



Key performance indicators to evaluate regional bioeconomies

Deliverable 2.2

MAIN AUTHOR: CIRCE

DATE: 30 APRIL 2019

PUBLIC

Project POWER4BIO “emPOWERing regional stakeholders for realising the full potential of European BIOeconomy”

Grant Agreement no. 818351

H202-RUR-2018-2020

Disclaimer excluding Agency responsibility
Responsibility for the information and views set out in this document lies entirely with the authors

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under Grant Agreement No 818351





Document Factsheet	
Project duration	From October 2018 to March 2021
Project website	https://power4bio.e-p-c.de/
Document	D.2.2: Key performance indicators to evaluate regional bioeconomies
Work Package	WP 2 Methodology and support tools for developing regional bioeconomy strategies
Task	Task 2.2 Determining the key factors and main features for characterizing regional bioeconomies
Version	1
Version date	30 th April 2019
Main Author	CIRCE
Contributors	DBFZ, WR, META, AKI, NAK, EPC, DRAXIS, BZN, UNFU, CAPDER, MAE, USB, CCB, SPRING, EWI, SUA, ECRN
Reviewers	WR
Type of deliverable	[R] Report
Dissemination level	PU Public

Table 1 Document Factsheet

Document History			
Version	Date	Main modification	Entity
Draft 1	15/02/2019	Literature review of projects, tools, articles, etc.	CIRCE
Draft 2	11/03/2019	Partners' review. Feedback integrated	ALL, CIRCE
Draft 3	27/03/2019	Telcos. Inputs integrated from the telcos with the partners	ALL, CIRCE
Consolidated	10/04/2019	Partners' review. Feedback integrated	ALL, CIRCE
Consolidated 2	17/04/2019	Integrate comments from partners (from the working session meeting in Madrid). D2.2 circulated	CIRCE
Final Draft	25/04/2019	Partners review. Review by WR	ALL, WR
Final Version	30/04/2019	Integration of remarks from Review	CIRCE

Table 2: Document History



ABBREVIATIONS

BSAT: Bioregional Strategy Accelerator Toolkit

DoA: Description of Action

R&D: Research and Development

WP: Work package

PROJECT PARTNERS

CIRCE: Fundación CIRCE Centro de Investigación de Recursos y Consumos Energéticos

DBFZ: DBFZ DEUTSCHES BIOMASSEFORSCHUNGSZENTRUM GEMEINNUETZIGE GMBH

WR: STICHTING WAGENINGEN RESEARCH

META: META GROUP SRL

AKI: AGRARGAZDASAGI KUTATO INTEZET

NAK: MAGYAR AGRAR-, ELELMISZERGAZDASAGI ES VIDEKFEJLESZTESI KAMARA

EPC: EPC Project Corporation Climate. Sustainability. Communications. mbH

DRAXIS: DRAXIS ENVIRONMENTAL S.A.

BZN: Bay Zoltán Nonprofit Ltd. for Applied Research

UNFU: Ukrainian National Forestry University

CAPDER: Junta de Andalucía – Consejería de Agricultura, Pesca y Desarrollo Rural

MAE: Mazovia Energy Agency

USB: University of South Bohemia

CCB: Chemie Cluster Bayern GMBH

SPRING: Sustainable Processes and Resources for Innovation and National Growth

EWI: VLAAMS GEWEST (Government of Flanders)

SUA: Slovak University of Agriculture in Nitra

ECRN: European Chemical Regions Network (ECRN) e.V.



PUBLISHABLE SUMMARY

The document aims to identify and compile consistent factors, features and key performance indicators for the short and medium-term bioeconomy potential assessment. This set of indicators represents a standardised method of analysis along the execution of the project. Then, they will facilitate the analysis and the use of the information gathered. Furthermore, the selected key performance indicators will be useful to compare the potential impact of a specific proposed action to the situation beforehand and how well they are accomplishing their intended results.

A general set of key performance indicators were identified seeking to avoid as much as possible subjectivity. Also, the indicators have been selected in the search of using reliable data. Additionally, it was taken into account that the POWER4BIO addresses a large number of stakeholders with different profiles and expertise. As a result, the set of indicators are meant to be easy to understand, use and support the bioeconomy situation in the region from very diverse points of view and needs.

An intensive work was carried out to scan, digest and select the most relevant indicators from the following sources of information:

- Review of the preliminary factors identified
- Literature review (papers, guidelines, etc.)
- Relevant projects targeting bioeconomy (reports, etc.)
- Indicators used in existing tools and their relevant parameters considered
- Feedback from technical and regional partners

The set of main factors characterizing regional bioeconomies were grouped in eight categories: availability and use of resources, infrastructure and industrial factors, research and innovation, market/economic, transition towards bioeconomy, public and institutional support/governance/policy framework, funding and social and environmental aspects.

The aforementioned 8 factors are introduced by a general description which explains and depicts the main features of them. This will allow a clear understanding for all stakeholders. The 8 factors sum a total of 67 key performance indicators. These indicators are the basis to develop bioeconomy strategies and will be used to build up the BSAT (Deliverables D2.4 and D2.5). Furthermore, this common “language” will enable an easy harmonization of the data collection and its analysis along the project execution.



TABLE OF CONTENTS

PUBLISHABLE SUMMARY	4
1 INTRODUCTION	6
2 LIST OF KEY FACTORS FOR BIOECONOMY CHARACTERISATION	7
2.1 Overall approach and methodology	7
2.2 Type of factors	8
3 Proposal for regional bioeconomies characterization	10
4 CONCLUSIONS	17
5 REFERENCES	18



1 INTRODUCTION

The bioeconomy development targeted in POWER4BIO project is based on the use of renewable raw materials in diverse sectors such as food and feed, bioenergy, biomaterials, and biochemicals, through the application of research, innovation and industrial biotechnologies.

One of the objectives of POWER4BIO is to define a standardized methodology that will help and guide European regions in the development of strategies and roadmaps for realising the full potential of bioeconomy in their regions.

To achieve this, among the specific objectives of WP2, the definition of the main factors and features to assess the existing regional bioeconomy potential is included. The identification of the main features related to bioeconomy development is an initial but also crucial step to develop an operative and well-adjusted regional bioeconomy strategy.

The region's performance of the bioeconomy encompass a broad number of aspects, especially when targeting regions with different entrepreneurial initiatives, regulations, financing schemes, administration structure, biological feedstock availability, industry potential, etc. The list of main factors embraces the most important aspects affecting the bioeconomy potential in the region.

The factors listed will contribute to diagnose the bioeconomy development in the region and the identification of the existing gaps and potential in regional but also at national level and will contribute to developing a well-grounded bioeconomy strategy for the specific region.

The list of factors and main features establishes the first step to identify relevant aspects for bioeconomy development in a region and will be aligned with all the tasks along the project; particularly, with the BSAT (deliverables D2.4 and D2.5), the description of biobased solutions and best practice examples (deliverables D3.3 and D3.4) and the basis to analyse bioeconomy situation in CEE regions (deliverable D5.2) as much as possible.



2 LIST OF KEY FACTORS FOR BIOECONOMY CHARACTERISATION

2.1 Overall approach and methodology

According to EC (2012)¹, Bioeconomy encompasses the production of renewable biological resources and the conversion of these resources and waste streams into value added products, such as food, feed, biobased products and bioenergy.

The sectors involved in the diverse possible bioeconomy value chains cover a wide range of resources, industrial technologies, markets, etc. Therefore, the main drivers involved in the bioeconomy development add a large number of aspects. The list to be established aims to cover the key factors and main features in order to allow a representative bioeconomy potential analysis.

For this aim, a general set of factors was identified, seeking to avoid as much as possible subjectivity and looking for reliable data. Additionally, the factors considered take into account the need to be as easy as possible to be understood by large number of stakeholders with different profiles and expertise (policy makers, companies, researchers, etc) and provide a useful and comprehensive description of bioeconomy situation in the region. For this aim, where necessary, factors identified include the corresponding explanation or examples were added so that the final user gets a better understanding of the information required.

The work started by considering the following preliminary list of factors:

- Long-term competitive availability of the resource
- Necessary infrastructure to host bio-based solutions
- Active business community/cross-sectorial trend for cooperation
- Access to finance
- Public support
- Legislation/regulation/permitting
- Internationalization/Cross-border and cross-regional collaboration
- Local and global market healthiness and access
- Social acceptance and awareness

Secondly, an intensive work was carried out to identify the most relevant factors and features through literature review (papers, guidelines, etc.).

¹ Innovating for Sustainable Growth - A Bioeconomy for Europe (2012)



Thirdly, the list of factors was completed with the assessment of the relevant factors identified by other EU projects. Those assessed projects have been selected by its importance in the field of bioeconomy. Also, the indicators used in those projects as well as the tools they mention in their projects were also taking into account in the overall analysis.

The outcome of the process resulted in a large list of factors that was further processed to avoid duplications, delete the parameters that were out of the scope, etc. The set of factors was then grouped in eight categories to allow a better structure of the document and make it more accessible for the final user.

The eight sections are aligned to a large extent with the categories identified in other project reports and reference documents: availability and use of resources, infrastructure and industrial factors, transition towards bioeconomy, public and institutional support/governance/policy framework, funding, research and innovation, market/economic and social and environmental aspects.

The first draft of the list of key factors and main features was produced and shared with the partners in order to retrieve different points of view and add important factors that were not considered yet as well as delete the factors that were considered not relevant.

Feedback was provided from technical and regional partners and compiled in the second draft. Each comment and suggestions were answered and included when corresponding in the list. Some issues pointed out by the partners were further discussed in the teleconferences held with the partners to further retrieve suggestions and comments. The inputs provided were integrated in the third draft. This document was again shared with the partners to get final comments from technical and regional partners. Special attention was paid in the special discussions with the WP leaders of POWER4BIO. The T2.2 is developing indicators that will be used later on by the WP leaders and are meant to be largely used along the project. Therefore, a specific workshop took place with the WP leaders to deeply elaborate on the difficulties and challenges of using those references in upcoming activities within the project. This specific workshop was held the 11th of April 2019 after the Steering Committee in Madrid (Spain). This exercise was instrumental to align the ideas of the different WP leaders in the harmonization of which indicators are the most important for the overall project. The outcome of this workshop fed into the final list of key factors and main features which are presented in this deliverable.

2.2 Type of factors

This work distinguishes between different types of factors that play different roles in bioeconomy potential assessments. The list of factors produced intends to integrate inherent factors related to the regions as well as extrinsic factors related to bioeconomy.

The list of key factors and main features characterizing regional bioeconomies was structured in eight sections as mentioned previously:

- 1. Availability and use of resources:** includes factors related to the raw materials that will or could be used in bioeconomy value chains for different applications (bioenergy, biomaterials, biochemicals and food and feed). The factors added to the compilation intend to provide to the final user of the list, when quantified, enough information to be able to get a representative overview of the most relevant feedstocks that could be used and its current



and mid-term availability in the region. The factors included in this section encompass the production efficiency of different resources (agriculture, forestry, fishery, aquaculture), feedstocks' characteristics, waste and side stream potential, competition with other sectors, etc. Even though raw materials can be imported from other regions (which is indeed one of the aim of the project, seeking to enhance cooperation among neighbouring regions) it is pivotal to have a realistic and accurate assessment of the regional resources availability in order to assess the most promising routes, and consequently draw a successful bioeconomy strategy adapted to the region potential.

2. **Infrastructure and industrial factors:** corresponds to the factors related to the industrial framework in the region, paying special attention to the infrastructures and installations that link the feedstock production sites to the collection nodes. But also, the conversion into products and the consumption taking into consideration that the requirements of the supply chain are a key element to implement the initiatives covered in the bioeconomy roadmap. This section includes factors related to the primary and secondary sector strength, logistic operators operating in the area, conversion technologies, transport/distribution infrastructures or identification of missing actors along the chain.
3. **Research and innovation:** intends to evaluate the contribution that different research entities in the region carry out in the bioeconomy field and its direct implication in bioeconomy applications. For instance, the lack of knowledge can be one of the barriers drawing back bioeconomy initiatives, while in the opposite sense the synergies between industry and research centres can lead to pilot or flagship projects contributing to the development of bioeconomy in the region. Hence the importance to assess these aspects in the region in order to assess the bioeconomy potential. The factors included cover the establishment of networks, technological expertise in the region, research entities carrying out dissemination activities, patents produced, training or coaching programmes performed, or support provided by research entities to industrial actors.
4. **Market/Economic aspects:** the aim of this section is to evaluate the regional, national and international market framework as well as the economic aspects related to the biobased products and their value chain. The economic balance of a specific bioeconomy value chain is key and will determine the feasibility of the initiative. A complete economic assessment will of course require the evaluation of many parameters, but for the aims pursued, only the most significant factors were included, in order to keep it as simple as possible and obtain valid factors and features that will help the regions to assess the bioeconomy potential. The section includes factors such as the local and global market for bio-based products, comparison of production costs - including avoidance of cost related to the disposal of residues now used for the production of biobased products-, competitive advantages, innovative technologies commercialisation, investors, identification of under-used biological resources, number of employees or turnover.
5. **Transition towards bioeconomy:** the aim of this section is to point out factors that will contribute to identify opportunities for the implementation of bioeconomy initiatives or, on the contrary, contribute to highlight the existent barriers that need to be overcome in the region in order to achieve a successful implementation of such initiatives. The list of factors included in this section will of course not cover all aspects involved in a transition towards bioeconomy, due to the large number of elements that would need to be included (making the list not operative), and also due to the specificity that each region implies. Therefore, the main features affecting broadly the bioeconomy strategy development were considered. This section covers the technology maturity, industrial sector seeking for a shift from fossil



resources, flexibility to use different feedstock in the production process, “zero waste” production initiatives, flagship projects or enterprises investment in innovation.

6. **Public and institutional support/Governance/Policy framework:** the objective of this section deals with the institutional and legal framework that is closely related to the applicability of the bioeconomy roadmap designed. The regulations, subsidies, etc. in the region will be highly effective if the actions established in the bioeconomy strategy are promoted and can be implemented easily, or on the contrary if they will take some time and might require an elaborated process to carry them out. The features included in this section encompass the existence of a supportive policy framework, cross-border collaborations, political programs stability, industrial partnerships, regulations, measures fostering innovation, stability of supportive measures, importance of R&D in the regional budget, valorisation schemes or existent policies and measures.
7. **Funding:** closely linked to the previous section, this section intends to cover the principal funding schemes that bioeconomy alternatives could apply, and which in some cases could be a key to implement the actions foreseen in the roadmap. Flagship projects for instance are often launched as pilot projects that otherwise would be very difficult to finance only with private investment. The funding programs that tackle bioeconomy in a region will most likely play a key role when implementing the actions designed in the bioeconomy strategy.
8. **Social and environmental aspects:** the aim of this section is to take into consideration the social and environmental dimension. Any type of activity will generate a social and environmental impact that needs to be contemplated since, among others, it might for instance affect the demand behaviour of consumers towards biobased products. This section includes factors such as the available skilled workforce, well-informed society, sustainable consumption promotion, environmental awareness, consumer preference for bio-based products or administration transparency when informing society.

3 PROPOSAL FOR REGIONAL BIOECONOMIES CHARACTERIZATION

The following table (Table 3) compiles and summarises the 8 key factors, the general description of them, and the final list of key performance indicators to characterize the regional bioeconomies.

Key factors, main features characterizing regional bioeconomies	
<p>1. Availability and use of resources: this criteria relates to the availability and access to raw materials, trends in demand, evolution, information and statistics on available types of feedstock, as well as their existing and potential competitors for its use.</p> <ul style="list-style-type: none"> • Production efficiency of agricultural/forestry/fishery/aquaculture/other production in the region (average production yield/year) • Current exploitation of waste and residues streams in the region • Region existent resources’ characteristics (physical and chemical) • Constraints leading to low production yields (for example low water availability in the region) 	<ul style="list-style-type: none"> ○ Currently ○ Potential scenario by 2030



<ul style="list-style-type: none"> • Raw material supply and demand balance at regional, national and international scale 	<ul style="list-style-type: none"> ○ Imported biomass and/or residues ○ Exported biomass and/or residues
<ul style="list-style-type: none"> • Long-term competitive and consistent availability of the resources at regional level • Existence of multiple consumers for the feedstock (competition over the resource) • Potential for higher valorisation of resources 	<ul style="list-style-type: none"> ○ Currently ○ Potential scenario by 2030
<p>2. Infrastructure/Industrial factors: intends to draw a picture of the set of infrastructures and installations that enable the link between feedstock production sites, collection nodes, production and consumption, to meet the requirements of the supply chains, considering that these aspects are key decision factors for investors. Infrastructure and technologies for the treatment and utilization of the feedstock are considered.</p>	
<ul style="list-style-type: none"> • Existence and level of development of agro-food, fishery, livestock, aquaculture, wood/paper value chains or waste recovery infrastructure with a strong technological specialisation in the region (logistic for the existent feedstocks in the region) 	
<ul style="list-style-type: none"> • Existence of necessary infrastructure to host bio-based solutions in the region 	<ul style="list-style-type: none"> ○ Availability of logistic services (significant number of logistic operator) ○ Homogeneous distribution within the region/ surrounding regions of these logistical services ○ Existence of areas with concentration of services and industry (industrial parks)
<ul style="list-style-type: none"> • Type and size of the existing industries, farm exploitations, etc. in the region adequate for the implementation of bio-based value chain 	
<ul style="list-style-type: none"> • Active presence of actors required along the value chain in the region or on the contrary lack of any of the actors required along the bio-based value chain 	
<p>3. Research and innovation: is related to the supporting institutions such as universities, testing and certification bodies, research institutions, and other organizations that could build and transfer know-how and offer technical and technological assistance to the entrepreneurship willing to be or already being part of the Regional Bioeconomy Strategy.</p>	
<ul style="list-style-type: none"> • Establishment of scientific network with researchers and industry stakeholders to increase the capacity of the region/country on fields related to bioeconomy 	
<ul style="list-style-type: none"> • Existence of technological expertise in technology transfer process 	
<ul style="list-style-type: none"> • Development of pilot scale plants producing of bio-based products (for instance as part of research projects) 	



<ul style="list-style-type: none"> • Knowledge on bioeconomy related topics available for the public (existence of information compiled that would allow to solve doubts regarding the value chain, cost, funding available, sustainability, etc.) 	
<ul style="list-style-type: none"> • Existence of operational industrial and research clusters (size, management and governance) or entities communicating coherent and reliable data 	
<ul style="list-style-type: none"> • Number of patents related to bioeconomy field registered in the region and country 	
<ul style="list-style-type: none"> • Development of training programmes and performance of learning activities, mostly related to the emerging technology, but also related to markets, networks, users etc. 	
<ul style="list-style-type: none"> • Correlation between industrial needs and research activities (research activities provide support regarding emerging technology to industrial actors) 	
<ul style="list-style-type: none"> • Existence of coaching programs to identify opportunities and assist companies interested (coaching services) 	
<p>4. Market/Economic aspects: focus on the framework conditions for establishing regional markets, including: production conditions of biobased products, potential clients of regional production, innovative producers, institutions facilitating networking, investment framework, etc.</p>	
<ul style="list-style-type: none"> • Active local and global markets and easy access for bio-based products 	<ul style="list-style-type: none"> ○ Difficulties for companies to access local and global market ○ Difficulties to launch a new bio-based product ○ Actions carried out to create a demand for the emerging technology/product
<ul style="list-style-type: none"> • Production costs of bio-based products comparing to alternative non bio-based products 	
<ul style="list-style-type: none"> • Competitive advantages of the bio-based product/processes (different from cost) 	
<ul style="list-style-type: none"> • Avoidance of waste management costs and/or environmental damages costs (related to disposal of feedstock now used as raw materials for biobased products for instance) 	
<ul style="list-style-type: none"> • Possibility of additional profit generation for the raw material producers in bio-based value chains 	
<ul style="list-style-type: none"> • Demand of biobased product (volume of biobased products purchased in the region) 	
<ul style="list-style-type: none"> • Commercialisation of innovative technologies at national level 	
<ul style="list-style-type: none"> • Existence of investors (public investors, private investors, banks, venture capital, business angels, crowdfunding) active in the bioeconomy sector 	



<ul style="list-style-type: none"> • Existent opportunities: Under-used resources that remain unexploited (the aim is to identify, for instance, if an end user in a region demands a biobased product which could be produced in the region instead of imported since the regions accounts with the raw materials to produce it but maybe the technology required is not available, etc.) 	
<ul style="list-style-type: none"> • Number of employees (for each bioeconomy sub-industry, for all bioeconomy, for all regional economy) 	
<ul style="list-style-type: none"> • Turnover (for each bioeconomy subindustry, for all bioeconomy, for all regional economy) 	
<ul style="list-style-type: none"> • Share of the bioeconomy in number of employees and turnover terms (share from all regional economy) 	
<p>5. Transition towards bioeconomy. Using an interdisciplinary approach is key to define and assess the dimensions of the bioeconomy as a means of achieving sustainability from the industrial point of view. To this end, to move from fossil fuel industries to biobased industries is at the heart of the overall bioeconomy-related concepts in public, scientific, and political discourse. In regional policies, the evaluation of existing facilities and the adaptation to a new bioeconomy paradigm appears to be critical.</p>	
<ul style="list-style-type: none"> • Chemical, agro-food or other industrial companies that look for a shift from fossil resources to biological resources and bio-based products in the region or neighbouring regions 	
<ul style="list-style-type: none"> • Technology maturity of the industrial sector in the region (chemical industry, bioenergy, etc.) 	
<ul style="list-style-type: none"> • Feedstock flexibility of conversion technologies in the region or neighbouring regions 	
<ul style="list-style-type: none"> • Number of consolidated industrial players, but also small and innovative young companies or entrepreneurs with the potential to stimulate innovation in the region or neighbouring regions 	
<ul style="list-style-type: none"> • `Close to zero` waste production initiatives/examples and/or number of bio-based initiatives in the region 	
<ul style="list-style-type: none"> • Existence and/or development of demonstration flagship technologies/biorefineries projects in the region 	
<ul style="list-style-type: none"> • Existence of non-operative/dismissed plants in the region looking for conversion into modified (bioeconomy) plant 	
<ul style="list-style-type: none"> • Active and dynamic business/entrepreneurial community/ cross-sectorial trend for operation in the region (for example number of start-ups, existent companies' expansion process, etc.) 	



<ul style="list-style-type: none"> • Innovation culture among companies: willingness and capacity (since they are often small, do they focus on their core business or innovation is one of their strategic objectives) 	
<p>6. Public and institutional support/Governance/Policy framework: This is a prerequisite for investor confidence. Information regarding the existence of policies and programs for the development and channeling of entrepreneurial talent for increasing the effectiveness of entrepreneurs and demand for entrepreneurship is needed. Furthermore, the existing regulatory framework for facilitating the establishment of new entrepreneurship is of paramount importance.</p>	
<ul style="list-style-type: none"> • Existent supportive bioeconomy policy framework 	
<ul style="list-style-type: none"> • Policy correlation/coherence at regional and national level (Bioeconomy, rural development, etc. priorities/targets aligned at regional and national level) 	
<ul style="list-style-type: none"> • Cross-border and cross-regional collaboration/alliances (supporting regional and inter-regional projects of strategic importance for development of the bioeconomy sector) 	
<ul style="list-style-type: none"> • Supporting strategic partnerships between industries and enterprises in the region or among neighbouring regions 	
<ul style="list-style-type: none"> • Legislation/Regulations/Permitting process to facilitate implementation of initiatives (including for instance the reduction of the level of bureaucracy leading to lengthy administrative and approval procedures) 	
<ul style="list-style-type: none"> • Existent measures differentiating among regulations (imposed by law), financial support measures and soft measures (guidelines): 	<ul style="list-style-type: none"> ○ fostering innovation ○ to promote industrial symbiosis ○ to support valorisation schemes ○ to support local value chains implementation ○ to facilitate the cooperation between government, research institutions and industry (including agriculture/forestry, harvesting, logistics, biomaterials, bioenergy, etc.) (for example collaboration agreements between industry-research institutions) ○ to optimise the innovation and knowledge transfer system (funding programmes targeting innovation and dissemination)
<ul style="list-style-type: none"> • Existent policies: 	<ul style="list-style-type: none"> ○ Energy and climate policies ○ Circular economy support policies



	<ul style="list-style-type: none"> ○ To strengthen interactions and greater involvement of stakeholders ○ Policies supporting innovation in technology (focus on conversion process) ○ Policies focusing on the biomass supply such as forest, environmental and nature conservation/sustainability policies, production close to zero waste policies, policy aiming the implementation of sustainable rural and water management systems, waste management policy, etc.
<ul style="list-style-type: none"> ● Existence of national bioeconomy strategy (including the corresponding Action Plan) 	
<ul style="list-style-type: none"> ● Relevance of regional development planning 	
<ul style="list-style-type: none"> ● Stability of the policies and policies duration supporting bioeconomy initiatives (to avoid uncertainty caused by changes in government which often results on the cancellation of plans and programmes established by the previous government without a broad political consensus) 	
<ul style="list-style-type: none"> ● R&D budget (when it is reduced it is difficult for companies to access) 	
<p>7. Funding: It defines the current situation of the region in accessing both private and public funds and other kind of investment mechanisms, if existing. For example, private institutions interested to finance sustainable industrial projects or public budget to be invested in this kind of projects. In addition, it assesses the framework conditions to create an environment in which innovations can be developed, reach the market and become widely used.</p>	
<ul style="list-style-type: none"> ● Existence/availability of funding programmes targeting bioeconomy at national and regional level (specially for the commercialisation of bio-based technologies and products) supported for instance by European Investment Bank/Fund 	
<ul style="list-style-type: none"> ● Establishment of mechanisms that enable feasible synergies and combination of different sources of funding 	
<ul style="list-style-type: none"> ● Internal coordination among programmes 	
<p>8. Social and environmental aspects: Bio-based products and processes may produce impacts on society and environment. These impacts may occur along the entire value chain of bio-based products and can be linked to the production of biomass, to biorefinery processes, distribution or market uptake. Moreover, these impacts are in general specific for each region and can change over short periods of time which makes challenging to evaluate these aspects.</p>	



<ul style="list-style-type: none"> • Available skilled workforce (along the value chain: raw material collection and management, logistic, processing, distribution) 	
<ul style="list-style-type: none"> • Communications to society regarding bio-based activities (regular flow of information) 	
<ul style="list-style-type: none"> • Actions carried out to promote the change toward sustainable consumption 	
<ul style="list-style-type: none"> • Environmental awareness: 	<ul style="list-style-type: none"> ○ Information disseminated regarding GHG decrease achieved with bioeconomy initiatives/technologies ○ Resource depletion concerns ○ Others
<ul style="list-style-type: none"> • Actions implemented in the primary sector in the region or neighbouring regions (already in place or expected in the coming 5 years): 	<ul style="list-style-type: none"> ○ Contributing to the reduction of greenhouse gasses and other pollution ○ Strategy aiming for a 'zero waste' circular bio-economy implemented ○ To decrease the use of non-renewable fossil raw materials
<ul style="list-style-type: none"> • Willingness to pay for bio-based products or/and consumer preferences towards bioproducts 	
<ul style="list-style-type: none"> • Feeling of the society regarding the participation and transparency of the regional/national administration 	

Table 3. Key factors, the general description of them and the final list of key performance indicators



4 CONCLUSIONS

The list of key factors and main features produced provides a robust and a comprehensive methodology to assess short- and medium-term bioeconomy strategies for any region in Europe. Additionally, the main features identified may allow to compare the potential impact of a specific proposed action to the previous situation, and to assess the degree of accomplishment of the expected results. The work performed will contribute to support the BAST development (T2.2).

The most relevant factors and their key performance indicators have been developed taking into account regional aspects. For this reason, the list of indicators has been circulated several times to the POWER4BIO regional representatives. Their feedback has enormously contributed to setting up useful indicators for the regional final users. All in all, the final set of key performance indicators are also defined to tackle different beneficiaries of the project, such as: policy makers/administrative bodies, research personnel/ consultants and companies as stakeholders with different involvement in the bioeconomy strategy development.

On the other hand, the assessment of the evolution of the bioeconomy in the region was addressed considering inter-disciplinary topics covering all value chains, according to the following eight categories:

- Availability and use of resources
- Infrastructure and industrial factors
- Research and innovation
- Market/Economic aspects
- Transition towards bioeconomy
- Public and institutional support/Governance/Policy framework
- Funding
- Social and environmental aspects

The diversity of regions participating in the Pwoer4Bio project have enriched the final set of indicators. They have actively contributed to take into account all kind of possibilities from different experiences and realities. Moreover, the indicators developed are broad enough to touch upon all the elements in all potential value chains of the bioeconomy concept. Furthermore, these indicators will enable the dialogue between regions and technical expert in POWER4BIO as all the partners will use the same references. To sum up, both general and specific challenges have been combined in this exercise, representing all the geographical dimension and technical and non-technical barriers.

On the other hand, in some tasks, additional indicators will be necessary to either be more specific or target particular features. Then, this list of indicators allows some potential adjustments. It will facilitate the integration of all the tools and results of the project in the BSAT. To make this happen, a critical exercise of harmonizing the information will take place (Task 2.4) and these set of indicators are the basis for it.

Lastly, if during the execution of the project we identify a missing indicator, or any of the selected indicators by now is not really useful, we will fine-tune them in Task 2.4. This deliverable D2.2 is a very important document for the overall project as it frames the collection and use of the information and conclusions of all the tasks in the POWER4BIO. To this end, a thorough analysis of how to use them will take place in the upcoming tasks as starting point for discussion and analysis.



5 REFERENCES

Caitlin Burns, 2016. Bio-Based Products, Markets and Policy presentation. AgroCycle project Grant agreement No 690142. www.agrocycle.eu

Cambridge Econometrics, 2014. D1.1 Criteria and Indicators describing the regional bioeconomy. BERST project Grant agreement no: 613671. www.berst.eu

Department for Business, Energy & Industrial Strategy. Growing the Bioeconomy. Improving lives and strengthening our economy: A national bioeconomy strategy to 2030, 2018. Industrial strategy.

Eelke Wielinga, Alex Koutsouris, 2018. Tools to observe innovation processes: The AgriSpin experience. 13th European IFSA Symposium. Learning and knowledge systems, education, extension and advisory services. Theme 1.

Eelke Wielinga, Alex Koutsouris, Andrea Knierim and Adrien Guichaoua, 2017. Generating space for innovations in agriculture: the AgriSpin project. *Studies in Agricultural Economics* 119 (2017) 26-33

European Commission, 2012. *Innovating for Sustainable Growth - A Bioeconomy for Europe*. Brussels,

Hans van Meijl, 2015. Project final report. SAT BBE project Grant Agreement no 311880.

Hartmut Welck, 2018. Sustainability of biomass sidestream usage based on Multi-Criteria-Analysis (MCA). AGRIFORVALOR project Grant Agreement No 696394. www.agriforvalor.eu

Hendrik Kees, Evelien Lambrecht, Hartmut Welck, 2016. Good practice cases in practical applications of agro and forestry side-streams processing. AGRIFORVALOR project Grant Agreement No 696394. www.agriforvalor.eu

Imperial College London, 2015a. D5.3 Summary report on how sustainability aspects of introduction bioeconomy value chains are currently considered. S2Biom project Grant Agreement No 608622. www.s2biom.eu.

Imperial College London, 2015b. D5.4 Consistent Cross-Sectoral Sustainability Criteria & Indicators. Draft Report. S2Biom project Grant Agreement n° 608622. www.s2biom.eu.

Imperial College London, JAMK & Region of Central Finland, BioCampus Straubing GmbH & FNR, Wageningen University, Gemeente Westland & Biobased Delta, 2015. D3.1 Good Practices in selected bioeconomy sector clusters; a comparative analysis. BERST project Grant agreement no: 613671. www.berst.eu

Imperial College London, JAMK & Region of Central Finland, CERTH & Region of Western Macedonia University of Ljubljana, BioCampus Straubing GmbH & FNR, Madrid Biocluster & Parque Científico de Madrid, Wageningen University, Gemeente Westland & Biobased Delta, 2015. D3.2 A representative set of case studies. BERST project Grant agreement no: 613671. www.berst.eu

James Gaffer, 2017. Bioeconomy opportunities_Best in class presentation. AGRIFORVALOR project Grant Agreement No 696394. www.agriforvalor.eu

James Gaffer, 2018. Business models for a circular bioeconomy presentation. AGRIFORVALOR project Grant Agreement No 696394. www.agriforvalor.eu

Jukka Teräs, Gunnar Lindberg, Ingrid H G Johnsen, Liisa Perjo and Alberto Giacometti, 2014. Bioeconomy in the Nordic region: Regional case studies. Nordregio 2014:4



Katalin Kurucz, Nora Hatvani, Cristina Cabeza, James Gaffey, 2017. Needs and barriers analysis for New Bio-Industry Start-ups. AGRIFORVALOR project Grant Agreement No 696394. www.agriforvalor.eu

Marius Hasenheit, Holger Gerdes, Zoritz Kiresiewa, Volkert Beekman, 2016. D2.2 Summary report on the social, economic and environmental impacts of the bioeconomy. BioSTEP Grant agreement No 652682. http://www.bio-step.eu/fileadmin/BioSTEP/Bio_documents/BioSTEP_D2.2_Impacts_of_the_bioeconomy.pdf

Mathé, Syndhia, Guy Faure, Andrea Knierim, Alexandros Koutsouris, Tim H Ndah, Ludovic Temple, Bernard Triomphe, Eelke Wielinga and Eleni Zarokosta, 2016. D1.4 AgriSpin: Typology of innovation support services. AGRISPIN project Grant agreement No 652642. <https://agrispin.eu/>

Matteo de Besi and Kes McCormick, 2015. Towards a Bioeconomy in Europe: National, Regional and Industrial Strategies. Sustainability 2015, 7, 10461-10478.

Mieczysław Adamowicz, 2017. Bioeconomy-Concept, application and perspectives. Problems of Agricultural Economics, 350(1):29–49.

Myrna van Leeuwen, 2014. How to build Regional Bioeconomies and create new cross-sectoral business? (presentation). Symposium on “Cross-Sectoral and Cross-Regional Cooperation to develop an European Bioeconomy. BERST project Grant agreement no: 613671. www.berst.eu

Myrna van Leeuwen, Hans van Meijl, Edward Smeets and Ewa Tabeau, 2013. D1.4 Overview of the Systems Analysis Framework for the EU Bioeconomy. SAT BBE project Grant Agreement no 311880.

Ndah HT., Knierim A., Koutsouris A., Mathé S., Temple L., Zarokosta E., Wielinga E., and B. Triomphe, 2016. D1.3 Synthesis report on selected and documented innovation cases for Cross Visits. AGRISPIN project Grant agreement No 652642. <https://agrispin.eu/>

Nicolae Scarlat, Jean-François Dallemand, Fabio Monforti-Ferrario, Viorel Nita. The role of biomass and bioenergy in a future bioeconomy: Policies and facts. Environmental Development 15 (2015) 3–34.

Nina Hagemann, Erik Gawel, Alexandra Purkus, Nadine Pannicke and Jennifer Hauck, 2016. Possible Futures towards a Wood-Based Bioeconomy: A Scenario Analysis for Germany. Sustainability 2016, 8(1), 98.

Ruben Guisson, Myrna Van Leeuwen, 2014. BIOECONOMY REGIONAL STRATEGY TOOLKIT THE BERST PROJECT. 22nd European Biomass Conference, held in Hamburg. BERST project Grant agreement no: 613671. www.berst.eu

Silke Haarich, 2017. Mapping of EU Member States' / regions' Research and Innovation plans & Strategies for Smart Specialisation (RIS3) on Bioeconomy for 2014-2020. Bioeconomy development in EU regions. European Commission. Framework contract CE.16.BAT Lot 2. Specific contract RTD/F1/PP-03681-2015. PDF ISBN 978-92-79-68011-3

Wenhao Chen, Thomas Oldfield, Nicholas M. Holden, 2016. D6.1 Integrated Sustainability Assessment Framework. Including definition of the details, requirements and guidelines for LCA, LCC and S-LCA Analysis. AgroCycle project Grant agreement No 690142. www.agrocycle.eu

ZLTO, 2017. D3.1 Executive handbook on the identification of best practices. ENABLING Grant Agreement No 774578. www.enabling-project.com/



Zusepe Elias Zidda - euknow, 2018. D3.8 Best Practice Sheet in the EIP-AGRI format. ENABLING Grant Agreement No 774578. www.enabling-project.com/