and Process Innovation) and reducing waste.

- Connection to Data: Directly leverages „to design reusable products“ (Key Activities, Cluster 5 = Bio-based Product and Process Innovation) and „resource efficiency“ (Key Activities, Cluster 5 = Bio-based Product and Process Innovation), specifically for food products from „waste streams“ (implied through circularity focus).

At the moment potential CBMB for VTT in the cosmetics industry (as one of their target industries/markets) are developed with collected information.

4. Future work: CBMN as a part of the PRIMED Toolbox

The CBMN will be integrated as a strategic tool within the PRIMED Toolbox (lead by NAKED Innovation), enabling users to systematically design, test, and evolve innovative business models. The CBMN will support the generation of CBMB, helping organizations create sustainable value through resource-efficient and regenerative strategies. To reach the best possible CBMB we will further try to implement additional information (if we are able to gather those), such as:

- Shared Value Metrics: agreed KPIs not just for profit but for sustainability, supply reliability, and social impact.
- Multi-party Contracts: Flexible frameworks that allow dynamic adjustments in price, volume, or risk-share.
- Traceability: A shared system that records feedstock provenance, processing parameters, carbon emissions, etc...
- Joint Investments: funds or SPVs to co-finance agronomic R&D, infrastructure, or end-market development.
- Governance Forum: approach for coordinating among the value chain partners.

Key Features of the Integration:

Circular Bioeconomy Focus: CBMN is adapted to guide users in developing circular business models that align with bioeconomy principles—such as closed-loop systems, waste valorization, and sustainable value chains.

Interconnected Tools: CBMN connects with other tools in the toolbox, enabling smooth transitions and shared data across different innovation activities.

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Data Interchange: Elements defined within the CBMN—such as target customer segments, value creation mechanisms, or circular flows—can be exported to or informed by other tools, ensuring consistency and iterative learning. Additional the respective mapped value chains out of D3.2 will be integrated in the CBM development and the CBMN. This will be done to give specific and more tailored BM examples for the participating LLabs of PRIMED.

Dynamic Feedback Loop: Insights from prototyping, stakeholder input, or lifecycle assessments can feed back into the CBMN, allowing real-time adaptation of business models to improve both sustainability and market fit.

User-Centered Experience: The toolbox supports a guided, intuitive workflow where CBMN acts as both a strategic entry point and a central reference for business model coherence throughout the innovation process.

This integration empowers users to design sustainable business models that meet the specific challenges and opportunities of the bioeconomy.

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5. Appendix

Primary Sector	Business Model Component	CBMB-related characteristic per component	Cluster no.	Cluster	Possible Business Model	LLAB (use case)
Agriculture and feedstock	Key Activities, Channels,	to adress local needs.	1	Requirements for Local Impact and Sustainability	New biobased product	ALC
	Value Proposition, Customer	value for municipalities.	1	Requirements for Local Impact and Sustainability		
Fishery	Segments				New biobased process	FILSE
	Value Proposition	to ensure social value.	9	Collaborative Ecosystem Development		
Forestry					New (biobased) service	IBF
	Key Activities, Value Proposition	to design reusable products.	5	Biobased Product and Process Innovation		
						VTT
	Key Activities, Value Proposition, Customer Relationships, Customer Segments	to inform the end user about a product that has both: high value and does not harm the environment.	1	Requirements for Local Impact and Sustainability		
						CeNTI
	Key Resources, Value Proposition	biobased raw materials with performance at least as good as the fossil based options.	6	Flexible and Scalable Bio-Based Production Models		
	Value Proposition	to generate new bio-based products that are alternatives to the current fossil option.	5	Biobased Product and Process Innovation		
	Cost Structure	to ensure competitiveness on the market.	3	Market Competitiveness and Scalability		
	Value Proposition, Cost Structure	to offer competitive product prices.	3	Market Competitiveness and Scalability		
	Key Activities, Key Resources	to produce/scale-up new bio-based products.	5	Biobased Product and Process Innovation		
	Key Activities	creating new revenue streams for primary sector activities.	7	Project Value at Local Level		
	Key Activities	to understand the bottlenecks at each step of the value chain.	7	Project Value at Local Level		
	Key Activities	a modular production process according to availability and request.	6	Flexible and Scalable Bio-Based Production Models		
	Key Activities, Cost Structure	resource efficiency.	5	Biobased Product and Process Innovation		
	Value Proposition	to ensure ecological value.	7	Project Value at Local Level		
	Key Partners	a cooperation with education.	10	Network & Knowledge Integration		
	Key Partners, Key Activities	a cooperation with municipalities.	11	Multi-Stakeholder Collaboration & Open Innovation		
	Key Partners	a cooperation with other companies.	11	Multi-Stakeholder Collaboration & Open Innovation		
	Key Partners	a cooperation with researchers.	10	Network & Knowledge Integration		
	Key Partners	a cooperation with the government.	11	Multi-Stakeholder Collaboration & Open Innovation		
	Key Partners, Key Activities	a player to connect partners along the value chain.	10	Network & Knowledge Integration		
	Key Partners	synergies between stakeholders.	11	Multi-Stakeholder Collaboration & Open Innovation		
	Key Partners, Key Activities, Key Resources	the connection of previously distant industries.	10	Network & Knowledge Integration		
	Key Partners, Customer Relationships	to align and coordinate producers and downstream processing partners in a joint ecosystem.	9	Collaborative Ecosystem Development		
	Key Partners	collaborative value-creation among partners with different expertise.	11	Multi-Stakeholder Collaboration & Open Innovation		
	Key Partners	collaborative innovation.	11	Multi-Stakeholder Collaboration & Open Innovation		
	Key Partners, Key Activities	the organized value creation along the partners.	9	Collaborative Ecosystem Development		
	Key Partners, Cost Structure	to have involvement and buy in from biomass producers.	9	Collaborative Ecosystem Development		
	Key Partners, Key Activities, Key Resources	to share knowledge across sectors.	10	Network & Knowledge Integration		
	Key Partners, Key Activities	to share best practices.	11	Multi-Stakeholder Collaboration & Open Innovation		
	Key Partners, Key Activities	the internal quality control through testing of the final product.	4	Quality Assurance and Regulatory Compliance		
	Key Partners, Value Proposition	the external quality control through product certification.	4	Quality Assurance and Regulatory Compliance		
	Key Activities	to meet regulatory requirements necessary for production.	4	Quality Assurance and Regulatory Compliance		

Figure 4: Data basis of the CBMN (generated through GCM study)

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