BIOVOICES

CONNECTING BIO-BASED FORCES FOR A SUSTAINABLE WORLD

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This Project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 774331

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DELIVERABLE 3.3

Mapping bio-based products (applications) based on stakeholders' interests

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ACRONYMS

BBP	Bio-Based Product
FBP	Fossil-Based Products
SDG	Sustainable Development Goals[1]
LCA	Life Cycle Assessment
1G, 2G, 3G	First Generation, Second Generation, Third Generation
CSO	Civil Society Organisation
NGO	Non-Governmental Organisation
B2B	Business to Business (as user)
B2C	Business to Consumer (as user)
BBI	Bio-Based Industries
LCA	Life Cycle Assessment

[1] http://www.undp.org/content/undp/en/home/sustainable-development-goals.html

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1. INTRODUCTION

1.1 SLOW TAKE-OFF AND ACCELERATION OF BIO-BASED ECONOMY

The bio-based economy refers to the usage of renewable natural resources such as wood and crops for fuel and materials such as packaging and furniture. A larger market size of bio-based products would lower the usage of fossil fuels and chemicals and therefore contribute to a more sustainable society. Despite these benefits the transition towards a European bio-based economy in terms of market uptake is proceeding slowly due to several innovation challenges (Overbeek & Hoes, 2018). With market uptake we refer to the development phases of business cases with 95% mature products, go-to-the market with mature products for niche groups, and acceleration to more mainstream groups.

1.2 MOBILISATION AND MUTUAL LEARNING (MML) WORKSHOPS

BIOVOICES aims at contributing to the market uptake of bio-based applications, by establishing a multi-stakeholder platform and animating open dialogue and collaboration between the stakeholders.

To reach the goal of multi-stakeholder involvement, the Mobilisation and Mutual Learning (MML) approach is used. This approach includes MML workshops in which actors from government, business, research and civil society participate and in which all actors are committed to solving complex problems based on sharing different perspectives, ideas, knowledge and experiences in open dialogues.

1.3 THE AIM OF THIS DELIVERABLE (D3.3)

The overall aim of D3.3 is to **define the challenges to be addressed during the Mobilisation and Mutual Learning (MMLs**) that:

- Are relevant, attractive and motivating for the Quadruple Helix stakeholders
- Have been identified (by the stakeholder) as central for the Bioeconomy and BBPs market uptake
- Should be addressed to unlock the potential of Bioeconomy
- Could benefit from the Quadruple Helix collaboration to deliver impactful outcomes (policy recommendations, action plans, agreements, further collaboration among stakeholders, etc.)

These challenges will be validated during several rounds with stakeholders and experts in autumn 2018, will flow in the document “BIOVOICES Methodological approach for Mobilisation and Mutual Learning” (D4.4) to be used by the partners to design the MMLs at local, regional, national and international level.

1.3.1 Focus on challenges versus Bio-based Products

Compared to the planned objective of T3.3, namely “Mapping the bio-based products (applications) based on stakeholders’ interests”, the present deliverable is more focusing on “Challenges” that have been identified as relevant for the BBPs market uptake.

The analysis of the interviews conducted during T3.2 and the existing studies and literature show that there are challenges and opportunities common to different BBPs and Value Chains that need to be

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addressed to create the conditions for the Bioeconomy and BBPs market uptake. For this reason we decided to adopt a challenge-oriented approach, rather than a product-oriented approach to widen the impact of the outcomes and benefit from the Quadruple Helix Stakeholder collaboration, and contribute to the creation of favourable conditions for market uptake of Bioeconomy in general, rather than specific BBPs.

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2. MULTI-STAKEHOLDER ENGAGEMENT TO SOLVE COMPLEX PROBLEMS

Solving these innovation challenges to enhance bio-based markets requires ideas, information and actions from multiple stakeholders such as policy makers, businesses, researchers and civil society. The word *quadruple helix model* (QH) is used to highlight that all these stakeholders are needed to co-create the future and drive structural changes far beyond the scope of what any one organisation or person could do alone (Carayannis & Campbell, 2009).

2.1 The need to shift to Quadruple Helix model

The idea of the quadruple helix model is that the proactive collaboration among stakeholders from civil society, industry, academia and governments is needed to co-create the future and drive structural changes. The novelty of the quadruple helix model to enhance the market uptake of bio-based applications is that it avoids sectoral cooperation within one or two stakeholder groups, i.e. academia with industry or governments.

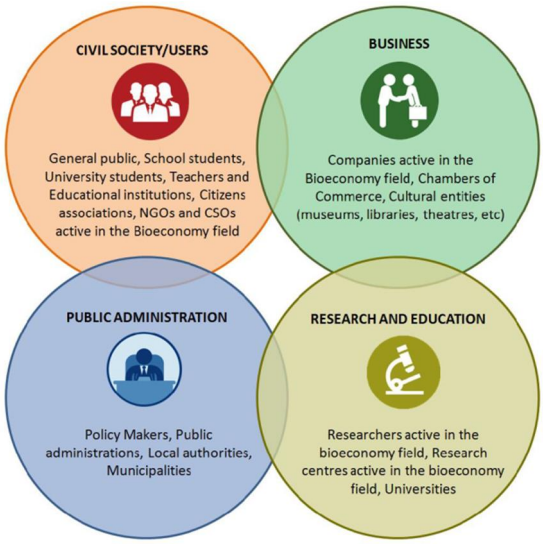

Fig. 1: The Quadruple Helix model

Both the Triple Helix concept (Etzkowitz & Leydesdorff, 1995) and the Quadruple Helix (Yawson, 2009) approach are grounded on the idea that innovation is the outcome of an interactive process involving different spheres of actors, each contributing according to its "institutional" function in society. Whilst the triple helix consists of university, industry, and government, in the quadruple helix civil society is the additional sphere included. Academia and businesses provide the necessary conditions for an integrated innovation ecosystem. Governments provide the regulatory framework and the financial support for the definition and implementation of innovation strategies and policies. Civil society not only uses and applies knowledge and demands for innovation in the form of goods and services, but also becomes an active part of the innovation system. Yawson (2009) formalised the user as a fourth sphere supported by the idea that innovation is driven by the needs of the users. This process implies two elements: first, an

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effective interaction between at least university and industries and second citizens' contribution to the innovation model. This entails a shift in focus from the more technical elements in an innovation process to the more social innovation challenges, in light of the Sustainable Development Goals (SDGs)[2].

The shift from a triple helix to a quadruple helix goes in tandem with a change in knowledge production. Initially a linear approach was introduced to explain knowledge production and innovation, including a sequence of research (basic and applied) and commercialization (market test and diffusion). This linear approach was later criticised and changed with the introduction of a dynamic/systemic behaviour in which different actors are considered to be interacting into a non-linear path characterized by feedback mechanisms. In this framework a systems approach is applied for describing the knowledge creation, i.e. from "Mode 1" to "Mode 2" (Gibbons et al., 1994) or even "Mode 3" (Carayannis & Campbell, 2006, Carayannis & Campbell, 2009, Carayannis et al., 2016). While the concept of "Mode 2" of knowledge production is related to a context-driven research, "Mode 3" knowledge production focuses on and leverages higher order learning processes and dynamics that allow for both top-down government, university and industry policies and practices as well as bottom-up civil society and grassroots movements initiatives and priorities.

Establishing a quadruple helix is not an easy task, because it requires shared objectives and a common language among stakeholders. The quadruple helix is useful in an innovation process where the needs of citizens are central. When creating an innovation in the triple helix model, there is often the involvement of the citizens and end-users is not foreseen and therefore their perspective is not considered or only indirectly taken into consideration. Arnkil et al. (2010) propose four different types of quadruple helix models, which are characterised by a specific owner of the innovation process and by the involvement of the user:

- The "**Triple Helix + user model**" is an approach where innovation has a technical nature and knowledge a scientific one, and where the owners of innovation belong to the industry or to the university sphere. Innovation is designed for users as informants (not as developers).
- The **Firm-centred living lab model** includes all the potential sources of innovation based either on the frontier-research or on new applications or combinations of already-existing knowledge and/or on user knowledge. Although the owner of the innovation process remains the industry sphere and users are considered as both informants and developers, innovation is designed with users .
- The **Public sector-centred living lab model** focuses on innovation in the public sector and its services. The owner of the innovation process is the government sphere. Interaction of experts with users aims at improving the efficiency and effectiveness of public administration products and services for citizens. Also here, innovation is designed with users and feedback information from the citizens can be gathered with traditional methods (e.g. surveys), with dialogue events (e.g. events) or within living lab environments.
- Within the **Citizen-centred Quadruple Helix model** innovation is led by citizens with the support of the other three spheres. Civil society is the owner of the innovation process and innovation is designed by users. In practice, the latter model is essentially a theoretical approach.

[2] http://www.undp.org/content/undp/en/home/sustainable-development-goals.html

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Arnkil et al. (2010) report that only the Triple Helix + users model and Firm-centred living lab model have actual applications. Cases of the Public sector-centred living lab model have been identified in some projects aimed at developing public services. Hence a shift from a technical to a social innovation is still a challenge that has to be made.

Also in the bio-based economy the quadruple helix cooperation is more an ideal situation than a reality. Usually, internal oriented stakeholders, i.e. research and business, mainly cooperate to realise technological development. This may end in the" valley of death"[3] if not enough attentions is paid to the needs and requirements of external stakeholders, i.e. government and civil society. As identified during the interviews conducted with the stakeholders during the first months of BIOVOICES project, there are some barriers hindering the Bioeconomy growth that could be addressed improving the circulation of information, awareness and shared action plans among stakeholders (ref D3.2). A typical example is the lack of norms, standards and labelling, identified as a key question to be addressed, because it is perceived by the stakeholders as an important constraint to research development, market diffusion or waste management of bio-based products.

2.2 CURRENT MULTI-STAKEHOLDER ENGAGEMENT IN BIO-BASED ECONOMY

Until now, actors and groups that do not participate in the technical development of bio-based applications, such as citizens and brand-owners, are marginally involved in the transition towards a bio-based economy. An earlier European study indicates that **groups such as citizens and brand-owners are mainly informed about the bio-based economy and play a minor role in facilitating, co-creating and financing bio-based applications** (Overbeek et al., 2016; Gerdes et al., 2018). This is a missed opportunity as user involvement (business to business and business to consumer) is key to develop bio-based applications that are considered valuable and desirable, essential for crossing the "valley of death" and achieving take-off and acceleration (Osterwalder & Pigneur, 2010; Rogers, 2003).

In order to create a shift from a technical to a social innovation, and from a triple helix into a quadruple helix, it is important to consider the different stakeholders and their perspectives, i.e. civil society, businesses, policy makers, research and education.

Civil society

Civil society organisations (CSOs) and non-governmental organisations (NGOs) and citizens play an important role in mobilising normative pressure which is usually necessary to trigger value chains to change their practice (Geels & Schot, 2007). So far, the number of CSOs and NGOs that cooperate with other stakeholders in the bio-based economy is quite low, which is argued to be caused by the technology development driven research agendas (Meeusen et al., 2015, Overbeek et al., 2016). CSOs and NGOs focus on societal impacts of the bio-based economy and its transformation failures rather than on technological/scientific development or business development and its market failures. Although to an

[3] The "valley of death" is a common term in the startup world, referring to the difficulty of covering the negative cash flow in the early stages of a startup, before their new product or service is bringing in revenue from real customers.

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increasing extent CSOs are interested in participating in bio-based research and coordination projects, the issue of bio-based economy is not high on their own agendas (Gerdes, 2018). If bio-based research and innovation agendas want to safeguard their legitimacy vis-à-vis European citizens, the globally agreed Sustainable Development Goals (SDGs) have the potential to drive a louder and more persistent voice to demand and implement the bio-based economy. The CIMULACT project (www.cimulact.eu) has demonstrated that up-stream engagement of citizens in research and innovation agenda-setting is possible.

CSOs and NGOs can play different roles in the bio-based economy varying from disrupting the status quo through confrontation (polarising) to constructive collaboration to develop alternatives. Many of them appear to have a watchful to critical stance towards the use of biomass for the production of bio-based products (Meeusen et al., 2015). They are wary of potentially negative environmental and social impacts of feedstock production and ask for transparent and credible information on sustainability aspects of bio-based products and their production processes. Corporate engagement has been an important issue for major NGOs/CSOs, the scope of which has been expanding to cover both environmental aspects and social aspects. They are actively working on issues related to bio-based products, their bio-degradability and sustainability certificates, which correlate with the phases of take-off and acceleration. They are most relevant as interlocutors, in particular with CSOs who seek constructive collaboration with business, government and other stakeholders to develop alternatives (Meeusen et al., 2015). Although these "polarisers" participate less often, their interests can guide the agendas of the collaborative CSOs and NGOs. MML sessions can help to clarify the user perspective and the expected societal impacts.

Businesses

Here, we consider the role of businesses in their entrepreneurial role to contribute to market uptake. Therefore, the availability of well-developed, but still not competitive and not institutionally adapted bio-based applications is important. Furthermore, the promise of further market development according to the perspective of other producers and potential users, is relevant to create business cases (Hekkert et al., 2011). Businesses that are ready for take-off may be compared to innovators as potential adopters of innovations (Rogers, 2003). Potential adopters evaluate an innovation on its relative advantage to current tools or procedures, its compatibility with the existing system, its complexity or difficulty to learn, its testability, its potential for reinvention, and its observed effects. Even with this high learning curve, potential adopters might adopt the innovation anyway. Businesses in the acceleration phase are comparative to early adopters. They are more discreet in their adoption choices than innovators.

In order to address common challenges, business may reconsider their value creation and define the problems of their customers more broadly than solely or mainly based on financial values (PWC, 2017). If they also want to generate social value, they have to focus on social impact areas that are strongly related to the rest of the company, and to realize that they are already generating multidimensional value. Businesses that sell products can, for instance, focus on developing fair supply chains. Integrating a social impact mission in a company's core value proposition can be achieved by developing a broader and more holistic view of customers and to consider them as part of an ecosystem of stakeholders that they want to support and improve. Mainstream businesses should therefore try to see their customers

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as partners with which they can cooperate to obtain a shared mission. A number of companies already work with NGOs and other consumer-oriented businesses to realise this. MML sessions can help to increase this collaboration.

Policy

For building innovation systems, there are not only actors giving impetus to new markets, such as researchers and technology developers, but also actors that judge the new technologies and decide whether to support them or not. Policy maker are important are important players in enhancing or hampering an innovation (Hekkert et al., 2011). Based on expectations of the innovation, they may invest in the technology development. Governments could also adjust the current legislation to stimulate the adoption of the new products. They can also create markets by introducing a more favourable taxation or incentives for Bio-based products, compared to fossil-based products.

This approach would be applied in particular in the take-off innovation phase when the dominant bio-based designs become clear. Another important role of selectors is that policy makers and investors can stop innovations with too little potential through a reduction of financial investments. This avoids too much time being spent on innovations without the possibility of success.

Research and education

Researchers have an important role in the development of new innovations. Besides contributing to the technological developments as such, they also create expectations of the new technologies and communicate them towards policy makers in order to obtain increased investment (Hekkert et al., 2007). Furthermore, researchers conduct feasibility studies, and contribute to conferences, workshops and knowledge exchange events. Besides undertaking research, universities and schools also have an important task to educate students as potential developers of new bio-based products and to inform citizens about new circular bio-based perspectives.

2.3 THE ROLE OF BIOVOICES IN BOOSTING MOBILISATION AND MUTUAL LEARNING AMONG STAKEHOLDERS

Promoting open dialogue and proactive collaboration among stakeholders is necessary to create a stimulating environment for the Bio-Based Products and in general for the Bioeconomy market uptake, maximising the opportunities and addressing the barriers.

To support this collaboration, BIOVOICES will establishing a multi-stakeholder platform and animating open dialogue and collaboration between the above mentioned Quadruple Helix stakeholders, using the Mobilisation and Mutual Learning (MML) approach. This methodology promotes the sharing different perspectives, ideas, knowledge and experiences in open facilitated settings.

To that end, each MML workshop, organised by the partners at international, national and regional/local level will address one or more of the challenges identified in Chapter 4, elaborating them based on:

1) The expected outcomes, that should be relevant and actionable by the QH stakeholders
2) The specific national/regional/local context/conditions
3) The most relevant key questions to be addressed in the selected challenge to reach and impact

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3. DEFINITION OF RELEVANT CHALLENGES FOR MMLS

In order to make sure that the contents addressed by the BIOVOICES MMLs are relevant, interesting, motivating for the stakeholders and that the MMLs workshops outcomes will have an impact on the BBPs market uptake, the project adopts the process and methodology detailed below to identify and elaborate on the most relevant challenges thus contributing to boosting bio-based market uptake.

3.1 DESIGN OF MMLS: THE PROCESS ADOPTED

The figure below summarizes the process used by BIOVOICES to design Mobilisation and Mutual Learning Workshops. In the process, the core document (D3.3, in light blue box in Fig. 2 below) aims at **identifying the most relevant challenges to be addressed during the Mobilisation and Mutual Learning (MMLs)** that will be organised by the BIOVOICES project at local/regional, national and international level.

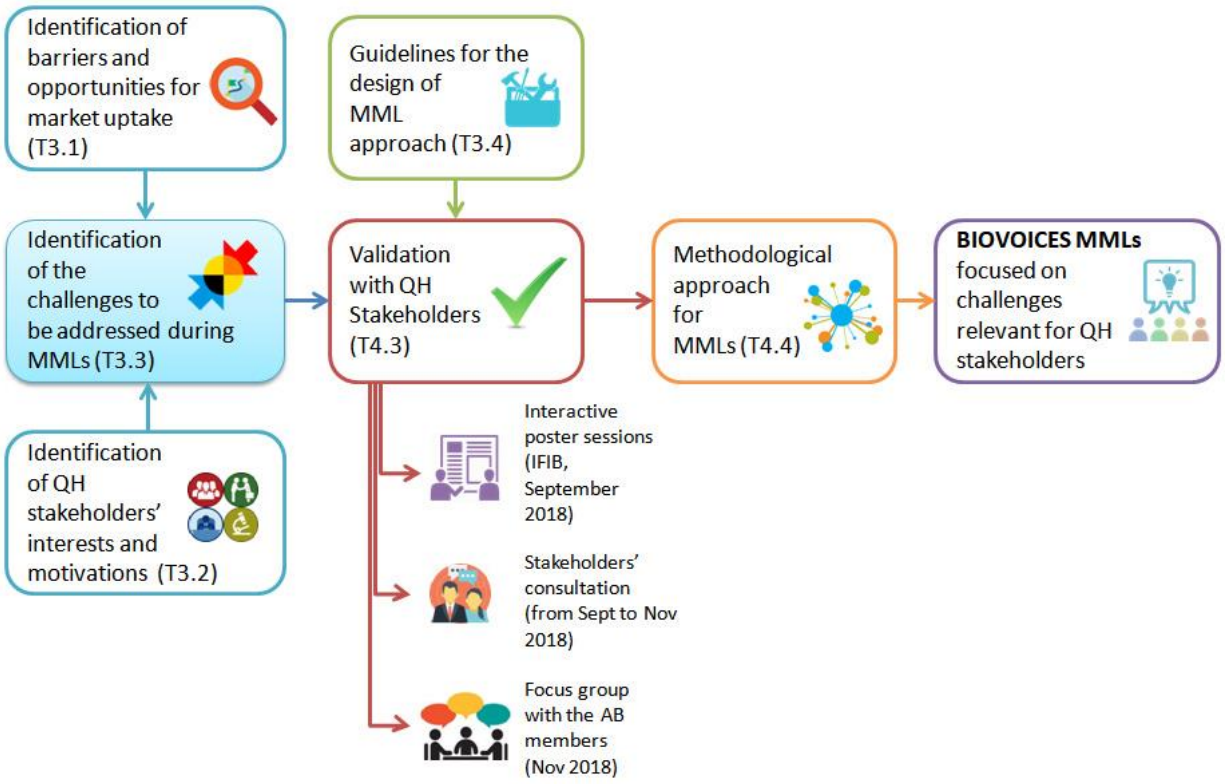

Fig. 2: The process used by BIOVOICES to identify the relevant challenges to be used during MMLs

To identify these challenges, two activities took place in the first months of the project to:

1) Identify and analyse the barriers and opportunities for market uptake (D3.1):
- Enablers
- Barriers
- Best practices and success stories
- Analysis of the most promising BBPs per application sectors and development phase

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2) Identification of Quadruple Helix stakeholders' motivation and interests (D3.2):
- 82 interviews conducted to identify the main interests and motivations for the Quadruple Helix Stakeholders
- Identification of the main challenges, taking into account stakeholder interviews, desk based research of policy documents, strategies and recommendations including the key priorities identified in the review of the 2012 European Bioeconomy Strategy (that will be delivered in October 2018).

The outcome of these activities enabled the partners to identify 12 main challenges and to cluster them in the following areas:

A: Market development

B: Awareness and trust building

C: Supporting strategies, regulatory frameworks legislation and standards

D: Supporting environment (Infrastructures, intermediaries, new business opportunities)

E: Regional/Local development

The 12 challenges will be further elaborated, integrated and validated during several forthcoming activities with a large number of stakeholders, specifically:

With whom	Context	When	How	Expected outcome
Experts and Quadruple helix stakeholders (international)	Partners' networks	From September to November 2018	Direct consultation	- Validation of the challenges - Possible identification of new challenges
Quadruple helix stakeholders (international)	IFIB – Torino, Italy	26-28 September 2018	Poster session: The challenges will be displayed in posters in a dedicated space at IFIB. The participants will be provided with coloured post-its (one colour per stakeholders' type) and they will be asked to note the key issues they believe should be addressed during an MML focused on the challenge the poster is dedicated to.	- Validation of the challenges - Possible identification of new challenges - Identification of relevant key issues to be addressed during the MMLs

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			In addition to that, the participants will be asked to suggest additional challenges they might find relevant.	
Quadruple helix stakeholders (international)	BIOVOICES Focus Group - Rome	13 and 14 November 2018	Focus Group with invited experts from the Quadruple Helix. During two days of workshop, the Stakeholders will analyse the 12 challenges and will identify, for each challenge, what are the key questions to be addressed during the forthcoming MMLs	ŏ Validation of the challenges ŏ Possible identification of new challenges

The validated challenges, together with the "guidelines for the design of the MML approach" (D3.4) will flow into the "Guidelines for the design of the BIOVOICES mobilisation and mutual learning approach" (D4.4), that will be used by the partners to design the MMLs at local, regional, national and international level.

3.1 DEFINITION OF RELEVANT CHALLENGES: THE METHODOLOGY ADOPTED

3.1.1 Clusters of Challenges

Based on the literature search (see Overbeek & Hoes, 2018) and the interviews (ref D3.2) we have distinguished five clusters each with two or three challenges dependent on the phase of development of the innovation.

A) The first cluster of challenges deals with the creation of markets by businesses that produce bio-based products, either for supply to the initial customer/s or for niche markets attracted by the unique selling points of sustainable innovations.
B) The second cluster of challenges concerns the building of awareness and trust with users by improved communication with interested business and consumers as well as among target groups that might be relevant for later adoption.
C) The third cluster of challenges concerns the development of European and national supporting strategies (incentives), regulatory frameworks, legislation and standards to stimulate the production and use of bio-based products.

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D) The fourth cluster of challenges relates to the environment required to improve the production of resources, such as more 2G feedstock and intermediaries to stimulate the production and use of bio-based products.
E) The fifth cluster of challenges is related to regional/local action plans and activities designed to stimulate the production and use of bio-based products.

The five clusters result in 12 challenges with different motivations for each quadruple helix stakeholder.

3.1.2 Development phases of innovation systems

To recognise and accommodate shared objectives, we will frame the interests of each stakeholder group into a list of shared challenges.

To identify and develop shared challenges, it is important to distinguish the phases in innovation systems in which both internal as well as external stakeholders are interested and can contribute effectively. Hekkert et al. (2011) distinguish the following phases of development:

- During the **Predevelopment** (P) and **Development** (D), the bio-based economy is introduced in the planning agenda and the policy, socio-economic and R&D landscape for its establishment and operation are created. The end of development is marked by the realisation of a commercial application and is mainly characterised by the entrepreneurial activity and research development.
- The phase of **Take-off** (T) shows a substantial growth: the first competitive bio-based products are sold in the market, new companies join the cluster or value chain, the infrastructure (business incubators, training centre etc.) is established, and the cluster is able to attract both private and public funding. During the take-off, it is more likely to get brand owners and manufacturers, governments and civil society interested in the development and market uptake of the bio-based economy. The take-off phase ends with a fast market growth. For the T-phase, entrepreneurial experimentation and production is critical in tandem with counteracting resistance to change and building legitimacy.
- In the phase of **Acceleration** (A), the cluster is able to produce competitive bio-based products at an extensive scale and can count on an increasing demand. This phase ends with market saturation. For the A-phase market formation is the most important system function, as a growing market fuels the innovation system to develop and diffuse further.

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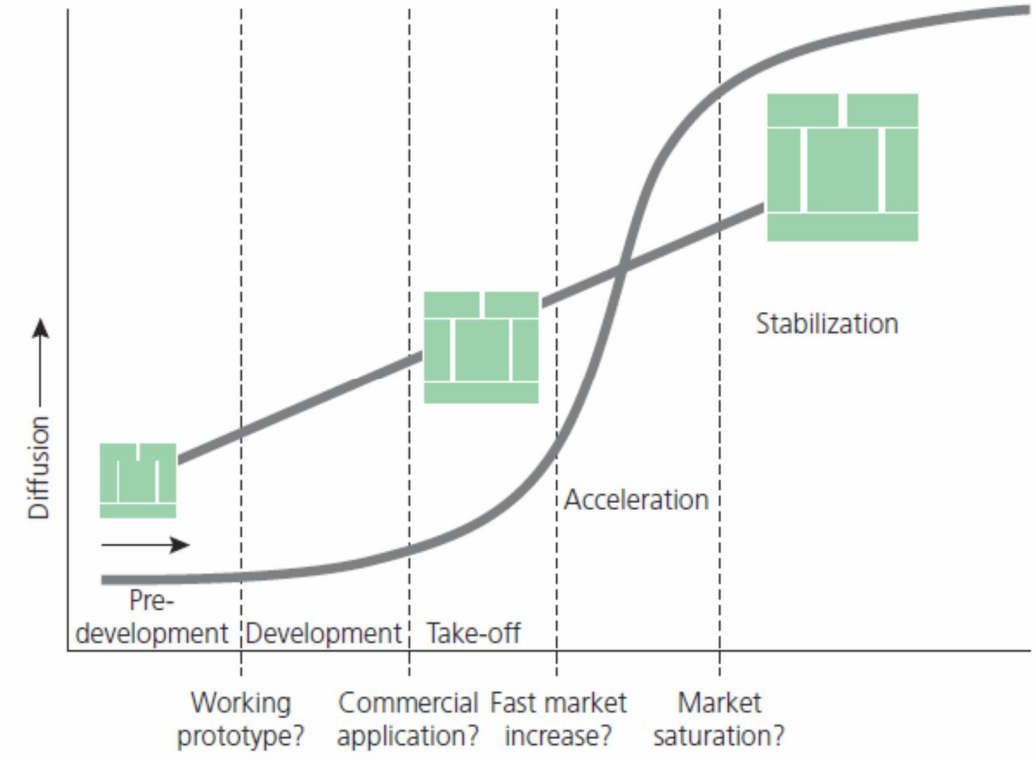

Fig. 3: Phases of development - Source: Hekkert et al., 2011.

For participative governance with shared challenges, commercial application, take-off and acceleration phases are most relevant to interest the external stakeholders, i.e. civil society and governments. At the (pre)development stage, when the innovation is relatively unknown, consumers and civil society organisations often play a minor role because potential applications and potential impacts are unclear. Despite this practical argument, several scholars note that perceptions of various stakeholders need to be integrated earlier to be able to develop applications that are viewed as valuable by consumers and citizens (Oudshoorn et al., 2004). Therefore, challenges will be included as long as they attract a balanced number of civil society actors to participate.

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3.1.3 Overview of clusters and related challenges

The following table summarizes the interconnections among the 5 clusters and the 12 challenges identified. The 12 Challenges have been structured based on three Development phases of innovation systems described below.

Clusters	Innovation Phase		
	1 Business case: Product is 95% mature and becomes a business case	2 Go-to-market: Product is mature and market increases to 5% among niche groups	3 Acceleration: Market increases above and reaches new user groups
A: Market development (Economy)	A1 Challenge: FIND FIRST CUSTOMERS	A2 Challenge: SPECIFY UNIQUE SELLING POINTS (USP)	A3 Challenge: UP-SCALING
B: Awareness and trust building		B2 Challenge: CHANGES IN PURCHASE HABITS	B3 Challenge: INCREASE THE ADOPTION
C: Supporting strategies, regulatory frameworks legislation and standards		C2 Challenge: INTRODUCE EU & NATIONAL INCENTIVES	C3 Challenge: REALISE STANDARDISATION
Cluster D: Supporting environment (Infrastructures, intermediaries, new business opportunities)	D1 Challenge: IMPROVE THE ECOSYSTEM TO ENHANCE BUSINESS CASES	D2 Challenge: B2B USERS AS FRONTRUNNERS	D3 Challenge: INCREASE SUSTAINABLE FEEDSTOCK FOR IDENTIFED BB PRODUCTS 2G BIO-BASED
Cluster E: Regional/Local development	E1 Challenge: ENHANCE LOCAL BIOECONOMY STRATEGIES and ACTION PLANS	E2 Challenge: BOOST LOCAL DEPLOYMENT	

3.1.4 Transforming Challenges into topics to be addressed during MMLs

Once the 12 challenges were itemised, the partners identified the elements that should be taken into consideration for the design of the Mobilisation and Mutual Learning workshop in order to address those challenges.

The chapter below describes for each challenge, the following elements:

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Challenge Title	Title
Related Cluster	*Area the challenge refers to :* *A: Market development* *B: Awareness and trust building* *C: Supporting strategies, regulatory frameworks legislation and standards* *D: Supporting environment (Infrastructures, intermediaries, new business opportunities)* *E: Regional/Local development*
Innovation Phase	*Innovation Phase where the Challenge is more relevant, among:* *1: Business case: Product is 95% mature and becomes a business case* *2: Go-to-market: Product is mature and market increases to 5% among niche groups* *3: Acceleration: Market increases above and reaches new user groups*
Explanation	*Explanation of the challenge*
Related application sectors	*To better contextualise the challenges, the following application sectors have been identified.* 1. *Cleaning and hygiene, personal care and cosmetics, health and biomedical* 2. *Textile products, clothing, sports and toys* 3. *Food packaging, disposable products for catering and events* 4. *Biofuels and bioenergy* 5. *Building, construction and restoration, paintings, decorations and furniture* 6. *Nutraceuticals, environmental bioregulation and biological sensors*
Key Questions	*The Key questions to be addressed during the MML.* *These key questions will be defined in collaboration with the stakeholders during the validation phases of the challenges, taking into consideration the expected outcomes of the MMLs in terms of "actionable knowledge" by the different stakeholders.*
Market perspectives (PESTLE)	*PESTLE* analysis to describe the Market* *A PESTEL analysis is an acronym for a tool used to identify the macro (external) forces facing an organisation. The letters stand for Political, Economic, Social,*

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	Technological, Environmental and Legal. Depending on the organisation, it can be reduced to PEST or some areas can be added i.e. International. https://blog.oxfordcollegeofmarketing.com/2016/06/30/pestel-analysis/
Literature	*Related literature*
Stakeholders' Motivations	*The motivation for each stakeholder type:* *B = Business* *C = Consumer* *G =* Government or Policy makers *R = Research and Education* *To identify the stakeholders having the main motivation push ("problem owner"), the following colour codes are used:* ***Green:** Stakeholder having the main motivation* ***Orange:** Stakeholder interested* *Others: important, but not indispensable*
Possible output	*Outputs related to the challenge*
Possible Collaboration	*List of projects/initiatives to collaborate with.* *It is important to start identifying not only projects that are focusing on topics related to the challenges identified, but also to start mapping international, national and local events where it could be possible to run an associated MML event.* *This content will be further elaborated in D3.4 and D4.4.*
Possible MML Format and type of outcome	*The format of the MML and the type of outcome (i.e. policy recommendations, action plan, users' involvement, etc…. will be elaborated in D3.4 and D4.4.* *Indeed this is not strictly related to the challenge, but rather to the MML designed in the context of the challenge. Indeed, the specific contents of an MML could focus on a dimension of a challenge or address more challenges in a workshop, depending on the context.*

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4. THE 12 CHALLENGES RELEVANT FOR THE BIOVOICES MMLs

As mentioned before, the BIOVOICES partners have identified and elaborated on 12 Challenges that will be further validated with experts and stakeholders, to be used for the MMLs.

This chapter proposes the actual status of the challenges, ready for the validation.

4.1 CLUSTER A: MARKET DEVELOPMENT

Cluster A: Market development	Innovation phases		
	1 Business case: Product is 95% mature and becomes a business case	2 Go-to-market: Product is mature and market increases to 5% among niche groups	3 Acceleration: Market increases above and reaches new user groups
Challenges	**A1: FIND FIRST CUSTOMERS**	**A2: SPECIFY UNIQUE SELLING POINTS (USP)**	**A3: UP-SCALING**
Explanation	Launching a BBP requires investment that can be made if customers or investors are present. The idea is to create markets through cooperation between the businesses that produces the BBP and their first customer(s) (who can be consumers, other businesses (B2B), governments and CSO's). The launching customer guarantees the first sales, can provide feedback on early versions of the product and share risks and benefits.	Identify bio-based (BBP) unique selling point such as additional features and functions which go beyond providing a sustainable alternative compared to FBP and bio-degradability (more than costs/features).	Find BBP that are consistently available in large quantities. Create, find and extend new markets by bringing more and diverse BBP to mainstream user groups.
Related application sectors	Packaging (3); Building (5)	Textile (2); Packaging (3); Building (5)	Cleaning and hygiene (1); Packaging (3); Building (5)

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4.1.1 Challenge A1: FIND FIRST CUSTOMERS

Challenge	A1: FIND FIRST CUSTOMERS
Cluster	A: Market development
Explanation	Launching a BBP requires investments that can be made if customers or investors are present. The idea is to create markets through cooperation between the businesses that produces the BBP and their first customer(s) (who can be consumers, other businesses (B2B), policy makers and CSO's). The first or "launching" customer guarantees the first sales, can provide feedback on early versions of the product and shares risks and benefits.
Key Questions	ŏ Which examples of innovative BBP business cases could be provided? ŏ How to increase innovative BBPs ability to meet consumer's expectations and select identified markets? ŏ How to find your first and launching customers? ŏ How to organise extended warranty, service contracts and take-back options for customers of first sales? ŏ How to increase the role of policy makers to boost the BBP market through being a launching customer? ŏ How to get access to private capital?
Market perspectives (PESTLE)	It makes economic sense o share risks and benefits (Overbeek & Hoes, 2018). Many fossil-based products have been developed in large companies or via developed value chains which were able to share risks associated with teething troubles and market failures. . Currently, there are few large companies or value chains which are prepared to share those risks. For start-ups it is difficult to take responsibility for all these risks during the last phase of development and to invest for years before they can go to market. Access to private capital is difficult for start-ups whilst significant investments have been made by large companies (Leoussis & Brzezicka, 2017). To mitigate uncertainties and to enhance sustainability credentials, new product development should be based on mutually beneficial collaboration between suppliers and customers in the value chains and reaching over sectoral boundaries. Similarly, guaranteeing benefit-sharing from increased "value added" between those who offer and those who compete for the valuable and scrutinizing resources will probably be an essential aspect (Pätäri et al., 2016). Although some member states have started pilot projects based on bio-based procurement, public procurement schemes in Europe are less developed than in the United States, where governments have created a bio-based preferred programme that clarifies the % of bio-based materials used in the total content of the product and its packaging. So far in Europe, there is no binding preference for bio-based products and no official EU- sanctioned product list (catalogue) as has been createdin the United States.
Literature	ŏ Leoussis, J. & P. Brzezicka (2017). *Study on Access-to-finance conditions for Investments in Bio-Based Industries and the Blue Economy.*

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	http://www.eib.org/attachments/pj/access_to_finance_study_on_Bioeconomy_en.pdf. The study provides an in-depth analysis of the challenges and opportunities faced by Bioeconomy projects in attracting financing and mobilising investment. ŏ Pätäri, S., A.Tuppura, A. Toppinen & J. Korhonen (2016). Global sustainability megaforces in shaping the future of the European pulp and paper industry towards a Bioeconomy. *Forest Policy and Economics,* 66, p. 38-46. https://doi.org/10.1016/j.forpol.2015.10.009 ŏ Overbeek, G & A-C Hoes (2018). *D1 BIOVOICES. Synthesis of market perspectives to develop bio-based value chains.* http://www.biovoices.eu/results/public-results. This report presents an overview of the existing barriers and opportunities to commercialise bio-based applications in Europe as described in current literature, to indicate key issues in the transition to the bio-based economy.
Stakeholders' Motivations	**Providing opportunities to launch an early version of a product in a "safer" setting than the market. Finding ways to manage expectations & apply open innovation (as customer provides feedback).** **B:** Start-ups need contact with customers to overcome teething troubles and market failures. As launching customer brand owner can shift to BBP without huge investments if they are properly informed about BBPs opportunities. **C:** Interested in products addressing specific needs and therefore motivated to assist start-up in developing and testing new BBP as long as business will take its responsibility and solve potential future failures (take-back option?). **P:** How to stimulate launching customer initiatives/open innovations and how to protect customer and adhere to customer rights/laws? Is it wise for public agencies to be a launching customer as this might bring extra risks and investments? R: Analyse risks and benefits for launching customer's ideas, for customer, consumer research, start-ups and government, and develop market plans and chains.
Related Applications	Packaging (3); Building (5)
Possible outcome	Ideas how to share risks and benefits of early products
Possible collaboration with EU-Funded projects	BIOPEN[4], BIOBRIDGES[5] (the project will start in September 2018)

[4] https://www.biopen-project.eu/about/
[5] https://www.bbi-europe.eu/projects/biobridges

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4.1.2 Challenge A2: SPECIFY UNIQUE SELLING POINTS (USP)

Challenge	**A2: SPECIFY UNIQUE SELLING POINTS (USP)**
Cluster	**A: Market development**
Explanation	Identifying bio-based product (BBP) unique selling points (USP) such as additional features and functions which go beyond providing a sustainable alternative compared to fossil-based product (FBP) and biodegradability (more than costs/features).
Key Questions	ŏ Which features and characteristics of BBP solve problems or add value? ŏ What are the USP the stakeholder perceives as most valuable? ŏ What are the expected worries/pains of BBP? ŏ Which BBP, which will be marketed as green, have (no) better life-cycle analysis (LCA) and end-of-life options compared to FBP counterparts? ŏ Which BBP, which will be marketed as more functional, have (no) perceived better features?
Market perspectives (PESTLE)	So far, scientific studies do not confirm that bio-based products offer additional functionalities to end consumers (Dammer et al., 2017). The current EU Bioeconomy policy leans strongly towards utilitarian and instrumental approaches to sustainable development, in which economic dimensions and concerns prevail over environmental and social dimensions (Ramcilovic-Suominen & Pülzl, 2018). The end-of-life options (biodegradable or mechanical recyclable) are relevant for consumers, as has been expressed during the interviews with stakeholders. They could be better clarified, both in its meaning as well as in describing the required waste behaviour (Pawelzik et al, 2013).
Literature	ŏ Pfau, S., L. Dammer & O. Arendt (2017). *Roadtobio D2.2 Public perception of bio-based products.* https://www.roadtobio.eu/uploads/publications/deliverables/RoadToBio_D2 2_Public_perception_of_bio-based_products.pdf. Overview of existing research and reports about public perception of bio-based products in order to identify barriers for further market development. ŏ Meeusen, M., J. Peuckert & R. Quitzow (2015). *Open-BIO Work Package 9: Social Acceptance Deliverable 9.2 Open-Bio Acceptance factors for bio-based products and related information systems*. www.biobasedeconomy.eu/research/open-bio. The report provides an overview of the relevant acceptance factors for the following three target groups: (1) consumers, (2) businesses and (3) public procurement officials. ŏ Pawelzik, P, M. Carus, J. Hotchkiss, R. Narayan, S. Selke, M. Wellisch, M. Weiss, B. Wicke & M. K. Patel (2013). Critical aspects in the life cycle assessment (LCA) of bio-based materials - Reviewing methodologies and deriving recommendations. *Resources, Conservation and Recycling,* 73, 211-228. www.sciencedirect.com/science/article/pii/S0921344913000359?via%3Dihub ŏ Ramcilovic-Suominen, S. & H. Pülzl (2018). Sustainable development – A "selling point" of the emerging EU Bioeconomy policy framework? *Journal of*

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	Cleaner Production, 172, p. 4170-4180. https://doi.org/10.1016/j.jclepro.2016.12.157
Stakeholders' Motivations	**USP needed to compete with FBP, more evidence-based sustainability claims** **B:** To provide BBP with a better or comparative advantage to FBP, and to specify particular features and (bio)degradability; C: When to use BBP instead of FBP? Interested in personal benefits (e.g. easier, healthier, weight) and in common benefits (social, environmental); **P:** Organising a framework to compare BBP and FBP; need to be certain of environmental/planet/sustainable benefits; to discuss externalities caused by FBP; Assess integral sustainability. **R:** Compare life cycles (LCAs) & end-of-life options and check whether biodegradability is beneficial for the environment; identify USP of BBP.
Related Applications	Textile (2); Packaging (3); Building (5)
Possible outcomes	Overview of the main issues to understand the relative advantages of BBP
Possible collaboration with EU-Funded projects	STAR-ProBio[6], BioCannDo[7], RoadToBio[8]

[6] http://www.star-probio.eu/
[7] https://www.allthings.bio/about/
[8] https://www.roadtobio.eu/

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4.1.3 Challenge A3: UP-SCALING

Challenge	A3: UP-SCALING
Cluster	A: Market development
Explanation	Find BBP that are available consistently and in large quantities. Create, find and extend new markets by bringing more and diverse BBP to mainstream user groups
Key Questions	ŏ Which BBP are relevant for up-scaling? ŏ How to scale up (transition pathways)? ŏ How to respond better to the circular economy by providing more cascading value? ŏ How to develop more BBP markets through hybrids versus 100% BB (scenario's)? ŏ Which actions concerning markets, products, investments and policies are necessary to develop large scale sustainable supply?
Market perspectives (PESTLE)	Mainly economical to increase the supply of BBP. So far, many bio-based products are produced in small amounts. In order to reach more groups and more consumers, strategies are necessary that take into account the price, the place, use of hybrids etc. The acceleration of BBP can contribute to the realisation of SDGs, if they respond to the sustainability criteria (see C3).
Literature	ŏ Dammer, L., M. Carus, K. Iffland, S. Piotrowski, L. Sarmento, R. Chinthapalli & A. Raschka (2017). *Current situation and trends of the bio-based industries in Europe with a focus on bio-based materials.* Pilot Study for BBI JU. nova-Institute. www.bbi-europe.eu/sites/default/files/bbiju-pilotstudy.pdf. A meta review of existing research on different topics relevant to the biobased economy such as products and markets, socio-economic aspects, climate change mitigation and environmental aspects, EU policies and regulations, research & technologies, trends, social benefits & consumer acceptance. ŏ Carus, M., L. Dammer, A. Puente, A. Raschka, Dr. Oliver Arendt (2017). *Bio-based drop-in, smart drop-in and dedicated chemicals.*
Stakeholders' Motivations	**Accelerating market share** **B:** To grow, compete and realise higher revenues. To have attention for cross-selling, to involve more brand owners, to use more hybrid BBP, and to promote current products with BBP. **C:** Cheap provision of BBPs, more competitive compared to FBPs P: Check whether BBP contribute more than FBP to the SDGs. **R:** Improve marketing new applications.
Related Applications	Cleaning and hygiene (1); Packaging (3); Building (5)

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Possible outcomes	Design of BBP plants based on feedstocks available in large quantities and constantly. Create, find and extend new markets by bringing more and diverse BBP to mainstream user groups.
Possible collaboration with EU-Funded projects	BIOBRIDGES[9], and BIOMONITOR[10] BBI Bio Based Industry[11]

[9] https://www.bbi-europe.eu/projects/biobridges
[10] http://biomonitor.eu/
[11] https://www.bbi-europe.eu/

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4.2 CLUSTER B: AWARENESS AND TRUST BUILDING

Cluster B: Awareness and trust building	Innovation phases		
	1 Business case: Product is 95% mature and becomes a business case	2 Go-to-market: Product is mature and market increases to 5% among niche groups	3 Acceleration: Market increases above and reaches new user groups
Challenges	-	**B2: PROMOTE CHANGES IN PURCHASE HABITS**	**B3: INCREASE THE ADOPTION**
Explanation		Raise awareness among early adopters (e.g. supermarkets, schools) and consumers to use BBP. Guarantee safety to increase trust in BBP, develop a coherent terminology (CEN/TC 411).	Making BBP widely available, easy to use discard and cheap. Identify ways to increase adoption by better communication and by finding better contexts to sell BBP products.
Application sectors	-	Packaging (3); Building (5)	Cleaning and hygiene (1); Packaging (3)

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4.2.1 Challenge B2: PROMOTE CHANGES IN PURCHASE HABITS

Challenge	**B2: PROMOTE CHANGES IN PURCHASE HABITS**
Cluster	**Cluster B: Awareness and trust building**
Explanation	To raise awareness among early adopters (e.g. supermarkets, schools) and consumers to use BBP. To guarantee safety and to increase trust in BBP, develop a coherent terminology (CEN/TC 411).
Key Questions	ŏ What are the positive and negative connotations about bio-based products? ŏ In which cases is a premium price allowed and which clarified benefits are important for a further market increase? ŏ What are successful awareness raising concepts/strategies (e.g. "not good, money back", and info-educational stories (such as the BIOECONOMY Village at Maker Faire)?
Market perspectives (PESTLE)	Among consumers there is a trend towards more information requirements about sustainable products in order to make an informed buying decision. Therefore, the 50% awareness levels of bio-based products can be a barrier, if the products do not clearly indicate their sustainability performance. In addition to this, producers show a low willingness to communicate the bio-based concept. The meaning of "bio-based" does not offer an additional value for many old application sectors, such as wood in construction & furniture, pulp in paper, and cotton in textile. Until recently, new application sectors such as bio-lubricants and surfactants did not really consider themselves to be part of the bio-based economy (Dammer et al., 2017; Meeusen et al., 2015). Conversely, some business make untrue claims that they produce biodegradable products or packaging.
Literature	ŏ Onwezen, M.C., M. J. Reinders & S. J. Sijtsema (2017). Understanding intentions to purchase bio-based products: The role of subjective ambivalence. *Journal of Environmental Psychology*, 52, p. 26-36 https://doi.org/10.1016/j.jenvp.2017.05.001 Subjective ambivalence; Intention; Bio-based product; Risk; Benefit; Emotion; Sustainability and consumer. ŏ Reinders, M. J.; M.C. Onwezen & M.J.G. Meeusen (2017). Can bio-based attributes upgrade a brand? How partial and full use of bio-based materials affects the purchase intention of brands. *Journal of Cleaner Production* 162, p. 1169 - 1179. https://doi.org/10.1016/j.jclepro.2017.06.126. Bio-based; Brand; Purchase intentions; Attitude; Emotions; Personal environmental norm ŏ Pfau, S., L. Dammer & O. Arendt (2017). *RoadtoBio D2.2 Public perception of bio-based products.* https://www.roadtobio.eu/uploads/publications/deliverables/RoadToBio_D2 2_Public_perception_of_bio-based_products.pdf. Overview of research and reports about public in order to identify barriers for further market development. ŏ Pfau, S., J. Vos & C. Vom Berg (2018). *RoadtoBio D2.3 Public perception of bio-based product - qualitative analysis of stakeholders' concerns.*

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	https://www.roadtobio.eu/uploads/publications/deliverables/RoadToBio_D23_Public_perception_of_bio-based_products_stakeholder_concerns.pdf. ŏ Meeusen, M., J. Peuckert & R. Quitzow (2015). *Open-BIO Work Package 9: Social Acceptance Deliverable 9.2 Open-Bio Acceptance factors for bio-based products and related information systems*. www.biobasedeconomy.eu/research/open-bio. The report provides an overview of the relevant acceptance factors for the following three target groups: (1) consumers, (2) businesses and (3) public procurement officials. ŏ Dammer, L., M. Carus, K. Iffland, S. Piotrowski, L. Sarmento, R. Chinthapalli & A. Raschka (2017). *Current situation and trends of the bio-based industries in Europe with a focus on bio-based materials.* Pilot Study for BBI JU. nova-Institute. www.bbi-europe.eu/sites/default/files/bbiju-pilotstudy.pdf. A meta review of existing research on different topics relevant to the biobased economy such as products and markets, socio-economic aspects, climate change mitigation and environmental aspects, EU policies and regulations, research & technologies, trends, social benefits & consumer acceptance. ŏ Overbeek, G & A-C Hoes (2018). *D1 BIOVOICES Synthesis of market perspectives to develop bio-based value chains.* www.biovoices.eu/results/public-results. This report presents an overview of the existing barriers and opportunities to commercialise bio-based applications in Europe to indicate key issues in the transition to the bio-based economy. ŏ Carus, M.; A. Partanen & L. Dammer (2018). *Detailed evaluation of Green Premium prices for bio-based products along the value chain.* https://bioforever.org/sites/default/files/publications/2018-03/Detailed-eval-GreenPremium-prices-for-bb-prod-along-value-chain.pdf
Stakeholders' Motivations	**To care for basic requirements, increase safety and trust to raise awareness** **B:** Public awareness and trust is essential to be able to sell BBP based on three main pillars: functionality (i.e. product must be at least as functional as FBP), declared environmental benefits, and price. **C:** Awareness raising, check reliable information to compare BBP, FBP and natural products. **P:** To develop and communicate coherent terminology, and increase safety R: New ways to promote education and awareness (especially targeting students)
Related Applications	Textile (2); Packaging (3); Building (5) – All applications
Possible outcomes	Plans and strategies to change the purchasing habits

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Possible collaboration With EU-Funded projects	BioCannDo[12], BIOWAYS[13], RoadtoBIO[14], STAR-ProBio[15] and BLOOM[16]

[12] https://www.allthings.bio/about/
[13] http://www.bioways.eu./
[14] https://www.roadtobio.eu/
[15] http://www.star-probio.eu/
[16] https://www.bloom-Bioeconomy.eu/

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4.2.2 Challenge B3: INCREASE THE ADOPTION

Challenge	**B3: INCREASE THE ADOPTION**
Cluster	**Cluster B: Awareness and trust building**
Explanation	Making BBP widely available, easy to use, discard and value for money Identifying ways to increase adoption by better communication and by finding improved opportunities to sell BBP products.
Key Questions	ŏ What are the messages to "convince" and who should be the sender? ŏ Who are the multipliers to address? How to reach them? ŏ Which media campaigns to include BBP in daily life (key messages, success stories)? ŏ What do brand owners and NGO's require to enhance the adoption? ŏ How to effectively address the issue of "green washing"[17] (the misuse of which is expected to increase)? ŏ Which arguments contribute to force the adoption of bio-based?
Market perspectives (PESTLE)	The main issue is the development of appropriate about marketing techniques development similar to target the wider market and break out of the niche markets. the adoption of other new products to reach more target groups than just to niches. Whilste niche markets pay attention to sustainable features, e.g. eco-products and plant protein products, in the last two decades, other target groups may be more interested in personal benefits, e.g. price, convenience, health etc. The pathways to increase the adoption can be different, and may be boosted by an early forced adoption, such as Coca-Cola using only bio-based bottles.
Literature	ŏ Philip Kotler, Kevin Lane Keller (2016). *Marketing management*. Global edition, 15th ed. Pearson. ŏ Reisch, L. & Thogersen, J. (eds., 2016). *Handbook of research on sustainable consumption* Cheltenham, UK: Edward Elgar Publishing
Stakeholders' Motivations	**To understand the message and the place where to communicate it** **B:** Campaigns for consumers in shops, outlets, concept stores, shopping malls. Whether to force the adoption of bio-based products, and if so, in which cases? **C:** To enhance engagement with BBP in daily life **P:** Public campaigns to promote sustainable choices **R:** To analyse requirements of the messages and the senders
Related Applications	Cleaning and hygiene (1); Textile (2); Packaging (3) and Building (5)

[17] Greenwashing (a compound word modelled on "whitewash"), also called "green sheen",is a form of spin in which green PR or green marketing is deceptively used to promote the perception that an organization's products, aims or policies are environmentally friendly.Evidence that an organization is greenwashing often comes from pointing out the spending differences: when significantly more money or time has been spent advertising being "green" (that is, operating with consideration for the environment), than is actually spent on environmentally sound practices. *Source https://en.wikipedia.org/wiki/Greenwashing*

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Possible outcomes	Design of a media campaign to include BBP in daily life supported by brand owners and NGOs Design innovative communication campaigns and activities
Possible collaboration with EU-Funded projects	BioCannDo[18], BIOWAYS[19], BLOOM[20], BIOMONITOR[21], BIOBRIDGES[22]

[18] https://www.allthings.bio/about/
[19] http://www.bioways.eu./
[20] https://www.bloom-Bioeconomy.eu/
[21] http://biomonitor.eu/
[22] https://www.bbi-europe.eu/projects/biobridges

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4.3 CLUSTER: C: SUPPORTING STRATEGIES, REGULATORY FRAMEWORKS LEGISLATION AND STANDARDS

Cluster C: Supporting strategies, regulatory frameworks legislation and standards	Innovation phases		
	1 Business case: Product is 95% mature and becomes a business case	2 Go-to-market: Product is mature and market increases to 5% among niche groups	3 Acceleration: Market increases above and reaches new user groups
Challenges	-	**C2: INTRODUCE EU & NATIONAL INCENTIVES**	**C3: REALISE STANDARDISATION**
Explanation	-	Develop policies that favour BBP above FBP, e.g. enhancing Sustainable Development Goals (SDG), reduce toxic materials (e.g nutraceuticals) and CO2 by several incentives (e.g. green taxes, information campaigns, regulation), and an obligation to increase % bio-based in products (similar to biofuels)	Realise standardisation & certification of BBP & waste behaviour. Ensure standardisation of logos and labels and develop a strategy for their effective communication (NB: Check CEN/TC 411)
Application sectors	-	All sectors	Cleaning and hygiene (1); Packaging (3); Biofuels and bioenergy (4)

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4.3.1 Challenge C2: INTRODUCE EU & NATIONAL INCENTIVES

Challenge	**C2: INTRODUCE EU & NATIONAL INCENTIVES**
Cluster	**Cluster C: Supporting strategies, regulatory frameworks legislation and standards**
Explanation	Developing policies that favour BBP above FBP, e.g. enhancing Sustainable Development Goals (SDG), reduce toxic materials (e.g nutraceuticals) and CO2 by several incentives (e.g. green taxes, information campaigns, regulation, Green Public Procurement), and obligigation to increase % bio-based in products (similar to biofuels)
Key Questions	ŏ Which strategic commitments (SDGs) to a long transition are implemented? ŏ Which incentive policies have proven effective for BBP, i.e. work in different national contexts? ŏ Which incentive policies in other fields have proven to be effective in stimulating (sustainable) consumption? ŏ Innovative form of incentives ŏ How to improve Green Public Procurement in order to become more effective? ŏ What are the Pros and Cons of increasing % bio-based materials in products?
Market perspectives (PESTLE)	Existing research shows that innovation systems are suffering under "transformative failure", which means that strategies, technology pushing policies, network support and demand-pull measures are not sufficient for inducing a change, if clear policies towards a phase-out of the dominant regime are missing. Therefore, several authors (mentioned in Overbeek & Hoes, 2018; Vom Berg et al., 2018) propose to create a consistent policy mix to support technology-push and demand-pull and thus create an environment delivering choice . They consider strategic commitment to a transitional period as a prerequisite for credible long-term policies. The fact that many products are hybrid could facilitate the interest of consumers, manufacturers and brand owners to transform their current applications with more bio-based content. The share of bio-based content will grow slowly due to the high cost of techniques, low oil prices, restricted functionalities, and low political support to impose a level playing field. Legal sustainability requirements for bio-based products are still not harmonised in Europe, because all member states have their own biomass policy for biofuels. There are both positive frameworks, such as in Italy or France, to guarantee market growth and investments; and negative frameworks with a focus on avoiding and reducing, such as in Germany and in the Netherlands. Italy and France favour the use of biodegradable plastics through legislation, other countries do not see this as an option to enhance a circular economy.
Literature	ŏ Vom Berg, C., L. Dammer, J. Vos & S. Pfau (2018). *RoadtoBio D2.1 Report on regulatory barriers.* https://www.roadtobio.eu/uploads/publications/deliverables/RoadToBio_D2

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	1_RegulatoryBarriers.pdf. This report synthesizes existing knowledge on hurdles and barriers for the bio-based economy and brings the earlier study findings up to date according to new developments in legislation, with a focus on understanding why legislative barriers came to be. ŏ Overbeek, G & A-C Hoes (2018). *D1 BIOVOICES. Synthesis of market perspectives to develop bio-based value chains.* http://www.biovoices.eu/results/public-results. This report presents an overview of the existing barriers and opportunities to commercialise bio-based applications in Europe as described in current literature, to indicate key issues in the transition to the bio-based economy. ŏ Imbert, E., L. Ladu, P. Morone & R. Quitzow (2017) Comparing policy strategies for a transition to a Bioeconomy in Europe: The case of Italy and Germany. *Energy Research and Social Science*. http://doi.org/10.1016/j.erss.2017.08.006.
Stakeholders' Motivations	**To favour BBP** **B:** Incentives are crucial for scaling up the production **C:** Incentives to decrease the premium price **P:** Develop legislation & implement measures to stimulate BBP that contribute to the SDGs **R:** Analyse impact of measures to favour BBP and provide an increased evidence base of sustainable BBPs (CO2-gain, no harming ecosystems and soil, and maximum use of CO2 remaining in products and materials).
Related Applications	All sectors
Possible outcomes	Agreement about the most important incentives Stimulation of innovative forms of incentive
Possible collaboration with EU-Funded projects	STAR-Pro-Bio[23] and RoadToBio[24]

[23] http://www.star-probio.eu/
[24] https://www.roadtobio.eu/

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4.3.2 Challenge C3: REALISE STANDARDISATION

Challenge	**C3: REALISE STANDARDISATION**
Cluster	**Cluster C: Supporting strategies, regulatory frameworks legislation and standards**
Explanation	Realising standardisation & certification of BBP & waste behaviour and logo's/labels
Key Questions	ŏ Which strategic commitments (SDGs) to a long transition are implemented? ŏ Which incentive policies have proven effective for BBP, i.e. work in different national contexts? ŏ Which incentive policies have proven to be effective in other fields of stimulating (sustainable) consumption? ŏ Innovative form of incentives ŏ How to improve Green Public Procurement in order to become more effective? ŏ What are the Pros and Cons of increasing the % of bio-based materials in products?
Market perspectives (PESTLE)	Certification of sustainable biomass addressing sustainability concerns and standardisation are essential to support the creation of new markets and to create trade opportunities for the bio-based economy. The application of standards can help to remove trade barriers, increase market transparency and increase public acceptance. Despite the existing sustainability principles, the question is how to guarantee the use of sustainable bio-based production and its resources from different countries. This requires a sustainability framework, which is relevant both for bio-energy and materials as well as for food and nutrition. Certification of sustainable bio-based products and the country of origin is therefore important. To address the lack of standards for bio-based products, the European Commission has issued several standardisation mandates to CEN. CEN develops European standards covering horizontal aspects of bio-based products as well as standards for specific bio-based products such as bio-surfactants (CEN/TC 276), bio-solvents (CEN/TC 411), bio-plastics (CEN/TC 249) and bio- lubricants (CEN/TC 19) (Bio-based Economy, 2014). Certification of sustainable biomass contributes to increased public acceptance of bio-based products and processes. Low expertise and lack of trust in existing standards and labelling on biodegradation in different environments accompanied by limited knowledge among the public, politicians and CSOs concerning the assessments of the properties, opportunities and benefits hinder the growth of bio-based materials (e.g. bio-based plastics). Therefore, develop labels that clarify the % of bio-based materials respective to the total content of the product.
Literature	ŏ Ladu, L. & K. Blind (2017). Overview of policies, standards and certifications supporting the European bio-based economy. *Current Opinion in Green and*

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	Sustainable Chemistry, 8, p. 30-35. https://doi.org/10.1016/j.cogsc.2017.09.002 ŏ Vom Berg, C., L. Dammer, J. Vos & S. Pfau (2018). *RoadtoBio D2.1 Report on regulatory barriers. https://www.roadtobio.eu/uploads/publications/deliverables/RoadToBio_D21_RegulatoryBarriers.pdf.* This report synthesizes existing knowledge on hurdles and barriers for the bio-based economy and brings the earlier study findings up to date according to new developments in legislation, with a focus on understanding why legislative barriers came to be. ŏ Overbeek, G & A-C Hoes (2018). *D1 BIOVOICES. Synthesis of market perspectives to develop bio-based value chains.* http://www.biovoices.eu/results/public-results This report presents an overview of the existing barriers and opportunities to commercialise bio-based applications in Europe as described in current literature, to indicate key issues in the transition to the bio-based economy. ŏ European Sustainability Week: https://www.esdw.eu.
Stakeholders' Motivations	**To uniform rules and to disseminate them, addressing existing barriers** **B:** Uniform rules are needed improve the marketing opportunities of BBP **C:** To develop a frame with uniform rules to provide a clear picture **P:** To develop a frame with requirements for uniform rules. Address gaps between international and national norms **R:** Calculate effect of standardisation & certificates
Related Applications	All sectors
Possible outcomes	Design of an international sustainability framework
Possible collaboration with EU-Funded projects	STAR-Pro-Bio[25], InnProBio[26], RoadToBio[27] and BIOMONITOR[28]

[25] http://www.star-probio.eu/
[26] http://innprobio.innovation-procurement.org/home/
[27] https://www.roadtobio.eu/
[28] http://biomonitor.eu/

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4.4 CLUSTER: D: SUPPORTING ENVIRONMENT (INFRASTRUCTURES, INTERMEDIARIES, NEW BUSINESS OPPORTUNITIES)

Cluster D: Supporting environment (Infrastructures, intermediaires, new business opportunities)	Innovation phases		
	1 Business case: Product is 95% mature and becomes a business case	2 Go-to-market: Product is mature and market increases to 5% among niche groups	3 Acceleration: Market increases above and reaches new user groups
Challenges	**D1: IMPROVE RESOURCES TO ENHANCE BUSINESS CASES**	**D2: B2B USERS AS FRONTRUNNERS**	**D3: INCREASE SUSTAINABLE BIO-BASED FEEDSTOCK FOR BB PRODUCTS**
Explanation	To improve and renew agricultural practises, consumer behaviour patterns, infrastructures (innovation support, marketing, LCA, crowd funding), to involve more intermediaries and to increase cross-sectoral cooperation in order to improve the market entry of sustainable BB products.	To inform intermediaries (B2B) to reach users, e.g manufacturers about BB packaging, architects and constructers about BB building and construction, surgeons about BB pins.	To increase sustainable bio-based feedstock (waste, side streams, by products) and to find appropriate bio-based products that are more sustainable and cheaper but usually less strong with 2G compared to 1G
Application sectors	Textile (2); Packaging (3); Biofuels and Bioenergy (4); Building (5)	Cleaning and hygiene(1); Packaging (3); Building (5)	Textile (2); Packaging (3), Building (5), Biofuels (4)

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4.4.1 Challenge D1: IMPROVE RESOURCES TO ENHANCE BUSINESS CASES

Challenge	**D1: IMPROVE THE ECOSYSTEM TO ENHANCE BUSINESS CASES**
Cluster	**Cluster D: Supporting environment (Infrastructures, intermediaries, new business opportunities)**
Explanation	To improve and renew agricultural practises, consumer behaviour patterns, infrastructures (innovation support, marketing, LCA, crowd funding), to involve more intermediaries and to increase cross-sectoral cooperation in order to improve the market entry of sustainable BB products.
Key Questions	ŏ How create a sense of urgency for BBP business cases through new agricultural practises and new consumer behaviour patterns? ŏ How to improve current infrastructures? ŏ How to involve more intermediaries? ŏ How to create more cross-sectoral cooperation (e.g. matchmaking) and crowd funding?
Market perspectives (PESTLE)	To reach the ambitious goals for climate protection and expansion of decentralized use of renewable energies (e.g.. through biogas plants), active support by the population, it will be necessary to create sustainable local solutions. In particular, when considering the realization of potential benefits for rural communities, it is crucial to take into account local knowledge when developing solutions tailored to the needs of the respective communities. Therefore, it is important to include concrete business cases with a societal impact, as has been shown in the CIMULACT project (www.cimulact.eu) and the ISAAC project to increase Social Awareness and ACceptance of biogas and biomethane (www.isaac-project.it).
Literature	ŏ Schumacher, L. K. & F. Schultmann (2017). Local Acceptance of Biogas Plants: A Comparative Study in the Trinational Upper Rhine Region. *Waste and Biomass Valorisation* 8, 7, p. 2393-2412
Stakeholders' Motivations	**Enhancing inclusive bio-based business rooted locally** **B:** Inclusive development creates new businesses, and increases efficiency; **C:** Acceptance of local biorefineries that contribute to societal objectives; **P:** More local employment and sustainable development; **R:** Improve marketing, Bioeconomy-related training and education programs
Related Applications	Textile (2); Packaging (3); Biofuels and Bioenergy (4); Building (5)
Possible outcomes	Ideas for local business cases

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Possible collaboration with EU-Funded projects	POWER4BIO (the new project funded under of RUR-09-2018[29]) FIRST2RUN[30], ISAAC[31]

4.4.2 Challenge D2: IDENTIFY B2B USERS AS FRONTRUNNERS

Challenge	**D2 IDENTIFY B2B USERS AS FRONTRUNNERS**
Cluster	**Cluster D: Supporting environment (Infrastructures, intermediaries, new business opportunities)**
Explanation	To inform intermediaries (B2B) to reach users, e.g manufacturers about BB packaging, architects and constructers about BB building and construction, surgeons about BB pins
Key Questions	ŏ What are good channels to communicate sustainable BBPs? ŏ How to increase the connections among Brand owners and BBIs?
Market perspectives (PESTLE)	Experts interviewed in D3.2 are reluctant to introduce BBPs to potential end users as long as these BBPs are hardly known and available. Therefore, they prefer to start with front runners and intermediates, which can stimulate others to buy BBP. B2B users as front runners are already known in the hygiene sector, textile and carpet sector. Brand owners and intermediates, such as architects, may stimulate others to use BBPs.
Literature	ŏ PWC (2017). What mainstream businesses can learn from social enterprises. https://www.pwc.nl/nl/assets/documents/pwc-what-mainstream-businesses-can-learn-from-social-enterprises.pdf
Stakeholders' Motivations	**Discuss and inform intermediaries and brand owners about the features with BBP** **B:** Contribute with new products to first mover advantage & support intermediaries to sell BBP **C:** Consumer organisations inform consumers P: Inform citizens by public events of BBP R: Improve the functionality of products (to better meet stakeholders needs)
Related Applications	Cleaning and hygiene(1); Textile (2); Packaging (3); Building (5)
Possible collaboration	A list of frontrunners and activities New Value Chains and collaborations among BBI and Brand Owners

[29] http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/rur-09-2018.html
[30] http://www.first2run.eu/
[31] http://www.isaac-project.it/

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with EU-Funded projects	BIOBRIDGES[32], RESURBIS[33], BioCannDo[34]

[32] https://www.bbi-europe.eu/projects/biobridges
[33] http://www.resurbis.eu/
[34] https://www.allthings.bio/about/

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4.4.3 Challenge D3: INCREASE SUSTAINABLE BIO-BASED FEEDSTOCK FOR IDENTIFIED BB PRODUCTS

Challenge	**D3: INCREASE SUSTAINABLE BIO-BASED FEEDSTOCK FOR BB PRODUCTS**
Cluster	**Cluster D: Supporting environment (Infrastructures, intermediaries, new business opportunities)**
Explanation	To increase 2G bio-based feedstock (waste, side streams, by products) and to find appropriate bio-based products that more sustainable and cheaper compared to 1G feedstock
Key Questions	ŏ When to use 2G instead of 1G for BBP? ŏ How to organise an adequate 2G infrastructure for biorefineries? ŏ How improve the legislation and incentives to consider waste a resource? ŏ How to achieve a fair competition for 2G feedstock with the bioenergy sector which is much more incentivised compared to other BBP application sectors? ŏ How to guarantee year long feedstock (non seasonality of 2G)?
Market perspectives (PESTLE)	Existing literature on biowaste has concentrated on the technological aspects associated with the valorization processes, but has neglected assessments on the development of a mature innovation niche and its market potential. So far, the system has shown to be weak especially as far as the low expectations are concerned (Morone et al., 2015). Relevant infrastructures are lacking to promote recycling of packaging and disposals among households and events to create large homogeneous amounts of waste streams for purification to facilitate the mechanical and chemical recycling of bio-based plastics. Many 2G feedstock is not considered a biomass resource but waste. Current lack of regulations, but also lack of incentives to consider waste as expensive are constraining the use of waste as resource. URBIOFIN (www.urbiofin.eu) in Spain is setting up an integrated biorefinery for the transformation of the organic fraction of municipal solid waste into new marketable bioproducts, building blocks, biopolymers and additives. BIOSKOH (https://bioskoh.eu) with a plant, located in a rural area of Slovakia, uses lignocellulosic biomass from agri-forest residues and dedicated crop cultures to produce 2G bioethanol for transport fuel. Also environmental organisations and municipalities produce waste streams that should be better valorized. In the Netherlands, the conservation of nature and forests results in huge volumes of unexploited rest streams. Therefore, the national forest organisation Staasbosbeheer collaborates with bio-based companies (among others Avantium, BASF, RWE) to gain sugar and starch from these rest streams and to use the resting lignin for biofuels.
Literature	ŏ Carus, M., L. Dammer & R. Essel (2015). *Quo vadis, cascading use of biomass?* Policy paper on background information on the cascading principle. http://bio-based.eu/policy. ŏ Morone, P.; V.E. Tartu & P. Falcone (2015). Assessing the potential of bio waste for bioplastics production through social network analysis. *Journal of*

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	Cleaner Production, 90 p. 43-54. https://www.sciencedirect.com/science/article/pii/S0959652614012761
Stakeholders' Motivations	**Appropriate products of 2G bio-based feedstock** **B:** How to create interest among farmers to provide side streams and to develop business models that prefer 2G (less expensive) instead of 1G (better features). **C:** How to collect wastes for 2G bio-based feedstock and when to use 2G BBP (more often for single use; no bearing functions)? **P:** How to develop regulations and infrastructure to collect 2G feedstock to be used as biomass? R: Cascading analysis & when to use 2G BBP
Related Applications	Textile (2); Packaging (3); Biofuels (4); Building (5)
Possible outcomes	Design of activities to increase sustainable feedstock
Possible collaboration with EU-Funded projects	RESURBIS[35], BIOMONITOR[36], FIRST2RUN[37], URBIOFIN[38], BIOSKOH[39] the INTERREG[40] projects

[35] http://www.resurbis.eu/
[36] http://biomonitor.eu/
[37] http://www.first2run.eu/
[38] www.urbiofin.eu
[39] https://bioskoh.eu
[40] https://www.interregeurope.eu/

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4.5 CLUSTER E: REGIONAL/LOCAL DEVELOPMENT

Cluster E: Regional/Local development	Innovation phases		
	1 Business case: Product is 95% mature and becomes a business case	2 Go-to-market: Product is mature and market increases to 5% among niche groups	3 Acceleration: Market increases above and reaches new user groups
Challenges	**E1: ENHANCE LOCAL BIOECONOMY ACTION PLANS**	**E2: BOOST LOCAL DEPLOYMENT**	
Explanation	Creation of an ecosystem to implement Bioeconomy business cases as a strategic asset for local development by dialogues and engagement with quadruple helix stakeholders'. Focus on cities and rural regions with feedstock and business cases missing a local Bioeconomy action plan (bottom-up).	Opportunities of local economies to contribute to increase the market uptake of business cases with BBP (through more local feedstock, local transport, local advice etc.) and local value chains targeted to the specific circular challenges.	
Application sectors	In regions with feedstock and BBP business cases (RIS3, LEADER/CLLD)	In regions with feedstock and BBP in mature sectors Packaging (3); Building (5)	

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4.5.1 Challenge E1: ENHANCE LOCAL BIOECONOMY ACTION PLANS

Challenge	**E1: ENHANCE LOCAL BIOECONOMY ACTION PLANS**
Cluster	**Cluster E: Regional/Local development**
Explanation	Creation of an ecosystem to implement bioeconomy business cases as a strategic asset for local development by dialogue and engagement with quadruple helix stakeholders.. Focus on cities and rural regions with feedstock and business cases missing a local Bioeconomy action plan (bottom-up).
Key Questions	ŏ Which BBP business cases and its related feedstock are relevant to implement locally? ŏ Which best and worst practises of Bioeconomy local action plans for implementation of business cases exist? ŏ How to develop regional cooperation among Quadruple Helix actors to improve business cases? ŏ How to create a local action plan to assess opportunities, challenges and threads?
Market perspectives (PESTLE)	Implementing a sustainable Bioeconomy in Southern Europe (and elsewhere, e.g. in the Balkans, Zelljadt et al., 2018) will depend – among other factors - upon new agricultural practices, new consumer behaviour patterns, new industrial technologies, new business models, new skill profiles, and new regulatory and governance approaches. This requires a sense of urgency to forward in a timely manner and mobilize human and other key resources of this process (Koukios et al., 2018). A number of bio-based projects focus on local feedstocks in Europe, i.e. the producers and waste-handlers and their (new) resources of agro-based biomass, rest streams and urban biowaste, and on short value chains (see D3). The FIRST2RUN project (www.first2run.eu) in Sardinia develops an integrated biorefinery in which low input and underutilised indigenous crops (cardoon) grown in arid and marginal land are used to produce monomers for bioplastics, cosmetics, lubricants, fertilisers, herbicides and animal feed. FIRST2RUN has established a local value chain involving farmers as biomass suppliers and as end-users of fertilisers, herbicides and animal feed. The RESURBIS project (www.resurbis.eu) aims to convert several types of urban bio-waste into valuable bio-based products, in an integrated single biowaste biorefinery.
Literature	ŏ Spatial Foresight, SWECO, ÖIR, t33, Nordregio, Berman Group, Infyde (2017). *Bioeconomy development in EU regions. Mapping of EU Member States'/regions" Research and Innovation plans & Strategies for Smart Specialisation (RIS3) on Bioeconomy for 2014-2020.* Study commissioned by DG Research & Innovation, European Commission. Brussels. https://doi.org/10.1016/j.jrurstud.2013.12.004 ŏ Koukios, E. Et al. (2018). Targeting sustainable Bioeconomy: A new development strategy for Southern European countries. The Manifesto of the European Mezzogiorno*. Journal of Cleaner Production,* 172, p. 3931-3941 https://doi.org/10.1016/j.jclepro.2017.05.020

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	ŏ Zelljadt, E., M. Stoyanov, C. Bianchini, F. Mazzariol, S. Davies, K. Millar (2018). *D6.2 BIOSTEP Strategies for strengthened regional bioeconomies in Stara Zagora and Veneto. www.bio-step.eu*
Stakeholders" Motivations	**To improve action plans with shared responsibilities in the region.** B: Interest in cross-sectoral innovation to improve current business cases C: Interest to save resources to which the action plans contribute P: Developing local circular economies with business cases R: Analysis of promising local perspectives
Related Applications	E1 Application sectors in regions with feedstock (see RIS3)
Possible outcomes	Ideas for local bio-based action plans
Possible collaboration with EU-Funded projects	BIOREGIO (RIS3)[41] , RESURBIS[42], BIOMONITOR[43], FIRST2RUN[44], BIOSKOH[45], POWER4BIO (the new project funded under of RUR-09-2018[46]), Made in Danube[47]

[41] https://www.interregeurope.eu/bioregio/news/news-article/3480/policy-development-in-bio-based-circular-economy/
[42] http://www.resurbis.eu/
[43] http://biomonitor.eu/
[44] http://www.first2run.eu/
[45] https://bioskoh.eu
[46] http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/rur-09-2018.html
[47] http://www.interreg-danube.eu/approved-projects/made-in-danube

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4.5.2 Challenge E2: BOOST LOCAL DEPLOYMENT

Challenge	**E2: BOOST LOCAL DEPLOYMENT**
Cluster	**Cluster E: Regional/Local development**
Explanation	Opportunities of local economies to contribute to increase the market uptake of business cases with BBP (through more local feedstock, local transport, local advice etc.) and local value chains targeted to the specific circular challenges.
Key Questions	ŏ How can local economies contribute successfully to the market uptake of BBP (examples)? ŏ How to improve/maintain sustainability of the local territory through providing BB feedstock for new markets (soil, water etc.)? ŏ How to exploit territorial Bioeconomy value chains of new BB markets (i.e. rural, costal and urban opportunities)?
Market perspectives (PESTLE)	Esparcia (2014) analysed a number of innovation projects in European rural areas and concluded that they tend to rely on the support of an extensive network of actors. This supporting network plays a significant role in the implementation and the development of innovative projects, while public actors have a strong presence, at least during the early stages.
Literature	ŏ Esparcia, J. (2014). Innovation and networks in rural areas. An analysis from European innovative projects. *Journal of Rural Studies* 34, p. 1-14. https://doi.org/10.1016/j.jrurstud.2013.12.004
Stakeholders' Motivations	**More local activity** **B:** New employment opportunities C: Citizens become aware of local opportunities. Creates a future proofed and desirable region **P:** Municipalities increase employment. local development, positive societal impact R: Analysis of contribution of local infrastructure
Related Applications	In regions with feedstock and BBP in mature sectors Packaging (3); Building (5)
Possible outcomes	Design of sustainable rural regions with the use of BBP
Possible collaboration with EU-Funded projects	BIOREGIO (RIS3)[48] , BIOMONITOR[49], FIRST2RUN[50], BIOSKOH[51], POWER4BIO (the new project funded under of RUR-09-2018[52]), Made in Danube[53]

[48] https://www.interregeurope.eu/bioregio/news/news-article/3480/policy-development-in-bio-based-circular-economy/
[49] http://biomonitor.eu/
[50] http://www.first2run.eu/
[51] https://bioskoh.eu
[52] http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/rur-09-2018.html
[53] http://www.interreg-danube.eu/approved-projects/made-in-danube

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5. CONCLUSIONS

This document describes **the challenges** relevant, attractive and motivating for the Quadruple Helix stakeholders **to be addressed during the Mobilisation and Mutual Learning (MMLs**) to unlock the potential of Bioeconomy by creating the favourable conditions for the market development of Bio-Based products, thanks to the proactive collaboration among the Quadruple Helix stakeholders.

These challenges, to be validated during several rounds with stakeholders and experts in autumn 2018, will flow into the document "BIOVOICES Methodological approach for Mobilisation and Mutual Learning" (D4.4) to be used by the partners to design the MMLs at local, regional, national and international level.

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ASEBIO, Asociación Española de Bioempresas
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Spain

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