BioSTEP

Promoting stakeholder engagement and public awareness for a participative governance of the European bioeconomy

Engaging stakeholders and citizens in the bioeconomy: Lessons learned from BioSTEP and recommendations for future research

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EXECUTIVE SUMMARY

Stakeholder and public engagement are key elements of EU policy development, as well as of responsible research and innovation. Over a period of three years, BioSTEP has designed and implemented a wide range of citizen and stakeholder engagement activities regarding the development of Europe's bioeconomy. These covered different modes of participation, ranging from education and information activities to intensive stakeholder dialogues and the co-creation of regional bioeconomy roadmaps.

BioSTEP experimented with different participatory tools including workshops, living lab activities, and exhibitions that aimed to facilitate stakeholder and public engagement in the bioeconomy. The lessons learned from these activities include the following:

- **Education and information:** BioSTEP's exhibition "Bioeconomy in Everyday Life" turned out to be a highly effective public engagement tool – particularly for interested members of the public that have no expert knowledge on the bioeconomy. Future exhibitions (or similar formats) should provide more background information on the bioeconomy concept, and provide specific information regarding the sustainability of bio-based products and processes. Out of all the social media venues used to promote the project (including Facebook and LinkedIn), Twitter was the most effective tool to reach the interested public.
- **Dialogue:** A key feature of effective stakeholder dialogues is the involvement of participants throughout the entire duration of the respective project/initiative. BioSTEP has shown that an initial broad online survey can be an effective tool to start engaging with stakeholders at a very early stage. Engagement activities should be tailored to the national/regional context and consider the respective "culture of participation." Activities and events should be relevant to current policy discussions. Mobilisation of individual businesses, NGOs/CSOs and citizens turned out to be difficult in BioSTEP; targeted outreach efforts, including direct personal invitations and financial compensation for participation may be necessary in future projects.
- **Co-production of knowledge:** The living lab approach as applied in BioSTEP can facilitate co-creation in the context of regional strategy development. However, the approach proved relatively time-consuming and limited in its ability to engage entrepreneurs. Its success depends on the commitment and participation of the respective regional authorities, as they are key stakeholders when it comes to strategy implementation.

New, innovative instruments for stakeholder engagement are necessary in the bioeconomy field, particularly regarding involvement of NGOs/CSOs and citizens. Building on these lessons learned, this report presents a set of recommendations for future effective stakeholder and public engagement in the bioeconomy, aiming to maximise the impact of EU Research & Innovation. BioSTEP's research recommendations focus on five distinct topics:

1. **Integrating priorities of civil society into bioeconomy research agendas**
2. **Developing and testing models for co-creation in the bioeconomy**
3. **Communicating complex topics of the bioeconomy to the general public**
4. **Analysing the regional transition to the bioeconomy**
5. **Ensuring responsible research and inclusive innovation in the bioeconomy**

The lessons learned and the research recommendations go beyond the bioeconomy and can be applied to other topics where effective stakeholder and public engagement can improve EU policy development, research and innovation.

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Abbreviations

BBSRC	Biotechnology and Biological Sciences Research Council
CEBC	Central European Biomass Conference
CSO	Civil Society Organisation
EFIB	Forum for Industrial Biotechnology and the Bioeconomy
EU	European Union
FP	Framework Programme for Research and Technological Development
IBioIC	Industrial Biotechnology Innovation Centre
NGO	Non-governmental Organisation
NGT	Nominal Group Technique
OECD	Organisation for Economic Co-operation and Development

pMCA	Participatory Multi-Criteria Analysis
RRI	Responsible Research and Innovation
SDGs	Sustainable Development Goals
SiS	Science in Society
SMEs	Small and medium-sized enterprises
TSP	Transformative scenario planning
UK	United Kingdom
UN	United Nations

1 Introduction

Stakeholder involvement and public engagement are key elements of EU policy development, as well as of responsible research and innovation. Consultation with entities affected by policies and with the public at large increases public understanding of scientific research, improves trust, and informs research by providing diverse perspectives - it enables innovations to better align with societal needs. Building on the same idea - namely that an open and informed dialogue on complex topics such as the bioeconomy and engaging with variety of stakeholders and the general public may bring the concept of the bioeconomy closer to the society - BioSTEP experimented with different participatory tools including workshops, living lab activities, and exhibitions. This report describes the ^ and provides recommendations for future EU research. The lessons learned and the recommendations go beyond the bioeconomy and can be applied to other topics where effective stakeholder consultation and public engagement can improve EU policy development, research and innovation.

After a brief introduction of the theoretical framework of stakeholder and public engagement in BioSTEP, the first part of this report briefly explains its methodological approach and gives an overview of the participatory instruments applied. It then analyses their effectiveness in terms of organisational issues, engagement aspects and policy impacts. The second part of the report presents five research recommendations and describes in detail their backgrounds and goals as well as their expected impacts.

2 Stakeholder and public engagement in the BioSTEP project

2.1 Analytical framework for public engagement in BioSTEP

In order to develop guidelines for stakeholder and public engagement in the bioeconomy, it is important to consider the current thinking on both the nature of and motivations for “engagement” as well as notions of good practice. This report looks at ways to support and promote good practice in the development of various engagement activities, drawing on the examples and case studies used in BioSTEP. The aim is to reflect on key aspects of the project that can be applied to public engagement in the governance of science and technology at large, so as to support a more participatory development of bioeconomy-related sectors.

The framework for analysis of public engagement in BioSTEP (Ribeiro and Millar, 2015) consists of three main dimensions: actors involved, motivations for engaging, and levels of engagement.

Figure 1: Actors, motivations and levels of engagement (Ribeiro and Millar, 2015)

2.2 Stakeholders and publics

In line with other approaches (e.g. Ross, 2003; Reed et al., 2009), BioSTEP identified that the groups of actors that are or might be involved in the bioeconomy belong to different interest groups. We distinguish between *stakeholders* and *members of the public*, the latter being citizens who do not formally identify with stakeholder groups. BioSTEP target groups for the engagement activities are

therefore generally defined as either "stakeholders" or "publics," both representing rather heterogonous groups of actors. Stakeholders include policy-makers, representatives of government institutions, research and development entities, businesses, NGOs and CSOs. Publics are people (part of civil society) who differ from stakeholder groups in terms of their level of organisation and visibility. They usually lack the resources to become organised or might not identify themselves with any formally organised group (see Mohr et al., 2013). The categorisation into stakeholders and publics is highly dynamic and context-dependent. In theory, any kind of "public" is *a priori* 'qualified' to participate in public engagement experiments, and participants themselves may redefine their role during or after engagement activities.

2.3 Motivations: from instrumental to normative approaches

The literature on promoting public engagement with science and technology identifies at least three main motivations for doing so (Marris and Rose, 2010; Pallet, 2012):

1. **Creating good relationships and building trust (instrumental):** public engagement seeks to improve public trust and reduce conflict to smooth the way for emerging technologies. It can also help achieve predetermined outcomes to serve the interests of powerful actors.
2. **Making better decisions (substantive):** public engagement incorporates non-experts' knowledge into decision-making processes to improve the suitability of technological developments for their embedding in society.
3. **Democratic responsibility to engage (normative):** public engagement responds to an ethical need or a 'right' of publics to be involved in decision-making processes, since science and technology directly affect our lives and are funded with public money.

Theory and practice of public engagement has been criticised mainly for drawing on instrumental rationales, which frame engagement as an act of providing knowledge or understanding to fill a deficit. This model is based on the idea that a lack of trust by the publics or a negative public perception of science and technology is a direct result of misinformed publics, i.e. that people who lack information on (the benefits of) science and technology tend to be opposed to these. According to some scholars, the deficit approach instrumentalises public engagement, as its purpose is to increase public support of emerging science and technologies. Those claiming to hold expertise then create spaces, define rules, and design and implement initiatives aimed at promoting public participation - but they might be creating only a certain type of public involvement and support (Felt and Fochler, 2010) and draw from only a limited number of engagement tools.

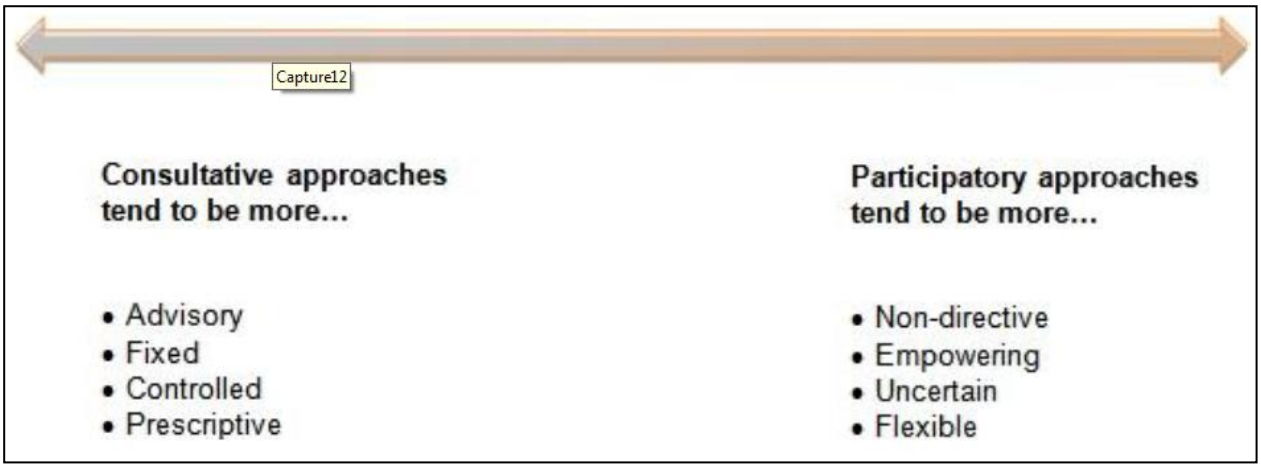
A 'democracy'-oriented approach, on the other hand, constitutes a more participatory form of scientific governance to which many thought leaders aim to transition. Current engagement processes can often be described as hybrid attempts at democratising science, where both deficit and democratic approaches coexist in different aspects of the engagement exercises (Irwin, 2006). Motivations to engage in discussions about e.g. the bioeconomy come from a broader ambition to participate in policy decisions and/or a willingness to support the transition towards a more sustainable society and economy.

2.4 Levels of engagement

Along with international conventions and engagement practices within assessment processes (UN Economic Commission for Europe, 1998; Roberts, 2003), the BioSTEP approach has made distinctions between different methods and levels of public engagement. These range from improving peoples' access to information to actual citizen participation in decision-making processes.

In general, engagement practices can take a more 'consultative' or 'participatory' form on a hypothetical engagement spectrum:

Figure 2: Public engagement spectrum in the context of impact assessment (based on Roberts, 2003)



Core values and principles that govern more participatory and democratic approaches to public engagement include:[1]

- directly involving citizens in decision-making processes;
- explicitly taking into account the publics' input in decision-making;
- designing engagement practices in agreement with participating publics;
- being transparent about how publics input may affect the decision;
- allowing individuals to express their interests and concerns in their own language and terms;
- addressing individuals' main concerns;
- proactively engaging with marginalised or underrepresented groups.

'Lower levels' of engagement are usually related to practices of top-down, one-way information transmission (experts and/or regulators inform/educate the public), whereas 'higher' levels are associated with consultation exercises, focus groups and questionnaires - even higher levels involve dialogue initiatives giving publics the opportunity to have some authority in the decision-making process, and are characterised by a two-way flow of information (Rowe and Frewer, 2000).

Neither type of engagement should a priori be considered 'better' or 'worse,' as their adequacy depends on the objectives of the organisers and participants. As noted by Roberts (2003), one cannot completely separate consultation and participation, as the outcomes of activities are typically located somewhere between the extremes of the engagement spectrum. Since the work of Roberts (ibid), models of engagement that were previous characterised as participation and now deemed to need or be co-creation or co-production processes. Outside of direct impact assessment, broader dialogues about science and technology that employ forms of public engagement rarely aim to be fully participatory or assume deliberative democratic aspects (Tlili and Dawson, 2010). In fact such activities, which range from citizens' juries to science festivals, are so varied in their characteristics and motivation for public consultation that they cannot be placed on a definite point on the spectrum. This is because public engagement with science and technology sits at the intersection between informal science education, democratic processes and 'science as entertainment' (Tlili and Dawson, 2010). It is therefore even more important to be aware of the nature of any engagement tool and its application - organisers should be transparent about the underpinning principles and limitations of their engagement activity.

2.5 Engagement practices in the bioeconomy

The results of our studies and activities in BioSTEP suggest that engagement practices for participative governance, particularly with publics and CSOs/NGOs, in the bioeconomy are rare. Particularly at the

[1] See http://www.iap2.org/?page=A4 and http://www.publicagenda.org/files/public_engagement_primer.pdf (last visited on 21 October 2015).

regional level, public engagement tends to constitute one-way communication focused on providing information to stakeholders. Engagement practices for participative governance within *national* bioeconomy strategies, on the other hand, often include explicit guidelines encouraging public participation.

The interplay between (inter)national organisations and regional stakeholders, as well as the evolvement of interlocutors that align national and regional strategies, is particularly relevant in this respect: Bioeconomy clusters like the Lombardy Green Chemistry Association in Italy, the Norwich Research Park in the UK, the Chemical Biotechnology Process Centre in Germany's Saxony-Anhalt, and Belgium's Ghent Bioeconomy Valley play a considerable role in the promotion of the bio-based economy within countries. However, the involvement of other publics (e.g. civil society) in the bioeconomy has just started.

Participative governance at the level of regional bioeconomy strategies is more complex: clear strategies for public engagement are missing, as rationales and designs of activities in this context seem to be limited to a one-way flow of information from stakeholders to the public. Those involved in the bioeconomy seek to increase public awareness of the benefits of the bioeconomy, and active involvement of civil society is still in its infancy. However, attempts to move towards participative governance can be identified as the following sections of this report will illustrate.

3 Methodological approach

An analytical framework that elaborated theory and practice of public engagement supported the design and implementation of the engagement tools used in BioSTEP. This analytical framework was derived from the academic literature on this topic. All project activities in BioSTEP built on this framework, such that it was used to e.g. design the project's public events, select stakeholders for participation in events, and evaluate the effectiveness of activities. The discussion paper that outlined the analytical framework (Ribeiro and Miller, 2015) set out the following guiding questions for the project's engagement activities:

- Who are the publics we are engaging with (i.e. what is our understanding of these publics)? If we categorise them, are we able to explain the relevance of such a categorisation in our work?
- Based on which criteria (informed by a set of assumptions or context) are we selecting / inviting publics? Are we open to reassess these assumptions?
- What are our motivations to engage with publics, within the remit of the project?
- How are we engaging and how would we classify the different activities we are promoting in the participation spectrum?
- What do we expect in terms of impact from our engagement activities (what are the changes we are hoping for)?

Table 1: Participatory tools applied in BioSTEP

Education & Information	Dialogue	Co-production of knowledge
Project website comprising information on the bioeconomy	Stakeholder interviews, workshops, validation meetings	Regional living labs
Social media: Twitter, Facebook, LinkedIn	Web-based stakeholder consultation	
Virtual exhibition of bio-based products	Policy workshops and conferences	
Exhibition series "Bioeconomy in Everyday Life"		
Various information materials on paper *		

* not covered in this report

Table 1 above gives an overview of the participatory instruments applied and tested in BioSTEP's activities, as well as the stakeholder groups engaged. But how effective are selected participatory tools when it comes to engaging stakeholders and citizens in debates about the bioeconomy? Rowe and Frewer (2000) argued that the empirical examination of the quality of participatory methods is not sufficient due to lack of appropriate benchmarks for the evaluation. We thus selected the following evaluation criteria as benchmarks:

Table 2: Evaluation criteria for the participatory tools applied in BioSTEP

Organisational issues	Engagement aspects	Policy impact
Outreach/promotion of the event	Topics discussed	Participation of policy-makers
Number of participants	Formats applied	Identification of policy gaps
Response rate	Mode of discussion	Results: outreach to relevant stakeholders
Representation of stakeholder groups	Feedback received from participants	Results: number of downloads
Geographical coverage		Page views (event website)

Due to the varied nature of the engagement tools applied in BioSTEP, the criteria defined above are not applicable to all tools. While evaluation of the organisational aspects is fairly objective (it involves quantifiable benchmarks like number of participants and geographic coverage), the evaluation of the engagement aspects and the policy impacts is more subjective as it requires qualitative assessment. Important questions in this context are:

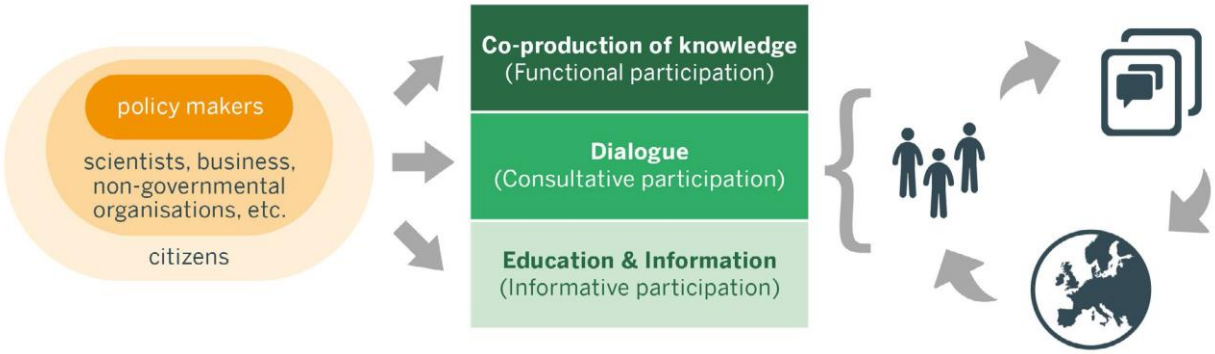
- What worked well? What didn't work out as expected?
- What could be improved / done better when the tool is applied next time?
- What is the tool's contribution to improved stakeholder engagement in the bioeconomy?
- Are there knowledge gaps or shortcomings that could be addressed by future research?

4 Evaluation of participatory tools applied in BioSTEP

BioSTEP applied a three-tier approach to engagement (see Figure 3) that distinguishes among the following modes of public participation:

1. **Education and information**, where experts provide other individuals and organisations with information on the bio-based economy (*informative participation*);
2. **Dialogue**, where some stakeholders consult and seek the views of other individuals and organisations (*consultative participation*);
3. **Co-production of knowledge**, in which experts, citizens and interest groups cooperate (*functional participation*).

Figure 3: Modes of public participation as applied in BioSTEP



Adapted from: Sedlacko, M. (2012), WU Wien

The overview of the engagement activities in BioSTEP (Chapter 4) is structured along these three modes of participation.

4.1 Education & Information

This mode of participation focuses on the transfer of knowledge. At BioSTEP's touring exhibition, visitors were offered the opportunity to learn more about bio-based products and talk to the BioSTEP consortium. Visitors were asked to voice ideas, concerns and suggestions in a survey on the bioeconomy in general and the exhibition in particular. The project also set up and marketed a virtual (online) exhibition that followed the same concept as the actual exhibition. Project participants also used social media channels, such as Twitter and Facebook, to communicate about these events and their results – and also to spread the word about interesting developments in the field, relevant studies, and events of other users.

The overall goal of the touring exhibition, the virtual exhibition, website and social media outreach was to raise awareness about the bioeconomy – to set the foundation for a better understanding and to enable a critical reflection on its challenges and opportunities.

4.1.1 Exhibition "Bioeconomy in Everyday Life"

The exhibition showcased various bioeconomy products, e.g. biodegradable plastics and other innovative materials, using pictures and texts that were easy to comprehend – as well as in most cases the product itself. Each product was placed in its "natural environment", meaning the brick manufactured by micro-organisms was displayed on a work bench in a garage while shoes made from rice husks were shown in a "sports corner" together with other athletic equipment.

4.1.1.1 Objectives of the exhibition

We pursued a low threshold approach to reach as broad of an audience as possible, aiming to engage primarily the interested public that has no expert knowledge on the bioeconomy. The selection of bio-

based products provided a “hands-on” opportunity to get an idea of what bioeconomy is, since most people are not yet familiar with the concept and what it entails.

Corresponding to our goal of reaching a broad audience, we chose exhibition locations that are frequented by an interested public and that also allow for discussion with attendees. We concentrated on locations that are especially attractive for families, as we wanted to reach a broad range of age groups and economic/social backgrounds. Science parks and museums fulfilled these criteria.

4.1.1.2 Summary of activities carried out in the context of BioSTEP

In the course of the BioSTEP project, the exhibition was showcased in Scotland, Italy and Bulgaria:

- 18 – 20 October 2016 in the Glasgow Science Centre, Scotland, UK
- 19 April – 7 May 2017 in AmbienteParco in Brescia, Italy
- 10 – 21 May in Fenice Green Energy Park, Padua, Italy
- 12 – 15 October 2017 in the Historical Museum of Stara Zagora, Bulgaria

Glasgow Science Centre, Scotland, UK

The exhibition was set up during a holiday week in Scotland. According to the management of the Glasgow Science Centre, approximately 3,000 visitors come on a weekend during this season. As our exhibition was situated on the first floor (however in an edge zone), it can be assumed that at least one third of the visitors walked through it. Since the official evening reception of the European Forum for Industrial Biotechnology and the Bioeconomy (EFIB) took place in the Glasgow Science Centre on the same floor, the exhibition also reached experts and companies in this field. It was promoted via the website of the Glasgow Science Centre, the website of the EFIB, various social media channels and the BioSTEP project website.

More than 60 people took the opportunity to fill out our ten-minute survey, which asked for their views on the bioeconomy, on public engagement (and whether there should be more of it), and how they liked the exhibition. Additionally, two posters were hung up for people to freely note their thoughts and ideas about the challenges and opportunities of the bioeconomy (the few entries on these posters did not generate further insights). Most survey participants came from Scotland. About 2/3 were 26-45 years old, followed by the age group 45-65 and then 18-25. A few participants (five) were older than 65.

Results of the survey: All visitors agreed that the exhibition raised their awareness of what the bioeconomy is and that there are already a range of products that are either bio-based or produced using bio-based processes. They liked the practical approach and valued that they were able to touch the different objects, which made the bioeconomy more tangible for them. Most were not aware that there are alternatives to oil in common products, including materials made from e.g. crop residues. While most perceived the exhibition as suitable for adults, some remarked that there were not enough “hands on” possibilities for children – suggestions included an interactive workshop or videos that go into detail about the processes needed to manufacture the innovations. Most respondents said they would appreciate more public engagement regarding the bioeconomy, with some stressing that they would first like to receive more information on the subject. Regarding how they would like to be involved, suggestions included further exhibitions, websites, social media, TV, radio and schools.

As for individuals’ view of the bioeconomy, 65 per cent strongly agreed with the statement that the bioeconomy can help reduce waste and establish a circular economy while 10 per cent strongly disagreed. Similar results emerged regarding the expected impact of the bioeconomy on mitigation and adaptation to climate change. Survey participants were a bit less clear on the challenges of the bioeconomy, with nearly half of respondents unable to agree or disagree with the statement that the bioeconomy poses challenges to food security. The evaluation of this section can be downloaded here.

Figure 4: Pictures of the exhibition (Glasgow)

AmbienteParco in Brescia, Italy & Fenice Green Energy Park in Padua, Italy

AmbienteParco is a Science Park with exhibitions on aquatic life, renewable energy/energy efficiency and circular economy. The BioSTEP exhibition was set up in the 'casa ecologica'. On weekdays, the park is visited by school classes that are guided trough the various exhibits by trained guides. Children that visited the BioSTEP exhibition were primary and secondary school age. During the weekend, the exhibition park is open to the public. About 1,900 people had the chance to walk through it and learn about bioeconomy including the school classes. Due to BioSTEP's requirement that participants be at least 18 to be surveyed, no surveys were filled out at this location. Since the exhibition was shown for three weeks in Brescia, the BioSTEP team was not present and available to explain and guide respondents through the survey – instead, the director of the park was asked to provide feedback on how the exhibition was received. She deemed it suitable for children older than 10 years and suggested there should be more information about the energy or materials saved when choosing a bio-based product over a conventional one. Selected exhibit components stayed in the 'casa ecologica' and have been permanently integrated into the existing exhibition. The director of the park is now looking into local products that can be added to the innovations from the BioSTEP exhibition.

The Fenice Green Energy Park location was similar: the site organises educational paths for children of pre-schoolers, primary school, and high school age on nature, technology and green energies. The BioSTEP exhibition "Bioeconomy in Everyday Life" was shown there for 11 days and visited by 44 school classes as well as the general public – in total, 1,040 people received guided tours. As the children were too young to be surveyed, their tour guide gave us valuable feedback. Overall, he viewed the exhibition as a great way to show the progress of the bioeconomy. He deemed it most suitable for people aged 17-45 years old. He particularly enjoyed the colour and design of the BioSTEP products and suggested to include more photos and videos – he also found the exhibition lacked detailed information on environmental problems. In terms of advertising, the BioSTEP exhibition in Padua was promoted via our channels and the external newsletter of the park, as well as by the Italian project partners.

Fenice Green Energy Park was also the site of a meeting of the Veneto living lab held on 10 May 2017. All participants of this meeting were given a guided tour through the exhibition afterward.

Figure 5: Pictures of the exhibition (Brescia & Padua)

Stara Zagora Regional History Museum in Stara Zagora, Bulgaria

BioSTEP's last exhibition took place in the Stara Zagora Regional History Museum from 13 – 15 October 2017. To reach as many people as possible, it was shown during the Augustiada, a festival of wine and cultural heritage that is a major event in the region and attracts many people.

The first meeting of the Bulgarian living lab took place parallel to the exhibition on its first day. Entitled "Organically grown essential cultures and essential oils production - development perspectives,

problems and plan of activities to help the industry" the event assembled regional companies, representatives of the Stara Zagora government, and interested citizens. During the breaks, participants of the meeting were guided through the collection of bio-based innovations. The products inspired conversations about Bulgarian innovations in this sector and potential untapped resources in the region. As a response to suggestions made by visitors of the exhibition in Italy and Scotland, a more detailed introductory poster about the bioeconomy was included into the Bulgarian exhibition. In total, around 200 people took the chance to visit the exhibition.

The exhibition was advertised via BioSTEP channels, in the context of the Augustiada (on flyers and the website of the museum) and via the Bulgarian Industrial Association (BIA). During the three days of the exhibition, the Bulgarian national press (*Standartnews* and *Monitor*) reported about it (see Figure 7: Bulgarian media reports).

Results of the survey (only 10 were collected): Five survey respondents were 18-25 years old, the other five 26-45. All stated that the exhibition had raised their awareness of what the bioeconomy is. They valued the information given as "useful and comprehensive" or "enriching." The only suggestion for improvement was to present the exhibits in a "more attractive way." All but two participants voiced that they would appreciate more public engagement: they would like to receive more information through social networks, videos, websites, exhibitions and lectures for students.

Half of the participants knew what the bioeconomy is. The majority strongly agreed that bioeconomy can help us to reduce our dependence on non-renewable resources, help us mitigate climate change, manage natural resources sustainably and reduce waste as well as establish a circular economy. The picture is more mixed when talking about the challenges bioeconomy poses to food security, biodiversity, soil, water, air and jobs. Most responses fell into the "neither agree nor disagree" answer.

Figure 6: Pictures of the exhibition (Stara Zagora)

Figure 7: Bulgarian media reports

Standartnews (Стандарт)

Monitor (Монитор)

Table 3: Number of visitors to the exhibition

Glasgow, Scotland	Brescia & Padua, Italy	Stara Zagora, Bulgaria	Total
~ 1,000	~ 2,940	~ 200	~ 4,140

4.1.1.3 Evaluation of the exhibition "Bioeconomy in Everyday Life"

One of our main goals was to get engaged with the interested public - to talk with them about the bio-economy, what it means to them and what fears and hopes they connect with the concept. With the help of the science centres – and the number of visitors they regularly attract – we successfully reached more than 4,000 people. The number of visitors can be considered a success. In addition to the general public, we also reached experts. In Glasgow, the reception guests of the EFIB walked through the BioSTEP exhibition. In Padua, the different stakeholders participating in the Veneto living lab came together to discuss the use of resources in their region and enjoyed the insights of the exhibition. The high visitor numbers in Italy were in part due to the long time span of the exhibition compared to the other locations. However, BioSTEP staff was not present throughout this time. Summing up, the surveys and feedback we received from the guides demonstrated that the exhibition is a suitable tool to practically show what bioeconomy entails. The organised exhibitions can be considered a success, as many people saw them and were willing to engage in discussions. They had a better understanding afterwards of what the bioeconomy entails.

4.1.1.4 Lessons learned

- Science parks are a great place for exhibitions, as people of all ages from a variety of backgrounds visit such locations. They have time and are willing to discover new things. However, an exhibition does not speak for itself and needs to be explained. The bioeconomy as a concept has to be introduced and some background information given. It was therefore

good that either the BioSTEP consortium or professional guides were present for inquiries. This should be the standard for future exhibitions.

- This exhibition is not suitable for children under 12. Although it has a “hands-on” approach, it is not entertaining enough for younger age groups. For future exhibitions, more multimedia content should be included - possibly shorter videos on specific topics of the bioeconomy, either on the production of specific innovations or larger subject areas such as aquaponics or vertical farming.
- The exhibition provides practical insights into items of everyday life that are not based on fossil fuels, are produced with the help of enzymes or consist of residues that would otherwise have gone to the landfills. Most visitors had little to no prior knowledge of such products or the context - thus, the exhibition was successful in raising awareness and awakening interest, which is the basis for an informed stakeholder and citizen engagement.
- Future exhibitions should contain a detailed introductory posters with background information on the bioeconomy. as people would like to learn more on why we need bioeconomy and what are environmental challenges that increase the necessity for a strengthened bioeconomy.
- The products we were exhibiting are innovative, but not (yet) evaluated regarding their sustainability. With the help of future research, the environmental footprint of bio-based products could be examined and compared with their traditional (fossil-resource-based) counterparts.
- The appeal of a tool such as the “Bioeconomy in Everyday Life” exhibition could be increased by including videos about the manufacturing process of the products. This would shed light on the resource and the production process.

4.1.2 Website incl. Virtual Exhibition & Social Media

The website www.bio-step.eu was set up in the beginning of the project. It introduces the consortium and the objectives as well as work packages of the project. In easy to understand texts and videos, it explains what bioeconomy entails. The website is the main platform for the results of the project. These can be downloaded in the *results* sections and are summarised in the *news* section. Visitors can register on our website for events and our newsletter. The “Get Involved” section invites them to actively participate in our project, to respond to surveys, to follow and comment on our social media activities, and to visit our exhibitions and living labs. The virtual website http://products.bio-step.eu/ follows the same concept as the exhibition. On the website, visitors can learn about the product and the material used for it. Additionally, the website offers a short quiz about the products to make it more interactive. BioSTEP has an active Twitter account, a Facebook page and a LinkedIn page.

4.1.2.1 Summary of activities carried out in the context of BioSTEP

The BioSTEP website was updated on a regular basis. This included the publishing of *news* as well as the updating of the *events* and *results* sections. Project news was further distributed to an ever-increasing number of subscribers. These subscribers registered via our project website or signed up during our workshop and conferences. In total, 5 newsletters were sent out.

Social media activities increased over the course of the project. Via the BioSTEP Twitter account, we published more than 300 tweets, followed more than 200 experts and were able to convince more than 700 individuals, institutions and public figures to follow our activities. Once a week, the BioSTEP team informed via Facebook about highlights of the bioeconomy and project results. Most of the Facebook posts assumed an uninformed public and stressed interesting innovations, such as edible water bottles or furniture made from residues. As there were no intense debates in the bioeconomy groups on LinkedIn, this medium was only used to advertise events.

4.1.2.2 Objectives of the website incl. virtual exhibition and social media

All our platforms were fed with content to raise awareness of and initiate a discussion on the bio-economy. The website was the mouthpiece for the project. It introduced BioSTEP’s goals and objectives and was of central significance for the communication of our results. Twitter, LinkedIn, and Facebook were other venues for reaching the interested public. To increase our reach, we did not just report about our own results, but were also constantly researching and distributing scientific and political news on the bioeconomy.

4.1.2.3 Evaluation of website incl. virtual exhibition and social media

All our communication material refers to our project website, which was visited by over 15,400 individuals with more than 43,737 page views by January 2018. Not surprisingly, most visitors started from the home page http://www.bio-step.eu/. The background section with information on the bioeconomy and the registration page were of great interest. BioSTEP had between 20 and 90 visitors per day. There were 11,185 visits from Europe, 2,065 from North America and 1,350 from Asia. The virtual exhibition of the BioSTEP project was visited more than 700 times. We introduced the newsletter around the halfway point of the project. Towards the end, it was distributed to more than 400 people who expressed interest in staying updated about BioSTEP.

On Twitter, the number of followers steadily increased throughout the project and reached more than 700 by January 2018. This is a rather high number for an EU-funded project that does not generate content on a daily or at least weekly basis. BioSTEP is followed by individuals engaged in the bioeconomy, companies, institutions and other project and initiatives. Examples of Twitter entities that follow us are industry networks such as the Scottish IBioIC, BIOWAYS, and Novozymes as well as several DGs of the European Commission. On average, our tweets were retweeted and liked by 6-8 people. One of the most attention-receiving tweets was distributed after our BioSTEP Forum, which took place in March 2017: it announced the publication of the BioSTEP Policy Paper. On Facebook, 155 people like the BioSTEP page. In comparison to Twitter, Facebook users generally engage in private communication and less professional exchange – this hampers engagement about the bioeconomy with this social media subgroup. LinkedIn was insufficiently used as a communication channel to be evaluated.

4.1.2.4 Lessons learned

- Twitter is a useful tool for raising awareness about a specific concept such as the bioeconomy and to communicate project results. To increase the number of followers, constant “tweeting” and “retweeting” is necessary, which is time-consuming. Evaluating the retweets and likes of BioSTEP posts, original tweets generate more attention than retweets - tweets with an appealing picture seem to raise more interest. Hashtags, such as #bioeconomy and addressing users individually (using @) help reach people interested in the same subject. Overall, Twitter is a suitable tool to communicate project activities and results. It gives a good overview of current debates and events on specific subjects.
- Facebook and LinkedIn proved less suitable for communicating project results and engaging users in bioeconomy-related discussions. On Facebook, BioSTEP was comparatively well rated with 155 likes. However, these numbers did not increase steadily during the project. The bioeconomy groups in LinkedIn were not highly frequented and hence did not generate expected audience growth.
- The virtual exhibition was promoted via social media and other channels of the project team. Every update of the website was communicated via Twitter, which increased its visibility. Nevertheless, the virtual exhibition could have been updated more frequently and publicised more widely.
- With future research, it would be interesting to evaluate whether social media tools, such as Twitter, succeed to reach beyond the expert community in order to find out whether they are capable of increasing the level of awareness of the general public for a specific topic.

4.2 Dialogue

BioSTEP's stakeholder consultation process was carried out in the context of WP3 and WP4. The objective of WP3 was to explore the development of two *national* bioeconomy strategies in Finland and in Germany and four *regional* bioeconomy strategies in Veneto (Italy), Scotland (UK), the BioBased Delta (the Netherlands) and Saxony-Anhalt (Germany). Desk-based research was accompanied by expert interviews with key stakeholders as well as by regional stakeholder workshops and validation meetings in each case study, resulting in best-practice guidelines for stakeholder and citizen participation in bioeconomy strategies. In parallel, WP4 focused on identifying existing policy gaps and potential (policy) measures to address them. This was done by conducting an online stakeholder consultation, a series of policy workshops at European, national and regional level, and by organising a stakeholder conference (BioSTEP Forum).

The findings of this consultation process are summarised in (a) good practice guidelines for stakeholder and citizen participation in bioeconomy strategies, and (b) a policy paper with five key recommendations for effective stakeholder and public engagement in a bio-based and circular economy, aiming to support the ongoing review and update of the EU Bioeconomy Strategy between 2017 and 2018. The overall consultation / stakeholder dialogue process is depicted in Figure 8.

Figure 8: Overview of the stakeholder dialogue process in BioSTEP

4.2.1 Stakeholder Interviews, Workshops and Validation Meetings

4.2.1.1 Summary of activities carried out in the context of BioSTEP

This section examines the objectives, outcomes and lessons drawn from the stakeholder interviews, workshops and validation meetings undertaken under WP3.[2] These activities focused on six case studies, which were led by different BioSTEP partners, drawing on existing networks and expertise in particular countries/regions:

- two national case studies: Finland (EPRC) and Germany (BIOCOM);

[2] Davies S., Griestop L., Vironen H., Bachtler J., Dozhdeva V., Michie R. (2016): Case studies of national bioeconomy strategies in Finland and Germany. BioSTEP Deliverable 3.1.; Charles, D., Davies, S., Miller, S., Clement, K., Overbeek, G., Hoes, A.-C., Hasenheit, M., Kiresiewa, Z., Kah, S., Bianchini, C. (2016): Case studies of regional bioeconomy strategies across Europe. BioSTEP Deliverable 3.2.

- four regional case studies: Bio-based Delta (WUR), Saxony-Anhalt (Ecologic), Scotland (EPRC), and the Veneto region (UCV).

Table 4 provides an overview of the activities undertaken for the six case studies:

- Each national case study drew on desk research and stakeholder interviews between November 2015 and January 2016, followed up by a validation process in October/November 2016 on a draft of BioSTEP's Good Practice Guidelines on Stakeholder and Citizen Participation (D3.3).
- Each regional case study involved desk research and stakeholder interviews between February and June 2016, as well as a stakeholder workshop (or citizen-oriented event) in May/June 2016, and a validation meeting in October/November 2016 on the draft of BioSTEP's Good Practice Guidelines on Stakeholder and Citizen Participation (D3.3).

The results are discussed in three public Deliverables focused respectively on the national case studies (D3.1), the regional case studies (D3.2) and a set of good practice guidelines for stakeholder and citizen participation in bioeconomy strategies (D3.3). A draft version of these guidelines was discussed in the validation meetings held as part of the six case studies, with participants invited to give feedback on the guidelines. In addition to the mandatory Deliverables, we also produced a summary version of the good practice guidelines in a more attractive format for policy-makers and other practitioners.

The following criteria were used to select the six case studies:

- A bioeconomy strategy (a set of ideas and actions) must be in place and being implemented.
- The strategy's existing participants must be interested in working with BioSTEP and in engaging in dialogue with non-participants (including NGOs/CSOs).
- A number of different stakeholders must already participate in the strategy. The strategy must already be co-produced by stakeholders from at least the policy, business and research arenas. Other actors (i.e. NGOs/CSOs and individual citizens) may have so far participated by being informed or consulted, rather than as co-producers of the strategy.
- The selected regional case studies should cover a diverse range of countries and regions across the EU.
- The regional case studies should cover different aspects of the bioeconomy e.g. both the 'old' bioeconomy (various biofuels) and the 'new' bioeconomy (refined biomaterials with a higher degree of value added).

Table 4: Summary of activities carried out under WP3

Case studies	Interviews	Workshops	Validation meetings
Finland	November 2015, 15 interviews	None (not foreseen for the national case studies)	4 October 2016, 7 participants, linked to a meeting of the national Bioeconomy Panel, held in Helsinki
Germany	November 2015 - January 2016, 15 interviews	None (not foreseen for the national case studies)	Planned for 14/15 November 2016, as part of a meeting of the German Bioeconomy Council, but removed from the agenda late in the day. Instead, we consulted four members of the Council, representing different types of stakeholders.
Bio-Based Delta (Netherlands)	March 2016, 13 interviews	Planned as part of a meeting of the Bio-Based Delta Board, which did not go ahead due to changes in the Board. Instead, we conducted a citizen survey at the Delta Innovation Days in Bergen op Zoom on 27 May 2016.	26 October and 10 November 2016, 5 participants, held in Bergen op Zoom
Saxony-Anhalt (Germany)	February-May 2016, 13 interviews	1 June 2016, 4 participants, linked to the 5th International Bioeconomy Conference, Halle	23 November 2016, 13 participants, linked to a meeting of the Advisory Council of the Competence Centre for Socio-Economic Partners, held in Magdeburg
Scotland (United Kingdom)	April-June 2016, 14 interviews	27 June 2016, 13 participants, held at the University of Strathclyde, Glasgow	1 November 2016, 8 participants, held at the Industrial Biotechnology Innovation Centre, Glasgow
Veneto (Italy)	February-April 2016, 15 interviews	24 June 2016, 25 participants, held at the Regional Association of Chambers of Commerce of Veneto, Venice	4 November 2016, 13 participants, held at the Regional Association of Chambers of Commerce of Veneto, Venice

4.2.1.2 Objectives of the stakeholder interviews, workshops and validation meetings

Following desk research to identify and obtain documents relating to the national/regional bioeconomy strategy and its implementation, and also concerning the national framework for the bioeconomy and stakeholder engagement, each case study leader identified a number of stakeholders and relevant publics. Interviews were held with 13-15 representatives of key stakeholders including actors involved in the development and implementation of the strategies, as well as representatives of the wider public. The aim of the interviews was to:

- Explore how different stakeholders had been involved in the design, implementation and review of the strategy.
- Draw out the potential benefits and challenges of broad-based participation in bioeconomy strategy development and implementation.

In the four regional case studies, a regional event was also held, either a stakeholder workshop or a citizen survey. These events explored the perceptions of engagement among those already participating in designing and implementing bioeconomy strategies and also among people and/or organisations who are usually not involved in the process. The regional workshops addressed the following research questions:

- Why would participants want to engage with others in relation to a bioeconomy strategy or activities in the region? What are or would be the benefits and challenges?
- Who do participants engage with now in relation to the bioeconomy? Who else might they engage with?
- How should different people and organisations be involved? What structures or support would be needed to allow this to happen?

In all six case studies (i.e. both national and regional), a validation meeting (or process) was also conducted with a view to:

- Gaining feedback on a draft of the BioSTEP good practice guidelines on stakeholder and citizen participation (D3.3),
- Stimulating further discussion on the potential for wider participatory approaches in the national/regional bioeconomy strategies, the possible benefits of wider participation, and the supportive steps that would be needed to facilitate stronger participation.

4.2.1.3 Evaluation of the stakeholder workshops and validation meetings

A) Organisational issues

Outreach / Promotion of the events

Outreach and promotion work was undertaken by the BioSTEP partner responsible for each of the six case studies, building on existing contacts in the country/region, and usually working in cooperation with stakeholders leading on or closely linked with the national/regional bioeconomy strategies. This collaborative approach aimed to ensure that the interviews, regional workshops, and national/regional validation meetings were closely aligned with the concerns of stakeholders within the country/region and, more broadly, to facilitate a participative approach.

Potential interviewees and participants in workshops and meetings were identified and invited directly to take part and voice their views. In addition, the workshops and meetings were publicised via the websites, social media presence, newsletters and networks of the BioSTEP partners, and also of national/regional stakeholders in bioeconomy strategies.

Practical difficulties occurred late in the day in relation to one workshop and one validation meeting, which meant that these could not take place within the necessary timeframe; alternative events/processes were organised instead, in order to ensure that the project deadlines were respected. A regional workshop was originally planned as part of a meeting of the Bio-Based Delta Board in May 2016 but, due to a change of Board director, this did not go ahead; instead, we conducted a citizen survey at the Delta Innovation Days in Bergen op Zoom on 27 May 2016. Similarly, we originally planned to hold the validation meeting for the German national case study as part of a meeting of the national Bioeconomy Council on 14/15 November 2016, but the Council decided to remove this from

the agenda late in the day; instead, we asked four members of the Council, representing different groups of stakeholders, to provide feedback on the draft good practice guidelines, and two members provided detailed feedback.

Number of participants

In order to maximise participation, the workshops and meetings were linked where possible to existing stakeholder events. Where this was not possible, we tried to ensure that events were hosted by a stakeholder organisation, or at least hosted by organisation that is well-known to stakeholders and in an accessible location (e.g. a local authority or a university). Table 5 provides an overview of the number and types of people interviewed, while Table 6 sets out information on participants in the regional workshops/events and national/regional validation meetings/processes. Overall, the following numbers of people participated:

- Across the six case studies, 85 people were interviewed.
- There were 37 participants in the three regional workshops, while a further 15 people participated in the citizen-oriented event in the fourth regional case study (Bio-Based Delta).
- Last, 47 people participated in the five national/regional validation meetings on the draft good practice guidelines, and a further two people took part in a validation process by email (in the case of the German national case study).

The degree of participation in the workshops and validation meeting varied. It was easier to ensure sufficient participation in case studies where BioSTEP partners already had strong links with stakeholders (e.g. Veneto) or where key stakeholders were particularly keen to cooperate with BioSTEP (e.g. Scotland), and more difficult where BioSTEP partners had more limited existing links with national/regional stakeholders (e.g. Finland, Saxony-Anhalt), sometimes leading to low participation, despite extensive efforts to ensure participation (e.g. personalised email and telephone contact, use of regional websites and newsletters).

Table 5: Interviews undertaken in Finland and Germany

	Finland	Germany	Bio-Based Delta (Netherlands)	Saxony-Anhalt (Germany)	Scotland (United Kingdom)	Veneto (Italy)	Total
National policy-makers	2	4					**6**
Regional/ local policy-makers & agencies	2	1	4	1	6	3	**17**
Business sector	4	2	2	3	4	10	**25**
Research/ education	2	3	1	2	2		**10**
Hybrid organisations		1	3	2	2	1	**9**
CSOs/NGOs	2	3	3	5			**13**
Experts/ consultants	3	1				1	**5**
Total	15	15	13	13	14	15	**85**

Table 6: Participants in workshops and validation meetings under WP3

	Finland	Germany	Bio-Based Delta (Netherlands)		Saxony-Anhalt (Germany)		Scotland (United Kingdom)		Veneto (Italy)	
Event	Validation meeting	Validation by email	Citizen event	Validation meeting	Workshop	Validation meeting	Workshop	Validation meeting	Workshop	Validation meeting
Number of people invited	50	4		14	160	80	30	36		105
Actual number of participants	7	2	15	5	4	13	8	8	25	13
Public/policy sector (incl. regional development agencies)	5	1		2			4	1		1
Business sector	2					1			25	7
Research/ education				1	2	2	3	3		2
Hybrid bodies (innovation centres, clusters…)		1		2	1		1	4		2
NGOs/ CSOs					1	10				
Citizens			15							
Other										1

Representation of stakeholder groups

For all case studies, we endeavoured to ensure balanced participation across different groups of stakeholders (including policy-makers, business representatives, research/education, and CSOs/NGOs, as well as hybrid organisations such as cluster bodies and innovation centres, which bring together a variety of stakeholder types). Tables 5 and 6 provide an overview of the types of participant in the different events.

- Of the 85 people interviewed, 23 were policy-makers, 25 business representatives, 10 from research or education, 9 hybrid organisations, 13 CSOs/NGOs and 5 other.
- Of the 52 people who participated in the four regional workshops/events, 4 were policy-makers, 25 business representatives, 5 research and education, 2 hybrid organisations, one CSO/NGO, and 15 individual citizens.
- Of the 48 participants in the validation meetings/processes, 10 were from the policy world, 10 from the business sector, 8 from research/education, 9 from hybrid organisations, 10 from NGOs/CSOs and one other person.

The profile of stakeholder groups varied across the case studies. In a number of cases, it proved most difficult to ensure strong participation from CSOs/NGOs, particularly in the workshops/events and validation meetings. In two regional case studies (Scotland, Veneto), it proved impossible to secure interviews with CSOs/NGOs, which had decided to focus on other issues than the bioeconomy, due to a lack of internal resources. This was despite extensive efforts to ensure CSO/NGO participation (e.g. email and telephone conversations and personal recommendations from other stakeholders). In contrast, there was strong participation from CSOs/NGOs in Saxony-Anhalt's validation meeting, which was linked to a meeting of the Advisory Council of the Competence Centre for Socio-Economic Partners (which provides support to various socio-economic partners, including chambers, business associations, trade unions, women's organisations, environmental organisations, local authorities, and entities representing agricultural and rural interests).

B) Engagement aspects

Topics discussed

Guidance documents (including checklists) were developed and provided to the case study leaders with a view to ensuring a consistent approach across all case studies. This material included:

- objectives, analytical framework and research questions for the stakeholder interviews, regional workshops and national/regional validation meetings;
- information on ethical considerations (including an information sheet and consent form for interviewees);
- templates for writing up the case study and the workshops/meetings;
- an evaluation form for the workshop/meeting participants
- for the regional workshops, Powerpoint slides with background information on BioSTEP and WP3, as well as the key findings from the national and regional case studies;
- for the validation meetings, additional Powerpoint slides presenting the draft good practice guidelines, and a full text of the draft good practice guidelines.

Interviews focused on:

- participation of a range of organisational stakeholders as well as citizens, in the design, implementation and review of national/regional bioeconomy strategies;
- benefits/opportunities and difficulties/challenges associated with stakeholder and citizen participation in relation to the national/regional bioeconomy strategies.

The three regional workshops explored:

- reasons participants engaged with other organisations or citizens in relation to the national/regional bioeconomy strategy;
- benefits/opportunities and difficulties/challenges of engaging with others;
- potential areas for expanding participation (e.g. new activities, new partners);
- types of structures or support that might be needed to facilitate broader/deeper participation

In the fourth regional case study, a citizen event was held at the Delta Innovation Days in Bergen op Zoom on 27 May 2016, after the regional workshop was cancelled at short notice, due to internal changes within the Bio-Based Delta Board which was hosting the workshop. A face-to-face survey of citizens was undertaken, focused on citizen awareness and views of the bioeconomy, which provided an opportunity to engage with individual citizens and enhance awareness of the bioeconomy.

The six national/regional validation meetings/processes included a presentation of BioSTEP's draft good practice guidelines on stakeholder and citizen participation (D3.3), including an overview of the experiences of the other case study countries/regions. The meetings focused on:

- collecting feedback from participants on the appropriateness and usefulness of the guidelines;
- whether there might be potential for wider participatory approaches in the national/regional bioeconomy strategies, given the experiences of other countries/regions;
- the types of action and support might be needed to facilitate stronger participation.

Formats applied and mode of discussion

The guidance documents provided core information on the research questions and key findings. However, the case study leaders were responsible for organising the workshops and meetings and were free to decide on the format of these events, in order to ensure that they were tailored to national/regional interests and needs. Similarly, the formats of the workshops and meetings were adapted, depending on the number and type of participants. For example, some workshops/meetings took the form of an open discussion among all participants (especially if only a relatively small number of people attended), while in other cases a combination of formats was used, e.g. smaller groups (World Café type, using posters and post-it notes for sharing ideas) and also large group (for feedback and open discussion).

Each workshop and validation meeting began with a presentation of the BioSTEP project and the research findings to date, both within the respective country/region and in (some of) the other case studies. The presentations were made by the BioSTEP case study leaders, who therefore had in-depth knowledge of the research outcomes of the individual case study, as well as key insights into the other case studies (from discussions at project meetings and other interactions among BioSTEP partners).

The workshops and validation meetings were generally organised in cooperation with one of the key stakeholders responsible for the national/regional bioeconomy strategy, and/or at an existing event (e.g. a regular meeting of a bioeconomy council). Preparations for the workshops and validation meetings therefore included engagement with key stakeholders on the appropriate format and focus of each event.

Feedback received

Steps were taken to collect feedback from the participants of the workshops and validation meetings, with a view to assessing their usefulness and effectiveness, and using this information to inform subsequent activities. The guidance package for case study leaders included a one-page evaluation form to be distributed either during or after the workshops and validation meetings. However, most participants either did not fill in the form or only completed the closed questions, providing no additional detail. The case study leaders also endeavoured to gain feedback during coffee/lunch breaks during the workshops and validation meetings, and these also provided opportunities to collect more nuanced and detailed views of participatory processes. Based on the information collected, participants stated that the workshops and validation meetings were good or very good.

C) Policy impact

Participation of policy-makers

Policy-makers were interviewed for all national and regional case studies. They also participated in the validation meetings/processes for both national case studies. Policy-makers participated in the regional workshop and the regional validation meeting in Scotland. In the Bio-Based Delta (where the regional workshop was replaced by a citizen-oriented event, due to last-minute unforeseen circumstances) and also in the Veneto, policy-makers took part in the validation meeting but not in the regional workshop. Policy-makers did not take part in either the workshop nor the validation meeting in Saxony-Anhalt.

Identification of policy gaps and measures to address them

The desk reviews of national/regional literature and the interviews with key stakeholders in national/regional bioeconomy strategies, as well as the regional workshops/events, were used to identify policy gaps in each of the six case study countries/regions, and to generate ideas for the types of measures that could be implemented to address these gaps. On the basis of the two reports on the national and regional case studies (D3.1 and D3.2), a first version of good practice guidelines for practitioners (D3.3) was drafted, and then discussed in the national/regional validation meetings, and subsequently revised. These guidelines provide a range of advice and suggestions on measures to be taken to address gaps in current policy approaches to stakeholder and citizen participation in bioeconomy strategies.

In particular, the good practice guidelines identify key reasons for undertaking participatory actions with stakeholders and citizens, including: (i) cooperating with others to create new opportunities; (ii) mobilising a range of viewpoints to inform decision-making; and (iii) ensuring that a range of people can voice their views and interests. In addition, the guidelines outline a range of typical challenges and obstacles to stakeholder and citizen participation, many of which shape the gaps and difficulties faced by policy-makers who are aiming to expand participatory activities.

One challenge identified in a number of case studies is that participatory activities are often not the main priority for any one stakeholder and/or are undertaken in an ad hoc way, rather than as part of a comprehensive approach. In response, the guidelines set out a series core principles that should be considered for all participation strategies, if they are to be successful, as well as additional resources and practical guidance on implementing these principles:

- design and prepare engagement activities carefully;
- ensure transparency, integrity and respect for all perspectives;
- ensure that engagement makes a difference;
- review and evaluate engagement to improve practice;
- tailor engagement to the national/regional bioeconomy;
- listen and engage people on what matters to them; and
- learn from other sectors, regions and countries.

Further, the guidelines provide detailed examples of the types of participatory measures which could be undertaken to address gaps in current approaches to participation. These include:

- dialogue with stakeholders e.g. via Bioeconomy Councils or Forums, and formal consultations;
- co-production of knowledge involving a range of stakeholders e.g. via hybrid organisations (such as cluster bodies or innovation centres), business-led cooperation, and policy funding for collaborative projects in the bioeconomy;
- citizen-oriented education, e.g. public communication and information campaigns, funding for education and training in the bioeconomy, and activities targeting consumers;
- citizen consultation and dialogue, whether focused on specific strategies/proposals, or via more open-ended forums,

Outreach to relevant stakeholders

The outreach to relevant stakeholders can be measured by the number of downloads of the relevant project outputs (as of January 2018):

- Downloads of case studies of national bioeconomy strategies in Finland and Germany: 102
- Downloads of case studies of regional bioeconomy strategies across Europe: 90
- Downloads of good practice guidelines for stakeholder and citizen participation in bioeconomy strategies: 48
- Downloads of BioSTEP Guidelines for Practitioners (short version): 46

4.2.1.4 Lessons learned

- Need to show the added value of participatory activities for stakeholders;
- Necessity of tailoring activities to the national/regional context e.g. existing policy debates or strategies e.g. the main focus of the leaders of regional bioeconomy strategies is often on engagement to support economic/technological development (instrumental participation), whereas leaders of national bioeconomy strategies may also have an interest in normative and

substantive dimensions of participation (e.g. mobilising capacities/support, and enabling different interests to be voiced);[3]
- Organise workshops and meetings in cooperation with an existing key stakeholder and/or an existing event in order to maximise publicity and participation;
- However, when organizing events in cooperation with other partners, there is also a need to be prepared to be flexible and to develop and implement alternative events, if the partner decides to cancel or change the event at short-notice;
- Importance of a longer term approach especially as participatory activities take time to develop and co-create shared visions and goals;
- Benefit of existing networks in ensuring participation in events; without such networks, extensive efforts may be needed over a period of time to generate interest and participation;
- In some countries/regions, the term 'bioeconomy' is not widely used or understood, but there are existing strategic and engagement processes in specific sub-themes of the bioeconomy (e.g. relating to forestry, food or bioenergy) to which engagement activities could be linked;
- Stakeholders may face 'engagement overload' i.e. there may be multiple engagement processes in (policy) fields related to the bioeconomy (e.g. on the circular economy and on sub-themes of the bioeconomy) which lead to a significant administrative burden.
- Difficulty of engaging with CSOs/NGOs due to their limited resources, especially where the bioeconomy is not high on their list of priorities;
- Difficulty of engaging with individual businesses, although bodies representing businesses (e.g. chambers, associations…) and hybrid organisations (e.g. innovation centres, cluster bodies…) are often keen to engage with others and can provide insights into the needs and views of national/regional businesses;
- Difficulty of engaging with citizens in a way that it is useful and meaningful, especially as there is often a lack of citizen awareness of the bioeconomy; many bioeconomy themes are complex and technical and so need to be translated into specific, citizen-relevant projects/events; and there is often no stakeholder in charge of stimulating citizen engagement on the bioeconomy;
- Formal evaluation processes (e.g. forms) of events do not always produce useful information; discussing informally with participants can also yield useful feedback;
- Evaluation feedback may not be transferable between case study countries/regions;

The two national case studies of Finland and Germany recognised the importance of instrumental, substantive and normative rationales for participation to a larger extent than the regional case studies. Governance processes in both Finland and Germany incorporate participatory mechanisms across a range of policy fields, involving formal institutions representing different societal groups and also some degree of citizen participation. In the two national case studies, broad-based participation was seen as particularly important due to the 'new' and cross-sectoral character of the bioeconomy.

4.2.2 Web-based Stakeholder Consultation

4.2.2.1 Summary of activities

The BioSTEP stakeholder consultation[4] was carried out between 30 October and 22 December 2015. Aimed at identifying bioeconomy-related policy gaps and measures to address them, the survey included three thematic sections: "benefits and challenges of the bioeconomy," "potential impacts of the bioeconomy," and "strategies to address challenges." It consisted of 16 closed- and open-ended questions.

The survey was accessible via EUSurvey, the European Commission's official survey management tool. Regarding the mobilisation of stakeholders, special attention was paid to ensure a regional and sectoral balance. The survey was completed by 182 individuals, which is a sufficient amount to draw meaningful conclusions on the results. Survey response analysts calculated a "weighted average score" for each question.

[3] Ribeiro B.E., Millar K. (2015): Public engagement in the bioeconomy: outlining an analytical framework for BioSTEP.
[4] Janssen R., Kiresiewa Z., Gerdes H. (2016): Results of the BioSTEP stakeholder consultation. BioSTEP Deliverable 4.1.

4.2.2.2 Objectives

The stakeholder consultation sought to mobilise relevant stakeholders in order to (a) generate knowledge about the potentials and obstacles of the bioeconomy at European, national and regional levels as inputs for the thematic preparation of BioSTEP's policy workshops, and to (b) raise awareness of the BioSTEP project and its activities among the European bioeconomy community.

4.2.2.3 Evaluation of the web-based stakeholder consultation

A) Organisational issues

Outreach / promotion of the survey

At the beginning of the project, a stakeholder database was established to collect and establish contacts with relevant stakeholders, including relevant national and regional contacts from previous tasks; and to facilitate targeted communities and disseminate information and activities. That database and the overview of actors and network activities undertaken under WP2 of BioSTEP were used to identify recipients of the online questionnaire. The questionnaire was sent to 455 stakeholders during the initial consultation period between 30 October 2015 to 6 December 2015. After six weeks, only 47 responses had come in, so the consultation period was extended until 22 December 2015 and networks of the project's Advisory Board were mobilised to disseminate the questionnaire. In addition, the German Bioeconomy Council distributed the survey link through different social media channels and BIOCOM sent the survey link to more than 1,500 contacts related to the bioeconomy from all over Europe, in particular to the participants of the Global Bioeconomy Summit 2015. These measures increased the number of responses to 182.

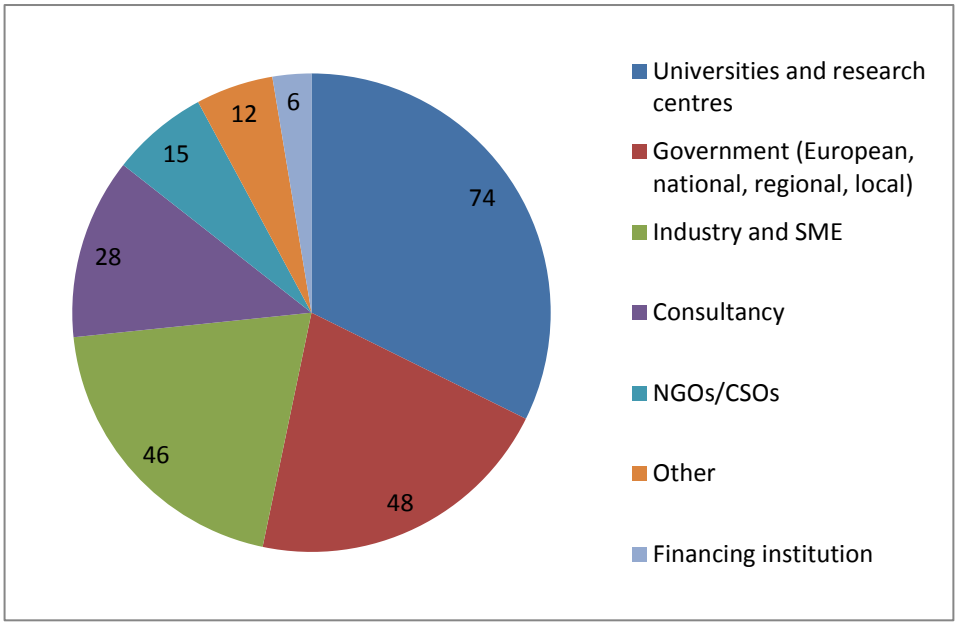
Number of participants / response rate

Due to the low response rate of the first survey wave (10,33%), the duration of the survey was extended. As it was distributed through various newsletters, the response rate of the second survey wave cannot be calculated. However, as a result of this additional measure, the total number of responses increased to 182, which provided a sufficient number to draw relevant conclusions from the survey results.

Representation of stakeholder groups

Just over half the survey respondents were affiliated with either universities, research centres, or government institutions, while the remaining 47 percent were affiliated with industry and SMEs, consultancies, NGOs/CSOs, financing institutions, or other sectors. It is worth mentioning that NGOs represented a relatively small share of the total number surveyed, even though the survey was distributed through newsletters specifically targeted at NGOs and CSOs.

Figure 9: Representation of stakeholder groups (in total numbers)



Sectoral coverage

Where possible, respondents identified the bioeconomy sector with which they were affiliated – there was relatively equal distribution among the three given alternatives: biofuels (20 per cent), biomaterials (22 per cent), and biorefineries (20 per cent). The other 38 per cent corresponded to "other sectors," including forestry, food environment, pulp and paper, aeronautics, biomass, bioenergy, policy research, education and innovation, and life sciences. This illustrates that the European bioeconomy covers a wide number of key sectors (including cross-cutting ones) such that it may be difficult to "cluster" stakeholders into specific categories. The consultation thus helped the project not only to understand how different actors perceive the challenges, opportunities and policy gaps surrounding the bioeconomy, but also how stakeholders position themselves within bioeconomy-related sectors.

Geographical coverage

Survey respondents covered at least 23 identified countries, mainly in the EU. Most of the respondents said they worked in either Germany, Italy, the UK, or the Netherlands. Other frequently represented countries, in order of number of respondents, include: Belgium, France, Spain, Austria, Denmark, Sweden, Norway, Ireland, Finland, Iceland, Switzerland, Turkey, Bulgaria, Croatia, Hungary, Kyrgyzstan, Malaysia, Poland, and Slovakia. Less than 10 participants could not be geographically identified.

B) Engagement aspects

Feedback received

The stakeholders participating in the consultation were asked whether they could be contacted for phone interviews or participation in other related activities of BioSTEP. They were also asked whether they were interested in receiving the results of the consultation and/or further information on BioSTEP's policy workshops. This created a list of interested stakeholders that were then invited to participate in different BioSTEP events and received regular information. Some respondents who expressed interest in the consultation and its results ended up playing an important role in supporting subsequent BioSTEP events. BioSTEP indeed managed to engage with a number of stakeholders throughout the whole duration of the project, using them as a communication channel and building activities on their expertise.

The feedback received from stakeholders participating in the consultation served well to get information on the importance and urgency attributed to certain benefits and challenges, as well as potential impacts of the bioeconomy. Furthermore, insights were provided on the appropriateness of certain strategies and specific measures to address challenges. It was easier to evaluate closed questions than open ended questions.

The rather high number of 182 completed questionnaires (even if achieved only after targeted efforts to promote the consultation) proves that such consultations are regarded as an appropriate tool by stakeholders (mainly from research and policy sectors). Stakeholders seem to be motivated to participate in consultations organised in the framework of EU-funded projects, as they assume and hope that outcomes are taken into account by EC representatives for future policymaking.

For this reason, most stakeholders also indicated their interest to remain involved in future BioSTEP activities - several of the stakeholders participating in the consultation attended the subsequent project policy workshops.

C) Policy impact

Participation of policy-makers

The web-based consultation aimed to identify policy gaps and formulate recommendations to be taken into consideration in discussions with policy-makers and institutions. Hence, the survey also targeted government representatives; 38 representatives of governmental organisations at European, national, regional and local levels participated in the survey.

It is noteworthy that the Bioeconomy Directorate of the European Commission's DG Research & Innovation expressed strong interest in the BioSTEP survey and its results. This indicated that the results were perceived relevant for the ongoing (2015-2017) review of the EU Bioeconomy Strategy. The preliminary results of the consultation had been sent to DG Research & Innovation in April 2017 on request.

Identification of policy gaps and measures to address them

The identification of policy gaps and measures to address them was among the main objective of the survey. Policy recommendations put forward by the survey participants focussed on the following aspects: ensuring policy coherence, improving intra-governmental communication, and ensuring appropriate financing. The key findings informed the design of BioSTEP's first policy workshop in Utrecht, which took place in April 2016. The following four main topics were identified as relevant among the participants of the consultation and were further discussed during the workshop:

- Thematic Discussion I: Engagement in the Bioeconomy–Opportunities and Challenges
- Thematic Discussion II: Sustainable Resource Management
- Thematic Discussion III: Public Acceptance
- Thematic Discussion IV: Sustainability Assurance

Outreach to relevant stakeholders

The number of stakeholders participating in the BioSTEP stakeholder consultation was adequate. Targeted mobilisation of stakeholders via expert databases and multiplicator networks was, however, necessary and more efforts in ensuring the support of other networks would have been beneficial to increase the number of respondents.

The distribution of stakeholders among sectors met expectations, with most contributions from research and policy stakeholders and less involvement of representatives from industry, SMEs and financing institutions. It turned out that such consultations are not an appropriate tool to address NGOs and CSOs, probably due to their limited resources. Also, the general public is not addressed through such consultations as prior knowledge on the subject is required.

The topics selected for the consultation as well as the questions posed to stakeholders seemed adequate to get information on general topics of interest such as the importance and urgency attributed to certain benefits and challenges, as well as potential impacts of the bioeconomy. However, future consultations could be shortened and focus on a more limited number of topics.

4.2.2.4 Lessons learned

- Web-based stakeholder consultations are an appropriate tool to get information on the bioeconomy, such as its potential impacts and the importance/urgency attributed to certain benefits and challenges.
- Targeted mobilisation of stakeholders via expert databases and multiplicators (e.g. German Bioeconomy Council) is necessary to ensure sufficient responses to the consultation.

- The results of such consultations can provide guidance selecting priority topics in further project activities.
- Since it proved challenging to mobilise NGOs and CSOs via a web-based consultation, using personal contacts to reach them and focusing their involvement on commenting final outcomes (e.g. policy recommendations) may be more effective forms of engagement for this stakeholder type.
- Closed questions with a number of pre-given responses and priority levels are more appropriate for online consultations than open ended questions which are difficult to evaluate.
- Consultations conducted in the early stages of a project can produce stakeholder interest that results in further involvement throughout the project's later stages.

4.2.3 Policy Workshops and BioSTEP Forum

4.2.3.1 Summary of activities

In the context of WP4, BioSTEP conducted three policy workshops at the European, national and regional level (see Table 7). The results of these are summarised in a draft policy paper presented and discussed at a stakeholder conference (BioSTEP Forum) that took place on 29 March 2017 in Brussels.[5]

Table 7: Summary of stakeholder consultation activities carried out under WP4

Stakeholder event	Objectives	Parallel event	Gover-nance level addressed	Stakehol-der group addressed	Format applied
Policy Workshop in Utrecht, the Netherlands 14 April 2016	Identify and discuss challenges, opportunities and policy gaps surrounding the development of Bioeconomy strategies	Side event at the 4th BioEconomy Stakeholders' Conference (BioEconomy Utrecht 2016)	European	all	4 thematic sessions
Policy Workshop in Glasgow, UK 18-20 October 2016	Identify the role of local and regional businesses in the Scottish bioeconomy	Parallel event to the European Forum for Industrial Biotechnology and the Bioeconomy (EFIB 2016)	Regional	SMEs	3 thematic 'mini-workshops'
Policy Workshop in Graz, Austria 20 January 2017	Discuss the role of civil society organisations in the strategy development process in Austria and the opportunities and challenges of the participation process	Workshop at the 5th Central European Biomass Conference (CEBC 2017)	National	CSOs	open plenary discussion
BioSTEP Forum in Brussels, Belgium 29 March 2017	Present and validate BioSTEP's five recommendations for effective stakeholder and public engagement in a bio-based and circular economy	Linked to a regular meeting of the EU Bioeconomy Stakeholders Panel	European	all	5 thematic *Word Café* sessions

[5] The detailed proceedings of the policy workshops and the BioSTEP Forum can be accessed at: http://www.bio-step.eu/results/workshops/

4.2.3.2 Objectives of the policy workshops and the BioSTEP Forum

The aim of the stakeholder consultation process carried out in the context of WP4 was to collect stakeholder opinions on existing policy challenges for the European bioeconomy and potential (policy) measures to address them. The results of BioSTEP's online stakeholder consultation formed the basis for the design of the policy workshops. The first workshop in Utrecht covered public engagement in the bioeconomy, sustainable resource management, public acceptance of the bioeconomy, and sustainability assurance. The second and third workshops focused on the role of two specific stakeholder groups in the bioeconomy: small and medium-sized enterprises (SMEs) and civil-society organisations (CSOs).

The web-based stakeholder consultation and the first policy workshop revealed that while entrepreneurs and SMEs play a crucial role in the transition towards a bio-based economy, they often lack the resources to build the required networks. CSOs are important actors in the transition to a bioeconomy, but involving them in ongoing debates (including in BioSTEP's participatory activities) is difficult. The BioSTEP team explicitly targeted CSOs and NGOs in the second and third workshops in order to explore existing challenges and possible solutions when it comes to engaging them effectively in debates on the bioeconomy.

The outcomes of all three policy workshops formed the basis for the development of a policy paper that BioSTEP produced in order to inform the ongoing review of the EU Bioeconomy Strategy. By covering all relevant governance levels (European, national and regional) and by exploring the roles of different stakeholder groups in the bioeconomy, the paper took account of a broad spectrum of stakeholder opinions – its policy recommendations were therefore representative.

The outcomes of this series of policy workshops have, together with relevant outcomes of the stakeholder consultation activities carried out in the context of WP3, been summarized in BioSTEP's policy paper, of which a draft has been discussed at the BioSTEP Forum in Brussels. The overall aim of the BioSTEP Forum was:

- to present and discuss the results of the stakeholder engagement activities in BioSTEP and its value to the current policy discussions on the bioeconomy and the circular economy;
- to discuss how strategies can be developed in a participatory way, ensuring that the change of economic value chains, necessary for the transition to a bio-based and circular economy, is understood and supported by all stakeholders;
- to provide an opportunity for stakeholders to discuss barriers and opportunities related to the participatory development of bioeconomy and circular economy strategies.

In sum, the stakeholder consultation activities carried out in the context of WP4 resulted in a set of policy recommendations that form the core of BioSTEP's policy paper "Creating Networks for the Transition to a Bio-based and Circular Economy", which was published in April 2017.

4.2.3.3 Evaluation of the policy workshops and the BioSTEP Forum

This section reflects on the effectiveness of the policy workshops carried out in the context of WP4 in terms of organisational issues, engagement aspects, and policy impacts.

A) Organisational issues

Outreach / Promotion of the events

All three policy workshops and the BioSTEP Forum were promoted through BioSTEP's communication channels and - in the case of the workshops in Utrecht and Graz - via the conference websites of the BioEconomy Utrecht 2016 and the CEBC 2017. External newsletters promoted the Utrecht workshop and the Glasgow workshop. The workshop in Utrecht and the BioSTEP Forum were also announced on the website of the Bioeconomy Directorate of the European Commission's DG Research & Innovation. In addition, the project team sent out direct invitations to selected stakeholders - the outcomes of this exercise were below expectations in the case of the Glasgow workshop, but resulted in strong stakeholder attendance in the case of the Graz workshop.

Number of participants

In order to maximise stakeholder participation in the policy workshops, they were linked to key stakeholder events, namely the 4th BioEconomy Stakeholders' Conference (BioEconomy Utrecht 2016), the European Forum for Industrial Biotechnology and the Bioeconomy (EFIB 2016), the 5th Central European Biomass Conference (CEBC 2017) and - in the case of the BioSTEP Forum - a regular meeting of the EU Bioeconomy Stakeholders Panel. This proved effective for the events that took place in Utrecht, Graz and Brussels. In the case of the policy workshop in Glasgow, the synergies between the EFIB 2016 and BioSTEP's policy workshop were limited: the workshop was not able to attract participants of the EFIB. On a positive note, the promotion of the workshop among local stakeholders did benefit from the fact the EFIB - as a thematically related event - took place in parallel. Overall, however, stakeholder attendance of the Glasgow policy workshop was below expectations. While the workshop attracted the interest of local and regional business development organisations, it did not sufficiently engage the main target group (SMEs). In the case of policy workshop in Graz, we successfully managed to gather 17 local, regional and national stakeholders. However, this was the result of resource-intense mobilisation efforts on the part of the BioSTEP team during the preceding weeks. In the case of the policy workshop in Utrecht and the BioSTEP Forum in Brussels, mobilisation of stakeholders turned out to be much easier due to the linked parallel events for which relevant stakeholders were already in town. More importantly, however, might have been the fact that EU-level stakeholders, which were present in Utrecht and Brussels, are comparatively easy to reach and mobilize. In total, all four events combined were attended by more than 130 bioeconomy stakeholders.

Representation of stakeholder groups

The first policy workshop in Utrecht included 37 bioeconomy stakeholders from science and academia, consultancies, industry, and the public sector. Researchers from universities and research centres were slightly overrepresented, making up about one third of the participants. While no NGO representatives took part in the workshop, CSOs were represented in the form of business associations and trade unions. Overall, stakeholders came from ten different EU Member States, mostly the Netherlands, Germany and Belgium (as the official seat of many European associations and institutions). The second workshop in Glasgow and the third workshop in Graz targeted specific stakeholder groups (SMEs and CSOs, respectively). The BioSTEP Forum in Brussels was attended by 55 bioeconomy stakeholders, including industry representatives, representatives of regional bioeconomy clusters, representatives of NGOs and CSOs, policy-makers, researchers, and consultants. Overall, stakeholders from 15 different EU Member States participated in the BioSTEP Forum; mostly from Belgium, Germany and the Netherlands.

It was the limited number of CSO representatives attending the workshops in Utrecht and Glasgow that prompted the project team to explore targeting this group in the Graz event. In organising that workshop, the project team developed a strategy for effective stakeholder mobilisation: consultation with relevant members of BioSTEP's advisory board who provided NGO contacts in Austria, and financial support for NGO/CSO representatives in Austria to attend the workshop (BioSTEP covered the conference fee for the CEBC 2017). As a result, the 17 workshop participants (not including the project team) consisted mainly of CSO representatives from all governance levels (local, regional and national) - policy-makers and scientists also participated. As far as the BioSTEP Forum in Brussels is concerned, the venue chosen was Mundo-B, where approximately 20 NGOs and CSOs have their offices. The aim was to ensure participation from those stakeholder types.

B) Engagement aspects

Topics discussed

Stakeholders tend to participate in events on the bioeconomy only if discussion topics are relevant/interesting to them. Thus, getting the topics "right" was important, and BioSTEP organisers consulted with key stakeholders from the particular country/region. The thematic sections for the policy workshops in Utrecht were defined based on the outcomes of the web-based stakeholder consultation. The topics discussed during the thematic 'mini-workshops' in Glasgow arose over the course of the work carried out in WP3. In addition, we contacted the United Kingdom's Biotechnology and Biological Sciences Research Council (BBSRC) in order to scope potential themes that could be covered in that workshop.

The workshop in Austria was prepared without the support of a local consortium partner and preliminary case study work. Here we followed a different approach. First, we attended the conference „*Patentrezept Bioökonomie - Lösung für nachwachsenden Aufschwung oder leeres Versprechen?*“, which took place in Graz on 6 October 2016. This allowed us to gain more insights into the current bioeconomy-related debates in Austria and to formulate relevant questions for discussion during the workshop. Second, we consulted national actors that organised a series of dialogue fora on the further development of the Austrian bioeconomy and policy makers involved in the development of the national bioeconomy strategy in Austria – they were invited to give presentations at BioSTEP's policy workshop. The crucial point for the Austrian event was that the national bioeocnomy strategy in Austria was under development at the time, and especially the topic of stakeholder engagement in the strategy process was of high political relevance.

The BioSTEP Forum was prepared in close cooperation with the Bioeconomy Directorate (Unit F1) of the European Commission's DG Research & Innovation. The topics were linked to the current political discussion on the further development of the EU Bioeconomy Strategy and its potential integration with the Circular Economy Package - this attracted many stakeholders.

Table 8: Topics of discussion at the policy workshops and the BioSTEP Forum

Stakeholder event	Topics of discussion
Policy Workshop in Utrecht, the Netherlands	1) Public engagement in the bioeconomy 2) Sustainable resource management 3) Public acceptance of the bioeconomy 4) Sustainability assurance
Policy Workshop in Glasgow, UK	1) Whisky production 2) Forestry 3) Mariculture
Policy Workshop in Graz, Austria	1) WHY should civil society participate in the development of bioeconomy strategies (opportunities, challenges, motivations)? 2) WHO should participate? 3) WHEN should civil society participate: during the strategy development, implementation or evaluation phase? 4) HOW should the participatory process be organised? Which participatory instruments could be used?
BioSTEP Forum in Brussels, Belgium	Five recommendations for effective stakeholder and public engagement in the development of bio-based and circular economy strategies

In sum, the fact that the bioeconomy and bioeconomy-related topics have been on the political agenda lately (not only at European level, but also in many countries and regions across Europe) made it easy to select relevant topics that attracted policy-makers and representatives of government organisations. At the same time, there are only a few NGOs/CSOs dealing with bioeconomy-related topics, which was among the reasons why it is difficult to engage with this stakeholder group.

Formats applied and mode of discussion

As shown in Table 7, each workshop followed a different format that had been selected based on the number and structure of participants, the planned duration of the meetings, the topic(s) of discussion, as well as the desired outcomes of the discussions. An additional motivation for the selection of the different setups was BioSTEP's objective to test different engagement tools in the context of the bioeconomy and to gather lessons learned about their effectiveness and limitations. In general, each format has its advantages and disadvantages - effective application depends on the individual willingness of participants to discuss a particular topic. Therefore, there is a need to develop innovative engagement tools, to combine existing and adopt them to the specific context, and finally to learn from the previous experiences and to exchange best practice for stakeholder engagement. There is always a risk that a few actors dominate the discussion while the rest of the audience does not contribute to the discussion. Keeping the discussion focused on the subject of the workshops may also be challenging. This was experienced during the thematic 'mini-workshops' in Glasgow where participants

had too many specific questions on the opening presentation. At the same time, there was a fruitful discussion during the workshop in Graz where we also applied the open plenary discussion format and where all participants equally contributed to the discussion.

All BioSTEP's workshops were facilitated by external or internal moderators and were kicked off by short statements from stakeholders with various affiliations. This proved a very effective tool for opening the discussion and ensuring that all perspectives are covered.

Particularly the "World Café" method that was applied at the BioSTEP Forum and the group discussions during the workshop in Utrecht provided a good opportunity for all participants to express their opinions. Participants who completed an evaluation form described the Word Café session as a good tool for networking and exchanging ideas. At the same time, evaluation forms showed there were not enough opportunities to network and exchange ideas at the workshop in Glasgow.

Having "important" keynote speakers such as policy-makers at EU or national level, or speakers form countries and regions identified as having best-practices for stakeholder and public engagement in the bioeconomy, also attracted many participants.

The combination of different setups at the workshop in Utrecht (e.g. group discussions with a rapporteur, group discussions summarised by the workshop moderator, plenary discussion kicked off by keynote speakers) was regarded as beneficial and can be an effective tools by a workshop with more than one thematic session.

Feedback received

Getting feedback from workshop participants was crucial to assessing effectiveness of this specific engagement tool and for the further development of subsequent engagement activities in the project. We developed an evaluation form that was either handed out after the workshop or distributed by email a few days afterward. The former method was not effective, as most participants did not have time to fill out the form or only quickly answered the closed questions without giving a detailed feedback. Encouraging stakeholders to complete the evaluation form via email after the workshop, however, proved even less effective. Experience has shown that coffee and lunch breaks as well as social dinners after the events provide the best opportunity for a constructive face-to-face feedback on the workshops.

Based on the completed evaluation forms, the following statements can be made:

- The BioSTEP Forum in particular was ranked as very successful and the applied World Café method was described as very appropriate for networking and exchanging ideas.
- The heterogeneity of the workshop participants was ranked moderate, as NGOs (Utrecht, Glasgow, Brussels), SMEs (Glasgow), financing institutions and government bodies (Brussels) were underrepresented.
- The contents of the workshops and the conference was perceived as very good.

C) Policy impact

Participation of policy-makers

Policy-makers attended the conference and all workshops except the one in Glasgow. Especially the BioSTEP Forum attracted many policy-makers and representatives from government institutions. EU policy-makers attended the first policy workshop in Utrecht and the BioSTEP Forum. The third policy workshop in Graz was attended by representatives of the Austrian Environment Ministry. Besides these, BioSTEP events attracted policy makers from other countries and regions where the development of a bioeconomy strategy is high on the political agenda, examples include Ireland's Agriculture Research and Development Agency and the Government of Catalonia, Spain.

Identification of policy gaps and measures to address them

The process of identifying policy gaps related to the bioeconomy started with a review of relevant literature and previous stakeholder consultations. The results of this review fed into the design of a questionnaire that formed the basis of BioSTEP's online stakeholder consultation, the outcomes of which in turn informed the design of the three policy workshops. Thus, starting with a long list of potential policy gaps and measures to address them, the process resulted in a set of five key policy

recommendations for effective stakeholder and public engagement in a bio-based and circular economy:

1. Support small and medium-sized enterprises in the creation of new networks
2. Facilitate involvement of civil society (actors) in bioeconomy and circular economy debates
3. Increase public awareness of and engagement with the bio-based and circular economy
4. Design and implement effective instruments for stakeholder and public engagement
5. Provide opportunities for participation in the development, implementation and evaluation phases of bioeconomy and circular economy strategies

As the issues discussed in the Glasgow and Graz workshops where relatively context-specific, the purpose of the BioSTEP forum in Brussels was, *inter alia*, to ensure that BioSTEP's policy recommendations are relevant to a broad spectrum of stakeholder groups and applicable across EU Member States and regions. The broad stakeholder attendance at the BioSTEP Forum fulfilled this objective.

The target audience for the policy recommendations were policy-makers involved in the development of bioeconomy strategies - at regional, national or European level. The development of BioSTEP's policy paper was strongly influenced by the ongoing review (2015-2017) of the EU Bioeconomy Strategy - we tried to ensure that the policy recommendations were relevant to the projected update of that Strategy. In this context, the project team also took into account ongoing policy discussions on the links between the bio-based and the circular economy. As a result, BioSTEP's policy recommendations are applicable to both policy domains and are thus relevant should the two concepts be combined in a single strategy.

Most of the measures identified by stakeholders to address existing policy gaps are at the strategic level, describing ways in which engagement processes can be set up so that they support the development of new or strengthened networks in a bio-based and circular economy. The underlying stakeholder consultation process ensured that a) the described policy gaps are relevant for a broad spectrum of stakeholders, and b) the proposed measures to address these policy gaps are equally supported by a broad spectrum of stakeholders.

It is noteworthy that we received positive feedback from policy-makers involved in the development of the bioeconomy strategies in Ireland, Austria and at EU level, pointing out that the BioSTEP Forum was a great opportunity to get a sense of what is happening across Europe and to exchange ideas.

Outreach to relevant stakeholders

Success of outreach to relevant stakeholders can be measured by the number of downloads of the relevant project outputs. As of January 2018, these are as follows:

- Downloads of Policy Paper (draft): 73
- Downloads of Policy Paper (final): 122
- Downloads of Workshop Proceedings (Utrecht): 58
- Downloads of Workshop Proceedings (Glasgow): 16
- Downloads of Workshop Proceedings (Graz): 22
- Downloads of Workshop Proceedings (Brussels – BioSTEP Forum): 31

Interest in the outcomes of BioSTEP's stakeholder consultation activities resulted in an invitation to organise a CommBeBiz webinar to present the policy paper to interested stakeholders. The webinar took place on 23 May 2017 and was attended by 18 stakeholders. In addition, BioSTEP was invited by the European Commission's DG Research & Innovation to present the project and its outputs in the context of the Horizon 2020 Bioeconomy Day on 16 November 2017 in Brussels - on this occasion, the European Commission also presented the results of its review of the EU Bioeconomy Strategy and Action Plan. The BioSTEP team had already been consulted for the *European BioEconomy Stakeholders Manifesto* and was invited to present lessons learned from BioSTEP's engagement activities at a regular meeting of the EU Bioeconomy Stakeholders Panel.

4.2.3.4 Lessons learned

- Linking policy workshops to larger events worked very well and maximised attendance. Furthermore, it provided better opportunities for networking and for joint activities (e.g. by the

organisation of field trips), and increased the visibility of the project. The experience has also shown that an “integrated event” should be preferred over a separate workshop on the previous or on the following day - too many people might leave before the follow-up event, or not come early enough for the precursor event.

- It is important to involve stakeholders throughout the entire duration of the project, starting at a very early stage. The online survey we used served as an effective tool for a) raising awareness of the project activities and b) the thematic preparation of the policy workshops. Ensuring that the respective event is policy relevant attracts more stakeholders - linking topics of discussion to ongoing political discussions (e.g. review of the bioeconomy strategy) is useful in this regard. Ensuring participation of relevant policy-makers as key note speakers can emphasise the relevance of the event to stakeholders and increases attendance.
- Mobilising stakeholders in a country without a local project partner, strong network, or local expertise is very resource intensive and requires in-depth research on the bioeconomy-related debates in the countries/regions where the workshop will be carried out. Key support may come from the involvement of local stakeholders as partners in the thematic preparation of the workshop.
- In terms of workshop formats, providing opportunities for networking and face-to-face discussions during and after the workshops turned out to be very important for many participants and was identified as further motivation to attend an event. A combination of different setups (e.g. panel discussion, discussion in breakout groups) for workshops with successive thematic sessions proved to be very successful.
- Despite the considerable time and effort spent on reaching out to individual businesses and NGOs, engaging with these stakeholder groups was very difficult. From this experience, it became apparent that there is a need for strong and targeted mobilisation efforts (e.g. direct invitations, cost takeover). Targeted research on innovative engagement tools and their impacts for specifically these groups would be useful.
- The evaluation tool we used to get feedback from participants proved ineffective. This goes both for evaluation forms provided during the meeting (only limited and very general feedback was provided) and a web-based evaluation form that was sent to participants after the event (very low response rate). In contrast, an internal “feedback-loop” with the project partners after each workshop proved effective tool in terms of self-evaluation and lessons learned for subsequent activities.

In sum, we managed to reach out to a wide range of stakeholders and engage with various stakeholder groups in an open dialog about the benefits and risks of the bioeconomy. Although NGOs and CSOs were underrepresented at most of the events, we managed to go beyond the triple helix of cooperation and to involve them in the discussions. The diversity of topics covered throughout the project, the combination of different geographic levels (regional, national and European), as well as the collaboration with the EU Bioeconomy Stakeholders Panel and the Bioeconomy Directorate of DG Research & Innovation turned out to be an effective approach for stakeholder mobilisation.

4.3 Co-production of Knowledge

BioSTEP applied the living lab concept, widely used as an operative tool to co-generate new knowledge, since the end of 2016. This brain storming method eases the process of consensus mapping among stakeholders compared with other similar techniques.

4.3.1 Living Labs

A living lab is a kind of public-private (and people) partnership that aims towards shared open innovation among stakeholders who work in the same geographical area. Citizens and end users take an active part in so-called user-driven processes of innovation that can range from new products, processes or services to concerted regional strategies, policies, or legislative proposals. Living labs allow for interactive communication among actors in order to find solutions to common needs. In this way, they can help connect research and academia, centres for local development, exponents of the manufacturing sector like Chambers of Commerce, trade associations, business clusters, incubators and experts as well as municipalities and other (local) government representatives.

BioSTEP designed and implemented two regional living labs in the Veneto region of Italy and the Stara Zagora region of Bulgaria to elaborate roadmaps for the future development of the regional bioeconomies.[6] The living lab concept was not completely realized during the planned period due to cultural and political limitations: living labs require many months and possibly years to pass for the full range of benefits to materialise, and the adapted living lab activities undertaken within BioSTEP had too short a timeframe.

4.3.1.1 Summary of activities carried out in the context of BioSTEP

Table 9: Overview of the Veneto living lab activities

	Phase I			**Phase II**			
Stage	Brainstorming / Creative Phase	Concept Mapping	Nominal Group Technique	Strategic Community Planning	Pilot Action	Developing drafts of strategies/ policies	Developing draft of agriculture policy strategy
Meeting	30.11.2016 **Developing bioeconomy in Veneto** Definition of objectives, roles and activities to be developed (Part I)	20.01.2017 **Developing bioeconomy in Veneto** Definition of objectives, roles and activities to be developed (Part II)	01.02.2017 **Developing bioeconomy in Veneto** Definition of objectives, roles and activities to be developed (Part III)	16.02.2017 **Developing bioeconomy in Veneto** Definition of stakeholders' strategic action plan	10.05.2017 **Developing bioeconomy in Veneto** Debate among local policy actors and stakeholders	17.05.2017 **Developing policy strategies** Discussion between Veneto Region Department for Research and Innovation and stakeholders	28.06.2017 **Agricultural policy strategies** Discussion among representatives of the agriculture sector

In the Veneto living lab, all of Phase I (two stages, three meetings) and the first two stages of Phase II focused on the development of the regional bioeconomy through defining the objectives, roles and activities to be developed, through related Nominal Group Technique (NGT) activities, through defining the stakeholder's strategic action plan, and through debate among local policy actors and stakeholders. The last two stages of Phase II focused on talks between the Veneto Region Department for Research and Innovation and the relevant stakeholders in the first meeting, and a discussion among representatives of the agricultural sector in the second meeting.

[6] The detailed proceedings of BioSTEP's living lab activities can be accessed at: http://www.bio-step.eu/results/living-labs/

Table 10: Overview of the Stara Zagora living lab activities

	Phase I			Phase II			
Stage	Concept mapping			Development of concrete measures			
Meeting	02.06.2017 **Brainstorming**	02.06.2017 **SMEs and bioeconomy**	20.07.2017 **Local authorities and bioeconomy**	13.10.2017 **Joint stakeholder meeting** Discussion of the potential of essential oil crops	31.10.2017 **Development of action plan for the strategy development**	10.11.2017 **The scientific potential of the Stara Zagora region and bioeconomy development**	24.11.2017 **Strategy for development of the bioeconomy in the Stara Zagora region**

The first phase of the living labs in Stara Zagora was devoted to making a concept for the development of the bioeconomy in the region (two stages, 4 meetings) and the second phase consisted of discussion and development of concrete measures (two stages, 3 meetings). The objectives of these meetings were to formulate the specific problems, to gauge the level of interest of individual groups, and to outline bioeconomy development measures to be taken in the region.

4.3.1.2 Objectives of the living labs

In order to define a program of measures, each living lab meeting focused on the following:

1. Mission, objective, users involved, mode of operation, tools.
2. Plan of activities vs. actual program of activities and presentations, discussions, debates and co-creation process results (analysis and comparison of bioeconomy products, processes, actors, and measures), draft strategies, proof of involvement / engagement at the political level.
3. Expected outputs vs. obtained outputs.

In the Veneto region, the living lab process also revealed the attitude of participants towards the bioeconomy. Activities around creating new business models in particular gauged the socio-economic interest and feasibility and the general willingness of those who would be involved. The second phase of the Veneto living lab was focused on a programme of measures, considering the main steps performed during the first phase that involved stakeholders in long-term goals. Taking into consideration the “milestones” defined by the working group and the need of reconstructing the chain model and the value chain, the following needs were highlighted:

1. define a common glossary
2. establish a code of ethics with confidentiality clauses
3. consider a specific disciplinary for production and tracking of bio-products
4. implement a bioeconomy marketing and communication strategy

The participants lamented the lack for funding needed to achieve these targets and the fact that administrative obstacles impede creation of a bioeconomy-specific network. The concept mapping exercise resulted in a conceptual map featuring each stakeholder, a list of priorities, and a shared action plan that ranked categories such as importance, feasibility, economic / financial burden, etc.

In order to build a plan for the bioeconomy development in the region of Stara Zagora, meetings were held with groups of stakeholders, during which concrete measures were discussed that are needed to achieve greater public and political engagement with bioeconomy development. The goals were to cover all stakeholder groups, to

- identify and discuss the full range of opportunities and assets of the region, and
- share good examples.

Participants from business and academia shared that there was no targeted funding for bioeconomy development. Thus, raw materials that could otherwise be part of a region's value chain are instead exported – this foregoes opportunities for processing and achieving a better socio-economic impact. The other major problem all participants identified was the need for information campaigns to achieve greater public interest as well as involvement and engagement of young people. This is extremely important for Stara Zagora as a university city, both for the bioeconomy and for promoting the benefits of related products.

4.3.1.3 Evaluation of the living labs

A) Organisational issues

Outreach / Promotion of the events

The Veneto living lab activities were promoted mainly during the first regional event organised in June 2016 and during the validation meeting that took place at Unioncamere del Veneto (UCV) on 4 Novembe 2016. This was done via Facebook and mailings. Organisers invited one hundred stakeholders with whom they were in contact after the interviews and surveys conducted as part of the research and the case study report (under WP3 of BioSTEP). The living lab was also promoted in the news section of the UCV - Eurosportello Veneto website on 4 December 2016 and 17 January 2017. Twenty participants learned of the living lab as a result of this effort.

The Stara Zagora living lab was promoted mainly through the BIA network in the region, the regional Chamber of Commerce and Industry, Trakia University and the related scientific units in the region, as well as through direct invitations to the individual company members of BIA. The advertising materials from the exhibition of bioeconomy products, organised with the German project partners in the Stara Zagora Historic Museum, were used to advertise the final meeting of the first phase, and on the day of the final meeting of the second phase some advertising materials and invitation for participation were placed in the building of the Municipality of Stara Zagora. The final meetings of the living lab in Stara Zagora and the exhibition were also widely promoted by the regional branch of the national radio, some newspapers and electronic media.

Number of participants

In the Veneto region, an average of 15 people took part in each of the seven meetings held in Venice and Padua. Dates of meetings and topics are reported in the Table 9 above. Over 30 participants took part in the Stara Zagora living lab. Dates of meetings and topics are reported in Table 10 above.

Representation of stakeholder groups

The stakeholder groups participating in the Veneto living lab were quite mixed – they included representatives from industry, agriculture, and business associations engaged in bioeconomy issues. The working group was specifically composed of companies and consultants from the construction industry, small farmers from mountains/high plains of the Veneto region, a large company processing cereals and oilseeds, consortia and associations, and a research institution.

The initial aim was to have representatives of academia, industry, policy and civil society, but after the initial regional event and validation meeting, involvement of civil society was up for debate. For several reasons, the working group eventually decided not involve civil society representatives due to their lack of knowledge on the bioeconomy. Although academics were invited to take part in the living lab meetings, they did not provide much feedback – overall they were less represented than other groups because they could not attend all the meetings and were more interested in specific topics closely connected to their research, rather than the general topics of the meetings. However, individuals from universities in Venice and Verona did provide interesting content and discussion points for the living lab without physically attending the meetings. The presence of one researcher, the Director of the Council for Agricultural Research and Economy Analysis of Rovigo, added value to the discussion..

Involving government officials/regional policy-makers proved very difficult - an officer of the "Veneto Agricoltura" (Veneto Agency for Innovation in the primary sector) managed to attend some living lab activities and organisers held one meeting with the Veneto Regional Government.

The interest of the stakeholders evolved during the two phases of the living lab because they better understood their role in the working group as a result of the methodologies used. Consequently, their

interest in being part of the network increased. The initial aim of having representatives of the entire quadruple helix was not always met because entrepreneurs kept a certain distance - they did not perceive an immediate return on investment from participating in the events. Members of civil society attended the meetings, though not as members of organised CSOs but as professionals, teachers, researchers and agricultural entrepreneurs.

In Stara Zagora, the stakeholder groups that participated in the living lab included producers and consumers, representatives of the scientific community/academia, business and non-governmental organizations, regional and local authorities, as well as ordinary citizens and students. What was common among all these participants was the desire to discuss their everyday problems and obstacles they encounter, but ultimately to unite in their efforts and achieve a better result - the need to create networks between the participants.

While efforts were made to involve citizens from the beginning, the outcomes of the living labs highlighted how their limited knowledge and experience in the bioeconomy prevents them from being fully involved.

B) Engagement aspects

Topics discussed

In the Veneto region, all of Phase I (two stages, three meetings) and the first two stages of Phase II focused on the development of the bioeconomy in region. Participants defined objectives, roles and activities and engaged in related NGT activities. They discussed a strategic action plan and engaged in debate – mostly among local policy actors and stakeholders. The first stage of Phase II focused on talks between the Veneto Region Department for Research and Innovation and the relevant stakeholders. and the second stage of Phase II consisted of a discussion among representatives of Veneto's agricultural sector.

In Stara Zagora, all stakeholders discussed the problem of bioeconomy development. All actors showed great enthusiasm, since the regional government appears to be interested and willing to cooperate to some extent in bioeconomy development. However, given Bulgaria's centralised government structure in which decisions are made mainly at the national level, the capacity of the regional government to influence policy is quite limited. Nevertheless, producers, academics and business organisations demonstrated very good collaboration and a desire for joint action at individual the meetings.

Formats applied and mode of discussion

In the Veneto living lab, the process divided activities into two conceptual phases (Business Modelling and Programme of Measures), which involve separate stages, respectively. As explained above, Phase I includes the *Creative Phase*, *Concept Mapping* and NGT. Phase II consists of *Strategic Community Planning*, *Pilot Action*, and draft strategies / policies.

These formats were chosen because partners considered them appropriate for the purposes of BioSTEP and because of the specific expertise of the University of Venice, with whom we cooperated. The chosen formats worked very well; the whole process flowed smoothly and was appreciated by the majority of participants. In particular, stakeholders had the opportunity to connecting immediately and for the longer term to partners with whom they would not normally interact.

The chosen formats are featured in a study by Ca' Foscari University, and have been applied in other engagement contexts. NGT software was useful for identifying and redefining priority actions and secondary actions through a stakeholder voting process. This technique allows participants to focus on the topic at hand, which is important when such a diverse group of stakeholders is involved. Consensus can be used to measure the level of homogeneity within a group, which in turn offers insights into the topics such as significance of an issue for all stakeholders. NGT's subsequent mapping stage aims to identify priorities by giving a value to the proposed actions in relation to the importance of the action, its networking value, and its feasibility. The group listed which macro-sectors it considered important and then voted on which actions should be taken in first. Participants reacted positively to the software-based NGT approach: they were surprised by its results and by their choices. The approach gave the living lab working group the chance to discuss and better define their targets because of the immediate and useful outputs.

The Stara Zagora living lab did not use NGT software, but also structured bioeconomy strategy building in individual stages by group. This made it possible to summarise the views and problems of each group that would be properly presented and discussed during the final meetings. This format worked well and the participants were satisfied. Presentations were made by representatives of the scientific community, producers, representatives of non-governmental organisations, and consumers.

Feedback received

In the Vento region, some living lab participants were not used to following an inductive path and could thus not understand the procedure's immediate results. They were used to receiving inputs and tools directly, rather than developing them as part of the living lab process, and thus left the group. Most stayed and were satisfied, however.

In general, participants cited lack of funding needed to achieve the defined actions and administrative obstacles in the way of creating a bioeconomy specific network. They found the NGT phase useful in facilitating a sincere and fruitful exchange of views - often even very divergent ones - between the various stakeholders about the bioeconomy clusters of actions.

Participants reported that the open approach of the living lab allowed them to "think outside the box." Rather than receiving information from authorities, they helped each other understand that the bioeconomy requires a real paradigm shift including sociological, economic, environmental concerns. This "meta" dimension was perhaps the most stimulating contribution.

Feedback on the Stara Zagora living lab was for the most part positive: most attendees participated in both phases. Some expected the involvement of the local authorities to solve their problems right away, and some did not fully understand the objectives of the living lab. The latter believed that a new body would be created to take care of their problems. This is typical for Bulgaria, given the rapid change of regime and governance structures.

C) Policy impact

Participation of policy-makers

In the Veneto region, policy-makers participated in two meetings (one in Padua on 10 May and one in Venice on 17 June 2017). The individuals involved were a high-ranked civil servant from the Veneto Regional Government and a couple of local politicians who actively promoted bioeconomy policies in various domains, ranging from green energy production and eco-friendly financial schemes to legislative proposals at the local and national level.

In the Stara Zagora living lab, policy-maker participation was limited. The individuals concerned preferred individual meetings and always supported all the action taken rather than being involved in the dynamic living lab process. This is due to the fact that those individuals have no facility to implement any actions decided because in Bulgaria local government has no powers – local governors also often change, depending on the parliamentary ruling party in the country.

Identification of policy gaps and measures to address them

The ultimate objective of the Veneto living lab activities was to come up with a 'strategic action plan' and concrete policy proposals. This was accomplished. Policy-makers are taking into consideration the reports and topics discussed during the face-to-face meetings. Policy tools are going to be proposed at the regional level and work is in progress on the actions decided at the meetings even at the national level. The existing regional regulatory framework is evolving to provide stakeholders with tools to promote the growth of the bioeconomy.

Unfortunately, politicians tend to dismantle programmes of their predecessors, which jeopardises be results so far secured. Moreover, environmental and sustainability legislation faces difficulties being implemented in the Veneto region, where other traditional priorities take precedence politically. To ensure that outcomes of the Veneto living lab process continue to be implemented even under changed political leadership, lobbying activities are in progress and the plan of activities of the living lab working group has already commenced. As a next step, living lab participants will try to form a bipartisan political base within the regional council, sufficiently strong to create a package of bioeconomy measures.

The 'strategic action plan' entails aspects mostly related to the "upstream" portion of bioeconomy supply chains, namely the primary sector (production). The plan ties in with existing regulatory efforts,

which incorporate so-called smart specialisation strategies, as well as e.g. rural development plans that incorporate soil saving strategies. Integrating bioeconomy plans into these existing efforts would create a so-called "business ecosystem" at the regional and supra-regional scale.

In Bulgaria, regional initiatives are not widely reflected at the national level - nevertheless the problems identified in the Stara Zagora living lab will be presented by BIA to politicians in order to launch a broad campaign to seek financing for bio-based producers in Bulgaria. Another planned measure is to spread the strategy for developing the bioeconomy of the Stara Zagora region to other regional structures and to achieve more local initiatives in this direction in 2018.

Outreach to relevant stakeholders

The Veneto living lab activities faced resistance from SMEs, who were not interested in developing new networks or committing to medium/long-term actions. Local companies are used to making decisions autonomously. It was also difficult to engage a group of stakeholders large enough to obtain relevant results. The living lab thus focused on the quality of the participants' engagement and outputs rather than the quantity of participants involved.

Due to the meetings held so far, BioSTEP's living lab activities created a network of stakeholders interested in the bioeconomy and in the BioSTEP objectives. Participants have not yet managed to find a common objective to develop a pilot project, but the synergies between these actors have been strengthened. The debates and follow-up meetings on specific themes and issues developed a support mechanism for mutual exchange of perspectives and contact information. Ultimately, participants were given the right forum and setting to connect and do business. In one case, a participant offered contact information of commercial suppliers and helped other participants in the working group solve material supply problems (e.g. textile material recovery for use in new products, for green construction, or for transforming them into semi-finished products and alternative products, thus re-engaging them into the economy). As a result of the inspirational and educational nature of the meetings, living lab participants are now becoming facilitators in their local areas and are spreading information and knowledge by involving their business contacts. Some are even independently organising events to promote the bioeconomy and BioSTEP.

Outreach for the Bulgarian living lab benefited from the fact that some of the participants knew each other earlier, given that the region is not very large. These participants had joint initiatives and shared problems, to which they introduced other attendees during the meetings. All united around the idea of joint projects and initiatives in the future. In some cases, the participants in the first phase of the living lab came to the second part with information for their colleagues on issues raised in the previous session. Partnerships were created, information was exchanged, and joint action initiatives were identified.

4.3.1.4 Lessons learned

For the Veneto living lab, the main lessons were:

- difficulty of effectively involving entrepreneurs and SMEs in a relatively short timeframe to accomplish the complex, iterative living lab process – especially when participants (those from the private sector) face time constraints and would prefer a one-time workshop to lengthier sessions;
- conducting in-depth interviews with entrepreneurs, representatives from SMEs, and other private sector actors can help fill the representation gap in the living lab;
- as NGOs and CSOs are generally non-profits strapped for funds, providing financial compensation or a small expense allowance for participation of individuals from this sector could increase their attendance and prevent "self selection" of participants;
- thematic specificity can limit participation, as it is challenging to discuss very technical topics which require expert knowledge with the broad range of participants included in living lab.
- it is important to emphasise to participants that while the background of the living lab approach is an economic one ("innovation" in the technological sense, focusing on the user-centric co-creation of services and products), *social* innovation is also a goal. In the Veneto region, both technological and social innovations (e.g. business opportunities in the hemp sector, but also green public procurement) were addressed.

In Stara Zagora, entrepreneurs were also less likely to respond to invitations to participate in the living lab given the unclear outcome. The main lesson learned was that a living lab approach is still new for countries with a history of centralised government and less participatory governance structures. The term “living lab” is associated with a laboratory process or seminar involving lectures rather than a dynamic co-creation process in such countries. Future initiatives should go beyond the special text that was added to the invitation explaining what is expected to happen during the laboratories, as it was difficult for the participants to see their involvement in the creation of a common document rather than just a discussion of an established one.

Participants at all meetings emphasised the need for information campaigns, particularly at the policy level to facilitate development of legislation conducive to bioeconomy development.

A final lesson is the need to involve young people (university and high school students), as these are most likely to contribute new ideas – in practice, these stakeholders did not take an active part in the process in Stara Zagora, but considered themselves observers even though a bioeconomy strategy affects their future more than that of other stakeholder groups. More efforts should be put into engaging young people in future living lab initiatives.

5 Conclusions

We drew the following lessons about the application of participatory tools from the project – they can provide inspiration for development of new innovative engagement tools in the bioeconomy sector and beyond.

In order to ensure continuous stakeholder participation in projects such as BioSTEP (or in other participatory initiatives), it is important to **involve stakeholders throughout the entire duration of the project**, starting at a very early stage: participatory activities take time to develop, as does the co-creation of shared visions and goals. BioSTEP has shown that an initial broad online survey can be an effective tool to engage with stakeholders (especially with researchers and business associations, to a lesser extent with NGOs/CSOs), and that is also a suitable tool to raise awareness about project activities at an early stage.

Successful stakeholder engagement requires **tailoring engagement activities to the national/regional context,** e.g. to existing policy debates or strategies. Leaders of regional bioeconomy strategies tend to focus on support for economic/technological development (instrumental participation) in their engagement approach, whereas leaders of national bioeconomy strategies have an interest in normative and substantive dimensions of participation (e.g. mobilising capacities/support, and enabling different interests to be voiced).

The best way to mobilise stakeholders is to ensure **policy relevance of events** (workshops, conferences) by linking topics of discussion to ongoing political debates (e.g. review of the bioeconomy strategy). Since the bioeconomy is a cross-disciplinary and multifaceted topic, its stakeholders often experience 'engagement overload' in which there are multiple engagement processes going on in related fields (e.g. on the circular economy and on sub-themes of the bioeconomy) which lead to a significant administrative burden.

BioSTEP's activities across Europe have shown that engagement is particularly difficult in countries where stakeholders are not used to being involved in the policy-making process or where they don't believe in their power to have an impact. The local "**culture of participation**" matters and should be taken into account in the development and application of engagement tools. Engagement on bioeconomy themes works better in regions where the development of a bioeconomy strategy followed a bottom-up approach (e.g. the BioBased Delta in the Netherlands). In some countries/regions, the term 'bioeconomy' is not widely used or understood, but there are existing strategic and engagement processes in specific sub-themes of the bioeconomy (e.g. relating to forestry, food or bioenergy) to which engagement activities could be linked.

Despite the considerable time and effort spent on **reaching out to individual businesses and NGOs/CSOs**, engaging with these stakeholder groups turned out to be difficult in BioSTEP. Targeted mobilisation efforts, including direct personal invitations and in some cases financial compensation for participation are necessary, given that NGOs and CSOs are usually non-profits that lack personnel and financial resources. While involvement of individual businesses is challenging task, bodies representing businesses (e.g. chambers, associations) and hybrid organisations (e.g. innovation centres, cluster bodies) were often keen to engage with others and could provide insights into the needs and views of national/regional businesses.

It is generally **difficult to engage with citizens** in a way that it is useful and meaningful, especially as there is often a lack of citizen awareness of the bioeconomy. Many bioeconomy themes are complex and technical, needing to be "translated" into specific, citizen-relevant projects/events – often there is no stakeholder in charge of doing so and thereby stimulating citizen engagement in the bioeconomy.

Twitter turned out to be a **useful social media tool** to raise awareness about the bioeconomy and to communicate project results – especially within the relevant expert community. Future research should evaluate whether social media tools like Twitter succeed in reaching beyond the expert community, i.e. find out whether they also increase awareness about the specific topic among the general public.

BioSTEP's exhibition "Bioeconomy in Everyday Life" turned out to be a highly effective public engagement tool – particularly for interested members the public that have no expert knowledge on the bioeconomy. Future exhibitions should a) provide more background information on the bioeconomy concept, and b) provide specific information regarding the sustainability of bio-based products and

processes. Future research should examine the environmental footprint of bio-based products compared to their traditional (fossil-resource-based) counterparts.

The **living lab approach** as applied in BioSTEP successfully facilitated the co-creation of regional bioeconomy roadmaps. However, the approach proved relatively time-consuming and limited in its ability to engage entrepreneurs. Success of a living lab in the context of strategy development depends on the commitment and participation of the respective regional authorities, as they are key stakeholders when it comes to strategy implementation. Both regions in which BioSTEP applied a living labs approach experienced difficulties engaging relevant regional authorities.

Despite an increasing number of EU funded projects dealing with engagement in and communication on the bioeconomy, there is a need to **develop new, innovative instruments for stakeholder engagement**, particularly regarding involvement of NGOs/CSOs and citizens. By doing this, a number of questions should be considered: How to bring stakeholders with different background and affiliation together and define topics that are relevant for all of them? How to communicate complex content, in particular when we engage with the public (e.g. negative environmental, social or economic impacts of bio-based products and processes)? How to engage with stakeholders in a country/region where the bioeconomy is an unknown concept and/or where there is neither demand nor production of bio-based products? How to engage when there is no “tradition of participation”: What kind of instruments to apply?

6 Research recommendations

Building on the lessons learned from BioSTEP's participatory tools, this chapter presents recommendations for future effective stakeholder and public engagement in the bioeconomy – they aim to maximise the impact of EU Research & Innovation.

6.1 Integrating priorities of civil society into bioeconomy research agendas

6.1.1 Background

The outcomes of current bioeconomy value chains do not fit the needs of society as a whole. It is therefore important that civil society get involved in research and innovation agendas – as a first step toward broad acceptance of bioeconomy products and processes, civil society organisations (CSOs) should be involved in discussions regarding bioeconomy implementation.

Involving CSOs requires understanding that they follow a different logic than scientists and business stakeholders (Martinuzzi et al., 2016). Mission-driven CSOs focus more on policy impacts and the needs of citizens than on scientific publications and building up academic track records. Their mission is to influence current bioeconomy policy-making at the regional, national or EU level – thus, they prioritise bringing science closer to civil society and increasing the diversity and resilience of bioeconomy research and innovation. If bioeconomy research and innovation agendas want to safeguard their legitimacy vis-à-vis European citizens, by avoiding a scenario in which agenda setting is driven by business interest groups, they should be guided by the globally agreed Sustainable Development Goals (SDGs).

In addition to involving CSOs as partners in research projects, future EU research framework programmes (FPs) should (1) involve them more significantly in other roles (e.g. agenda setting, proposal evaluation), (2) put stronger emphasis on the societal impacts of the whole programme, and (3) fund more and smaller projects to counter concentration effects and reduce entry barriers. Simulation of European research programmes showed that such a scenario would substantially increase the FPs' contributions to high-level policy objectives (e.g. SDGs), enhance the respective competencies of different types of organisations (universities, businesses and CSOs) and bring science and citizens closer without diluting scientific excellence (Martinuzzi et al., 2016). The CIMULACT project[7] has demonstrated that upstream engagement of citizens and CSOs in (bioeconomy) research and innovation agenda-setting is possible and marks a shift in how research and innovation is defined. Open science is not just about making science available to people, it is also about engaging people in setting the direction for research and innovation. CSOs and citizens – alongside experts and stakeholders – are capable of producing unique, concrete and innovative input to the bioeconomy research and innovation agenda.

6.1.2 Goal

For society at large to appreciate bioeconomy value chains, CSOs and the public at large must participate as co-creators in the relevant research and innovation agenda-setting. Developing balanced and inclusive bioeconomy research and innovation agendas implies that the traditional "triple helix" of university, industry and government must be expanded to a "quadruple helix" that includes civil society.

6.1.3 How to achieve this goal

Involving civil society in bioeconomy research and innovation agendas requires designing arenas for knowledge co-creation and innovation in which a broad variety of stakeholders participate. While consensus building at EU level can be difficult due to divergent regional needs and preferences, local and national bioeconomy research and innovation constitute starting points for broader coalitions.

[7] Citizen and Multi-Actor Consultation on Horizon 2020, URL: http://www.cimulact.eu/

National bioeconomy strategies implemented in e.g. Germany, Italy and France demonstrate a potential way forward. Future research should look at these case studies as examples of co-creation of research agendas and take into account good practices from other policy fields. It should also develop a structured approach for civil society participation in research agendas that includes as core components participatory multi-criteria analyses (pMCA), transformative scenario planning (TSP) and citizen vision workshops that promote social imagination.

6.1.4 Expected impact

- democratisation of research and innovation agenda-setting to ensure an embedded participatory approach and greater democratisation in bioeconomy strategy building
- increased engagement of civil society and professionals in bio-based developments
- more societal knowledge regarding the contribution of the bioeconomy to the UN's Sustainable Development Goals

6.2 Developing and testing models for co-creation in the bioeconomy

6.2.1 Background

Although public engagement is currently a hot topic – especially new ways to engage with different stakeholders and publics – most activities in this arena still fall into the realm of direct dissemination and dialogue rather than ***co-creation*** of new knowledge. The latter is a more innovative and informed type of engagement in which wider stakeholders and publics are embedded, empowered and involved. There is a need for greater understanding of the strengths and limitations of co-creation, and a need to develop new tools to facilitate this form of engagement.

Placing co-creation (also referred to as co-production) in context, models of science/society relationships and the nature of the engagement strategies can be characterised as: (1) public education; (2) public dialogue and participation, and (3) public and stakeholder co-creation of research agendas, knowledge, and innovations.

A ***public education*** approach to engagement often portrays the biosciences and biotechnology as sources of societal progress that need to be promoted in society at large, but also protected from societal intervention – publics are not part of the knowledge creation process. The approach assumes that the public mistrusts science (due to science illiteracy and ignorance) and thus cannot make informed judgements about new biosciences and technologies. The role of scientists and experts is thus to *instruct* and *educate* publics, and to tackle this mistrust of new science.

A ***public dialogue and participation*** approach to engagement involves more open societal debate around bioscience research and biotechnology development – it is the approach prominent in current policies around the bioeconomy and EU engagement initiatives. Debate often involves public authorities, industry and citizens (and / or their representatives) as advisors, but publics do not participate in the *direct* creation of scientific knowledge and technological development. In fact, involving stakeholders and publics in open debates can legitimise bioscience research and biotechnology development decisions, even though it is not clear what role and input these stakeholders and publics have had in shaping them.

An approach of ***co-creation of research agendas, knowledge, and innovations*** intertwines science and technology with society. Citizens and other interest groups are actively involved in the process of knowledge production – scientists, experts and lay publics collaborate and work together in new hybrid forms of collectives. Knowledge is still created in formal R&D spaces (such as laboratories), but it takes into account activities of citizens outside the laboratory.

This last form of engagement offers exciting opportunities to encourage the involvement of a range of representatives (e.g. researchers, industry, etc.), stakeholders and publics in the development of the biosciences, biotechnology and wider innovation in a democratic and socially just co-created form that can ensure wider societal benefit.

6.2.2 Goal

The goal of this research recommendation is to create awareness around and improve current methods for co-production / co-creation and to develop and test new tools. Specifically the goal is to:

a. facilitate greater awareness and understanding of existing co-creation tools
b. develop new forms of co-creation that can empower and inform a wide range of stakeholders

6.2.3 How to achieve this goal

The above goal can be achieved through a number of activities:

a. Greater awareness and understanding of existing co-creation tools

- further define co-creation principles by bringing together a wide range of researchers and practitioners

- create an online open access data catalogue of existing co-creation tools – map their characteristics, strengths and weaknesses

b. Develop new forms of co-creation that can empower and inform a wide range of stakeholders

- create new tools for co-creation for the bioeconomy
- train practitioners to apply those new tools
- create and test new infrastructure and spaces that can facilitate co-creation, such as innovation locations that have dedicated 'engagement labs' or engagement services

6.2.4 Expected impact

Investing in research that supports greater understanding of the strengths and limitations of co-creation, and developing new tools to facilitate this form of engagement will lead to:

Specific Impacts

- enhanced socially robust product development
- confidence in both product design and implementation
- increased awareness among consumers and citizens about bioeconomy processes and products
- greater public ownership of bioeconomy investments
- greater understanding of the bioscience innovation process (risks and benefits)

Overarching Impact

- democratically informed research and innovation processes that support development of a sustainable knowledge-based bioeconomy

6.3 Communicating complex topics of the bioeconomy to the general public

6.3.1 Background

The bioeconomy as a system is complex and difficult to communicate, and the same holds true for specific bio-based products and processes. Knowledge about the social, economic and environmental impacts of bio-based products and processes is indispensable to an informed public debate about the future development of the bioeconomy at regional, national and EU level. Although bio-based products and processes have less of a “negative image” than fossil-based products, there is a general lack of awareness and knowledge of them. The prefix “bio” leads consumers to have high expectations that products are completely plant-based, organically grown, non-toxic and biodegradable, which is not always the case. During the BioSTEP exhibitions, citizens raised questions such as: How durable are bio-based products in contrast to their traditional counterparts? Does it take less energy and water to produce bio-based products? How long will it take for bio-based products to degrade? What is the overall social, economic and environmental impact of bio-based products? These questions should be addressed in a way that is easy to understand in communication materials.

Further research should therefore identify and test bioeconomy communication strategies – ones that that appeal to the public. These should use innovative visualisation concepts, augmented reality, multilingualism, participation and learning to reach citizens and convey benefits but also perceived risks of the bioeconomy.

6.3.2 Goal

- test and identify suitable tools for the communication of the complex topics which constitute the bioeconomy system that are interactive and fun, but also provide in-depth information on bio-based products and processes, so that citizens can make informed decisions about the bioeconomy (e.g. as consumers) and participate in informed debates about the bioeconomy (e.g. in the context of strategy development)

6.3.3 How to achieve this goal

- evaluate all communication efforts of relevant EU bioeconomy projects to identify promising engagement tools, then prioritise them and develop blueprints for the most effective tools
- use exhibitions about innovative bio-based products in public spaces, as these have proven to be an effective tool to catch the interest of the public – but develop exhibition communication formats that show a more complete picture of the bioeconomy and its complexity, including potential social, economic and environmental trade-offs
- start communication efforts about the bioeconomy ‘on the ground’ in biocommunities (e.g. among citizens in regions) and focus on contents such as health, waste, biomass management, recycling, and locally made bio-based goods
- engage with young people in particular, via education systems (schools, universities, etc.), taking into account that the media (especially television, radio and print) play a significant role in spreading information and raising awareness

6.3.4 Expected impact

- increased public awareness of the bioeconomy with increased knowledge on the specific bio-based products and processes including their effects and potential trade-offs
- better informed consumer decisions
- broader public engagement in bioeconomy debates and in the development bioeconomy strategies

6.4 Analysing the regional transition to the bioeconomy

6.4.1 Background

A shift towards a bio-based economy involves radical structural changes in value chains and business models. These changes involve new relationships between multiple different partners, different inputs and processes, combining knowledge in new ways, generating new markets, and different infrastructures (e.g. transport, waste reuse, research). The growth of the bio-based economy depends on the development of new forms of engagement and cooperation between a range of stakeholders and publics across existing sectoral and organisational boundaries, to create new networks and clusters.

As BioSTEP has shown (Davies et al., 2016), bio-based transitions can be facilitated by quadruple helix relationships. Clearly, businesses from a range of sectors are key players in the development of bio-based value chains, combining activities from primary (e.g. agriculture, fishing and forestry), industrial (e.g. chemicals, logistics, investors) and waste-related sectors. However, other entities are also key, including governmental bodies (as regulators, policy-makers and funders), universities and education/research institutions, hybrid entities (e.g. innovation centres and knowledge platforms), as well as civil society organisations and non-governmental organisations, customers/consumers, and citizens.

The capacity of actors to engage with others to build new bio-based value chains and clusters varies strongly between regions. New relationships are evolving spontaneously in some regions but, elsewhere, new bio-based networks are slower to emerge (even where there is clear potential), due e.g. to a lack of intermediary or bridging organisations to support new networks, or because of lock-in to existing relationships, markets and knowledge. Over one third of European regions are estimated to have low bioeconomy maturity, meaning that they cannot fully exploit existing potential on their own and so are slow to generate new bio-based economic, social and environmental benefits (Spatial Foresight et al., 2017).

There is therefore dual risk. First, the transition to a bio-based economy is slower than it could be, implying economic, social and environmental costs. Second, the structural shift to a bio-based economy further widens regional economic disparities, as laggard regions are slower to take advantage of new bioeconomy opportunities. Regional economic disparities widened within OECD countries in 1995-2013 (OECD, 2016) as productivity gains in leading regions did not diffuse rapidly to other regions – the gap in labour productivity between the leading 10 percent of OECD regions and the bottom 75 percent of regions grew by almost 60 percent. High-tech and knowledge-intensive sectors have become more concentrated in metropolitan areas, while former industrial hubs have lost medium- and low-skilled jobs and manufacturing has become more dispersed (Iammarino et al., 2017).

While studies (Charles et al., 2016; Spatial Foresight et al., 2017) have documented variation in bioeconomy development and its role in smart specialisation strategies across European regions (European Commission, 2017), it remains unclear *why* such regional differences exist. Variation is not simply due to the availability of bio-materials, the existence of businesses in relevant sectors, or the adoption of a bio-related smart specialisation strategy. Instead, regional differences in the bioeconomy are likely to be shaped by a broad range of place-specific factors and relationships which either support or hinder structural change towards bioeconomy-related activities.

6.4.2 Goal

- investigate the reasons for variations in the emergence, diffusion and growth of bio-based economic activities across European countries and regions – including specific regional economic, technological, institutional and socio-cultural factors
- in particular, explore how relationships and engagement between stakeholders/publics (or lack thereof) either facilitate the evolution and expansion of bio-based value chains and networks or inhibit bioeconomy-oriented structural change
- consider how support for engagement and interaction could help to reduce fragmentation and thereby accelerate the transition to the bioeconomy – especially in marginalised regions

6.4.3 How to achieve this goal

- conduct research that draws on case studies of regions with smart specialisation strategies (or other similar regional strategies which include a focus on bio-based themes or possibly a particular segment of the bioeconomy)
- include not only regions with successful bio-based sectors, but also regions which have identified bio-based activities as potential strengths but where growth is slow – investigated regions should cover varying degrees of economic and technological dynamism in a range of institutional and socio-cultural contexts
- examine the extent to which new bio-based networks are being formed across existing sectoral or institutional boundaries, and whether these are being supported or obstructed by existing networks / value chains
- investigate how new bio-based networks are forming, i.e. the different steps in the emergence and growth of new networks
- assess which factors are key to the emergence and cumulative growth of new networks in regions seeing an expansion of bioeconomy, as well as factors which are hindering growth of bioeconomy networks and transition

6.4.4 Expected impact

The above research will provide an improved evidence base for better policy instruments at EU, national and regional levels – including EU cohesion policy and EU rural development policy. Resulting better policy instruments can lead to:

- more inclusive, future-oriented, coherent and effective strategies for supporting regional and rural development – particularly in less-developed regions
- a more efficient and impactful allocation of EU regional and rural policy funding
- a stronger and more rapid transition to bio-based economic activities, particularly in areas undergoing industrial restructuring

6.5 Ensuring responsible research and inclusive innovation in the bioeconomy

Many of BioSTEP's engagement activities raised questions about social impact, ethical research practices, responsible innovation and the need for social inclusion and empowerment in the development of the bioeconomy. There appears to be a need for a recommendation in this area that goes beyond normal project recommendations and toward a suggested programme of work related to research, networking, knowledge transfer, training and possible infrastructure investments.

6.5.1 Background

Although innovators and policy-makers have considered the implications of advances in the biosciences and biotechnology for decades, recent years have seen an increasing focus on the bioeconomy's ethical and social dimensions. In parallel, policy-makers increasingly discuss the need to define responsibilities in bioeconomy innovation processes, examining the wider ethical dimensions of investment in and promotion of the bioeconomy.

Sustainability assessments are often used to map the bioeconomy's social, economic and environmental impacts, but more work is needed on improving the scope, tools and approaches to integrate these impact assessments within wider sustainability frameworks. A new science policy initiative, the Responsible Research and Innovation (RRI) agenda, constitutes such an approach and is a core component of European research policies. The RRI agenda emerged from discussions about ethical and social responsibility in science, set out in Europe's 2001 Science and Society Action Plan – that plan aimed at improving the connection between science and European citizens. Under the 7th Framework programme for Research and Technology (FP7), researchers in 2007 carried out the Science in Society (SiS) programme aimed at fostering '*public engagement and a two-way dialogue between science and civil society*' (European Commission, 2012). Since 2010, SiS has focused on developing a framework for Responsible Research and Innovation in which societal actors work together during the whole research and innovation process in order to better align both the process and its outcomes with the values and expectations of European society (European Commission, 2012).

Several working definitions of RRI have emerged (e.g. Douglas & Stemerding, 2013; Owen et al., 2012; Stahl et al., 2014); however a prominent advocate of RRI is European Commission officer René von Schomberg (2011) who proposes that RRI is a transparent and interactive process that spans and acknowledges mutual responsibility across different actors; its aim is to address the 'right impacts', in his words (von Schomberg, 2011, p.2), focusing on ethical acceptability, sustainability and societal desirability in order to achieve key positive impacts (Ribeiro et al., 2017). Stahl et al. (2014) state that RRI encompasses all aspects of the discourse concerning the question of what can be done in order to ensure that science, research, technology and innovation have positive, socially acceptable and desirable outcomes (Stahl et al. 2014, pp.76).

The RRI agenda was more explicitly set out in the Rome Declaration on Responsible Research and Innovation in Europe in 2014 (which builds on earlier declarations), and requires decisions in research and innovation to consider the principles on which the European Union is founded, i.e. the respect of human dignity, freedom, democracy, equality, the rule of law and human rights. The current European Commission Horizon 2020 RRI strategy interprets this as encompassing six 'key' themes:

- engagement
- gender equality
- science education
- open access
- ethics
- governance

New developments within the bioeconomy must embed these core principles not only within some funding and research processes, but as part of the development and implementation stages. With the latter only being done sporadically, more work is needed on raising awareness as well as developing, applying and testing tools.

6.5.2 Goal

The goal of this research recommendation is to identify ways to establish good ethical and RRI practice, through the development of new tools and processes that embed ethical principles and the RRI agenda, specifically focusing on the following objectives:

a. Greater understanding of the social, economic and environment impact of new bio-based products.
b. Enhance understanding and mapping of areas of uncertainty and the development of transparent approaches for managing uncertainty.
c. Delivery of more comprehensive and coherent ways of integrating bio-based technology assessment, which also makes any trade-off decisions more transparent.
d. Embedding of RRI principles in bio-based product research, design and technology development.
e. Democratisation and promotion of social justice in bio-based product development and innovation through the inclusion of key principles, such as inclusive engagement and gender sensitivity practices
f. Enhanced embedding of open science principles in bio-based product research.

6.5.3 How to achieve this goal

The above goals can be achieved through a series of research, networking, knowledge transfer and training activities:

a. Greater understanding of the social, economic and environmental impact of new bio-based products

- create new knowledge through original research on social, economic and environmental impacts
- further develop robust tools to map social, economic and environmental impacts
- create networks for researchers to work with technology assessment and impact assessment practitioners

b. Enhanced understanding and mapping of areas of uncertainty and the development of transparent approaches for managing uncertainty

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- map social, economic and environmental impacts
- identify areas of uncertainty in impact research, and how knowledge gaps can be filled
- develop tools to manage uncertainty, i.e. risk management approaches

c. Delivery of more comprehensive and coherent ways of integrating bio-based technology assessment, which also make any trade-off decisions more transparent

- develop approaches to facilitate the integration of different impacts within a sustainability assessment framework.
- develop scenario modelling that increases the transparency of any trade-offs calculus and embedded values.
- create new tools to support greater decision-making transparency in priority setting for bioeconomy investments, specifically making more transparent the process of weighing potential risk and benefits.

d. Embedding of RRI principles in bio-based product research, design and technology development

- set up new networks to share knowledge on the existing ethical and RRI tools that may be applicable to the bioeconomy

- develop new ethical frameworks and RRI tools for specific groups of bio-based products, e.g. for the automotive industry etc.
- evaluate existing and new tools and provide training for private and public institutions on how to use these tools.

e. Democratisation and promotion of social justice in bio-based product development and innovation through the inclusion of key principles, such as inclusive engagement and gender sensitivity practices.

- develop collaborative RRI standard setting approaches to define ethical product design.
- develop further approaches to facilitate inclusive engagement with local communities.
- develop ethical labelling standards for bioeconomy products.

f. Enhanced embedding of open science principles in bio-based product research

- produce new approaches to design transparency and for communicating ethical research and sustainability assessment.

6.5.4 Expected impacts

- socially and ethically informed bioeconomy investment decisions
- socially robust product development
- consumer confidence in bioeconomy product credentials
- greater ownership of purchase decision-making amongst consumers
- improved communication of the social, environmental and economic impacts of bioeconomy product development

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