

Towards a bioeconomy cluster in Swietokrzyskie Voivodeship



1. Introduction

1.1. What is a bioeconomy?

In the bioeconomy, biomass resources are transformed into competitive bioeconomy products. The total bioeconomy includes (EC, 2012^[4]):

- the traditional (100%) biobased sectors such as agriculture, horticulture, forestry, fisheries, food & feed, and pulp & paper; and
- the new biobased sectors such as biotextile, biochemistry, bioenergy and biotechnology.

As EU and national statistics do not split biobased and fossil-based activities within the textile, chemistry, energy and technology sectors, the RDI2CluB project uses data about the whole textile, chemistry, energy and technology sectors for approximating and indicating the future potential of the regional bioeconomy. Further, RDI2CluB applies tools that were developed in the BERST project (<http://www.berst.eu/>) in order to create Regional Bioeconomy Profiles for its five partner regions.

1.2. What is a bioeconomy cluster?

A bioeconomy cluster is perceived in RDI2CluB as a geographically proximate group of interconnected firms and associated institutions that have the common aim to develop the bioeconomy. In this cluster, firms are tied to other firms through 1) formal linkages (i.e. the input-output linkages) and 2) untraded interdependencies (norms, trust and a strong local network of private and public institutions). Given the broad coverage of bioeconomy sectors, bioeconomy clusters might be rather heterogeneous in their specific focus.

1.3. How to develop the bioeconomy cluster in Swietokrzyskie Voivodeship?

The bioeconomy cluster usually starts in one economic sector and in the course of time more economic sectors get involved due to cross-over activities that are explored. The development and strengthening of the cluster follows a collective learning process of active and open minded entrepreneurs, R&D institutes and policy makers, who together continuously develop new technical knowledge, adopt innovations, and adapt to changing local and global circumstances (see Figure 1 for conceptual framework). This learning process can be translated into a strategic roadmap of the biocluster at stake.

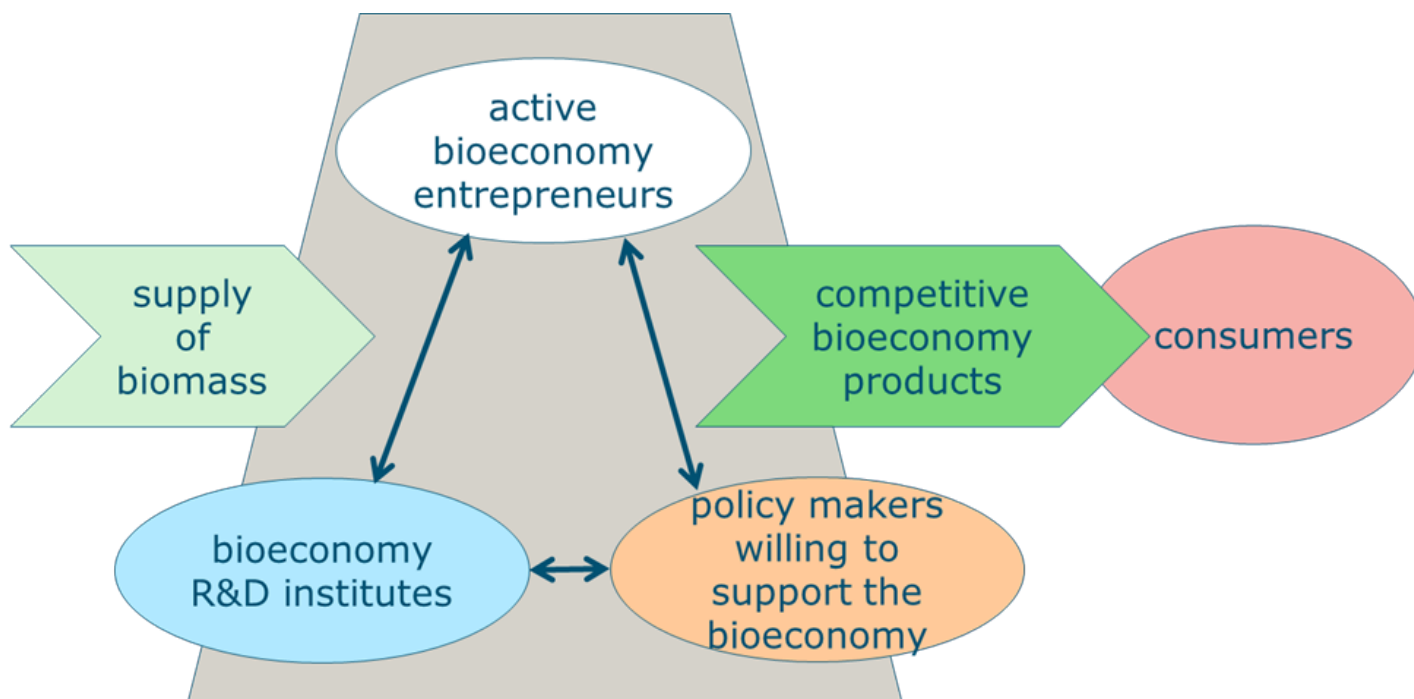


Figure 1 Conceptual model for the analysis of the strategy of a bioeconomy cluster

^[4] European Commission (2012), *Innovating for Sustainable Growth: A Bioeconomy for Europe*; Brussels, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, COM(2012) 60 final, February 13.

1.4. Aim of this regional profile report

This report provides an overview of the current state of the bioeconomy in Swietokrzyskie Voivodeship, suggests lessons for developing a bioeconomy cluster, and gives recommendations for instruments and measures. These ingredients can be helpful in drafting a smart development strategy for a bioeconomy cluster in Swietokrzyskie Voivodeship. The strategies for developing the regional bioeconomy should fit within the overall regional RIS3 strategy priorities that have been set by the region ([smart specialisation platform S3](#)). RDI2CluB can contribute to the RIS3 strategy approach as follows:

- the focus of RIS3 is on strategy targeted to develop the regional economy in general, and involves a process of developing vision, identifying competitive advantage, setting strategic priorities, making use of smart policies to maximise the knowledge-based development potential of any region, strong or weak, high-tech or low-tech;
- like in the BERST project, the focus of RDI2CluB is on developing smart strategies for the bioeconomy sectors, which could be linked to corresponding S3 priorities determined in the RIS strategy ([Eye@RIS3](#)).
- the roadmap in Section 5 can be used as guideline for where and how the bioeconomy cluster could best be developed or strengthened. Strategic discussions could be organised in regional Community of Practice meetings where entrepreneurs, R&D institutes and policy makers participate.

2. The bioeconomy cluster in Swietokrzyskie Voivodeship

2.1. Brief description of the bioeconomy cluster in Swietokrzyskie Voivodeship

The bioeconomy is an important element of the regional development in the Świętokrzyskie Voivodeship. Four of seven smart specialisations of the region (resource-efficient construction industry, modern agriculture and food processing, sustainable energy development, health and health-promoting tourism) relate exactly to the bioeconomy. It is an excellent starting point for further specialization in this field. The Voivodeship has the most abundant natural qualities in Poland (67% of the region's area), the quality of agricultural land above the national average and it is a leading national producer of fruit, including stone fruit, and open-field vegetables. Considerable forest cover (331 thousand ha, i.e. 28.3% of area) and growing abundance of timber for 1 ha of forest land as well as a strong tradition of use of forest undergrowth produce and game in food and paramedical industries (including food and cosmetic supplements) speak for enormous potential of the Świętokrzyskie forests in bioeconomy development.

Lately there has been noted a rapid growth in cultivation of fibre plants, which have been grown in the Świętokrzyskie Voivodeship for a long time. Fibre plants are a gold mine when considering a wide range of their possible use in bioeconomy. There is also a big potential for cultivation of biomass for energy purposes in the region (approx. 250 thousand ha of available area). For energy use one can also utilize biomass from residues of fruit and vegetable processing, agricultural production, food and gastronomic production, as well as out-of-date food (to approx. 55 thousand tons annually).

The use of new and more environmental-friendly solutions (biofuels, boilers) is gradually becoming a must due to growing social awareness of how the air quality affects human health and seasonal (during the heating season) below-norm air quality in the voivodeship. The voivodeship has also rich traditions and considerable business potential in the building material and feedstock production sector and the construction sector. Abundant deposits of mineral feedstock, including healing sulphide and iodide-bromide waters, are important assets of the Świętokrzyskie region.

The region lacks a bioeconomy cluster that would meet the criteria set out in this study. There are several clusters / ecosystems in the sectors covered by the above-mentioned smart specialisations of the voivodeship, but either they are at the initial development stage or their activities were suspended. Additionally, there are 14 groups of fruit and vegetable producers and 8 groups of agricultural (plant and animal) production. Unfortunately, there are no producer groups, companies or associations of producers of biomass for energy purposes. There are also in the region numerous bioeconomy-oriented entrepreneurs, including the biggest Polish producers of boilers meeting the strictest EU standards, fuel producers and wood processors. The region has also substantial regional and supra-regional scientific potential.

2.2. Barriers for the development of the bioeconomy clusters in Swietokrzyskie Voivodeship

High dynamics of law on EU and national levels is a serious development threat for many companies and the bioeconomy sector. Instead of providing supportive incentives for bioeconomy development and investment incentives, there are introduced in Poland regulations hampering or even eliminating the possibility for bioeconomy development (e.g. the Act on Renewable Energy Sources, lack of legal possibility to introduce biogas in transport). A big challenge is also to overcome bad experiences coming from the Polish history, due to which companies and individuals have little trust in cooperation, sharing ideas and joint use of available resources and infrastructure.

Additionally, intensity and quality of cooperation between business and science is affected by skeptic attitude of academia towards applied sciences. There is also a need to restore the vocational education system. Despite the longstanding traditions in the bioeconomy, it is based mainly on microenterprises, SMEs and fragmented farms, which create jobs based mostly on self-employment and searching for resources needed for development. A big regional potential in agricultural and biomass production is dependent on limited water resources and fertility/acidicity of the soil, which will undergo desertification if no appropriate actions are introduced. Although there are companies important at the EU and national levels specialized in, e.g. boiler production or wood processing, they don't aspire to becoming regional bioeconomy leaders. The voivodeship location between main agglomerations of the southern Poland (Warsaw, Krakow, Katowice, Lodz), alongside development opportunities brings negative consequences such as the drain of capital, new investment and highly-qualified workforce from the region. The region lacks its own major financial resources and is highly dependent on external national and international factors.

The region also lacks a centre that concentrates on milieus/ecosystems or initial-stage bioeconomy clusters, such as a bio-hub, which would create possibilities to bring together and network companies and R&D institutes, work on increasing social awareness in bioeconomy among key regional actors (business, administration and academia), mass media and local community. The hub would support the processes of creation and commercialization of bio-based products and services and serve as a platform for knowledge and information exchange with national and foreign partners.

3. Quantitative and qualitative indicators of the bioeconomy cluster in Swietokrzyskie Voivodeship

3.1. Regional structure

In a bioeconomy cluster, entrepreneurs, R&D institutes and policy makers closely cooperate to transform biomass into new, competitive biobased materials and products. In order to measure the state of the total bioeconomy in Swietokrzyskie Voivodeship we use a number of quantitative and qualitative indicators which we have grouped into criteria (classes) and indicators:

- *Environmental criteria* provide information on biomass availability in the region and the attractiveness of the region as a place to settle for entrepreneurs and researchers.
- *Economic criteria* reflect on the size of the total bioeconomy and that of economic sectors in which processing of new biobased products usually starts, the availability of public and private funding for the bioeconomy cluster, and the extent in which the regional actors are willing to innovate.
- *Social criteria* report on the presence of a bioeconomy strategy in the region, the management of the biocluster, demographic characteristics and the quality of the work force.

Annex 1 gives the list of criteria and indicators used, as well as explanations why these indicators have been selected, their reliability and how they have been calculated.

The *quantitative indicators* for the total bioeconomy in Swietokrzyskie Voivodeship in 2016 are compared to its national average levels in Poland in order to get insight in the performance of criteria describing the regional total bioeconomy in the national context (i.e. z-score in Table 1 and the *Bioeconomy Readiness wheel* in Figure 1).

The *qualitative indicators* for the total bioeconomy have been valued by regional stakeholders as weak, moderate or strong (Table 2). These scores have been obtained from a survey.

Note that the data used to calculate the indicators for the Polish regions are a mixture of 2015, 2016 and 2017. The data used to calculate the indicators for the Finnish and Norwegian regions refer to 2015.

Table 1. Indicators describing the potential bioeconomy in Swietokrzyskie Voivodeship in 2016 compared to Poland average

Criteria	Indicator	Swietokrzyskie Voivodeship	Poland	Swietokrzyskie Voivodeship (z-scores ¹)
Land use	Forestry land density (% of total land)	28.9	30.2	-0.19
	Agricultural & horticultural land density (% of total land)	41.3	46.0	-0.47
Biomass availability	Agricultural biomass production (kg/cap)	2,401.6	2,328.0	0.06
	Blue biomass production (kg/cap)	2.4	5.5	-0.45
	Forestry biomass production (kg/cap)	1,069.5	1,064.2	0.01
	Waste production (kg/cap)	94.5	195.8	-1.04
Innovation	SME birth rate (% of total firms)	8.6	8.4	0.43
	R&D expenditure (index)	0.2	0.2	-0.44
Employment structure	R&D employment (% of total employment)	0.1	0.3	-1.04
	Total Bioeconomy employment (% of total employment)	10.4	9.6	0.71
	Chemical employment (% of total employment)	0.4	0.5	-1.35
	Energy employment (% of total employment)	0.2	0.2	-0.58
	Paper & Pulp employment (% of total employment)	0.1	0.1	-0.75
	Textile employment (% of total employment)	0.8	0.9	-0.24
Firm structure	Total bioeconomy firms (% of total firms)	4.6	4.4	0.22
	Chemical firms (% of total firms)	0.4	0.5	-1.23
	Energy firms (% of total firms)	0.2	0.2	-0.56
	Paper & pulp firms (% of total firms)	0.1	0.1	-0.67
	Textile firms (% of total firms)	0.8	0.9	-0.20
Demographics	Population growth (% per year)	-0.2	0.1	-0.92
	Population 15-65 years (% of total population)	64.6	64.8	-0.27
	GDP (PPP) - index	49.00	61.81	-0.68
Quality of workforce	Secondary & Tertiary education (% of total population)	88.9	89.8	-0.38

Source: BERST report 1.1 'Criteria and Indicators describing the regional bioeconomy, 2014'; Eurostat, RIS, National statistics; 1) Z-scores compare the regional value with the national average (corrected for standard deviation) (see [Annex 2 for explanation](#)).

Further note that:

- Yellow coloured indicators in Table 1 are also presented in Figure 2
- Green coloured indicators in Table 1 are also presented in Figure 3
- Orange coloured indicators in Table 1 are also presented in Figure 4

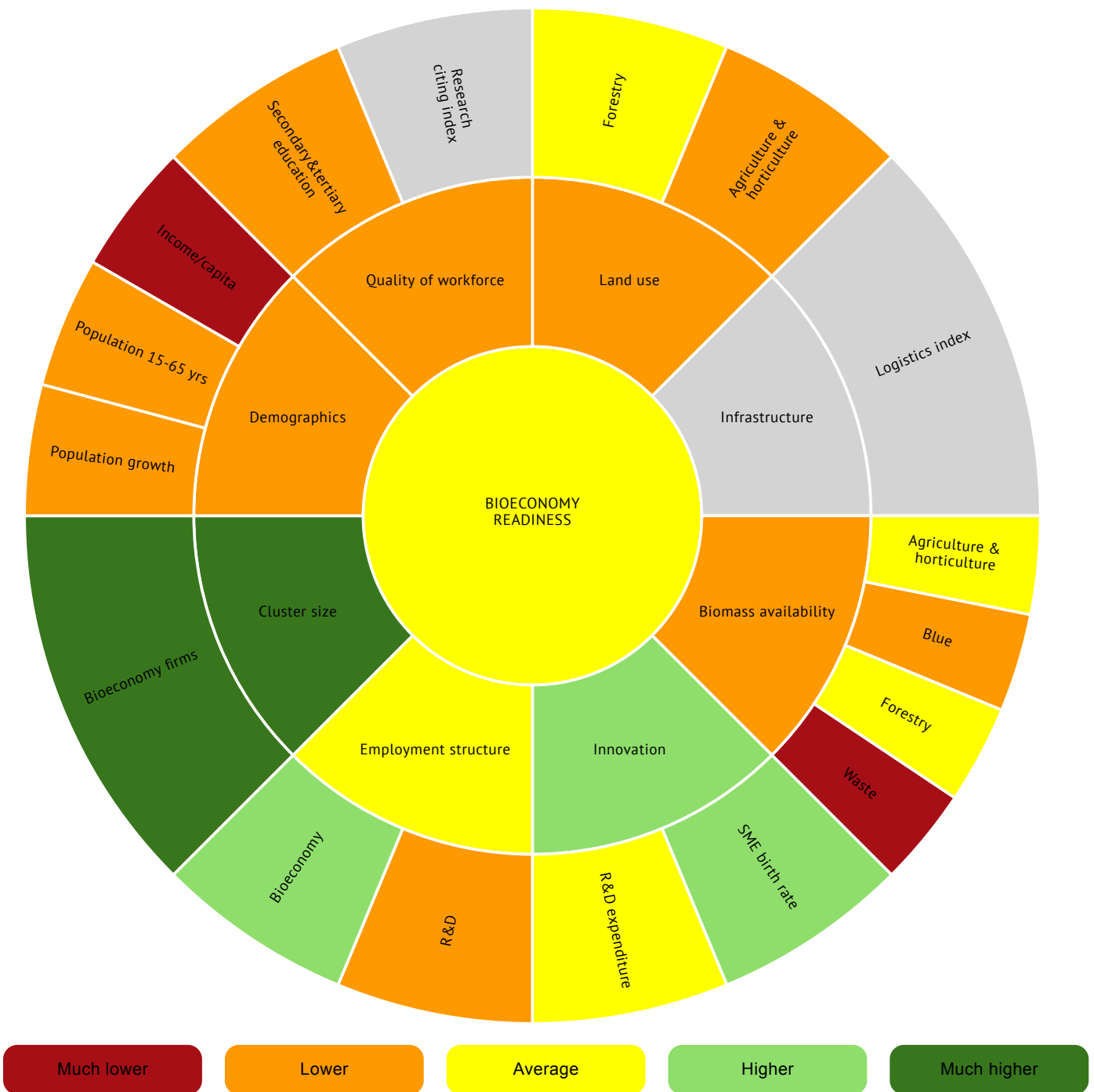


Figure 2. Bioeconomy Readiness for Swietokrzyskie Voivodeship in 2016 compared to Poland

The inner circle of Figure 2 gives the key criteria that describe the regional bioeconomy. The outer circle gives the indicators that measure a specific criterion. Each indicator has the same weight.

Annex 1 gives the list of criteria and indicators used, as well as explanations why these indicators have been selected, their reliability and how they have been calculated.

How to read the bioeconomy readiness wheel?

The criteria and indicators used in the readiness wheel should be regarded carefully and with knowledge about characteristics of the region under study. The criteria and indicators have been selected based on literature reviews, and they have been verified by the BERST regions. In principle they should be applicable to any European region, though from practice it has become clear that it is difficult to find a unique combination of indicators that is equally meaningful to all regions. First, this is due to the fact that some criteria simply lack a clear indicator which has consistently been measured across all European regions; e.g. the indicator *university ranking* is available in public sources for the criteria *Quality of workforce*, but unfortunately not all European universities are on the ranking list. Second, regions have different views on which indicator should be taken into account in some cases. What makes sense for the one region is not per se the case for the other region. For example, *Baltic regions* regard the availability of untapped *agricultural land* (measured in ha) as a key indicator for illustrating the potential bioeconomy development. On the other hand, the size of agricultural land is less important for e.g. the Dutch region *Westland* in which agricultural area consists mainly of horticultural area with a high product intensity per hectare. The potential of the supply side of the bioeconomy in the Westland could be better indicated by the *availability of biomass* (measured in tonnes) indicator. Third, regions are now compared to the national average, without any indication how the country scores in the EU or in global context. A region might score high in a national context, but low in an EU context (and vice-versa). In the RDI2CluB project, we have added a benchmark option that compares region x in country x with region y in country y, as long as data for EU regions have been collected under the BERST and RDI2Club projects.

"Start from what is available in the region and make strategy around it. That is valid to ALL regions in the world" according to Rogier van der Sande (rapporteur of Committee of the Regions) in his presentation at the Open Days of the Regions in Brussels; 13 October 2015.

Therefore, the colours of the traffic lights are NOT indicating a 'bad' or a 'good'. However, the colouring can be helpful to regional stakeholders where to make smart specialized strategy in order to best develop or strengthen the potentials for bioeconomy development.

Region is relatively strong in:

- Total bioeconomy (employment)
- SME birth rate (% of total firms)
- Total bioeconomy (firms)

Region is relatively weak in:

- Chemical sector (employment)
- Chemical sector (firms)
- R&D employment (% of total employment)
- Waste production (kg/cap)
- Population growth (% per year)
- Paper & Pulp sector (employment)
- GDP (PPP) - index
- Paper & Pulp sector (firms)
- Energy sector (employment)
- Energy sector (firms)
- Agricultural & horticultural land density (% of total land)
- Blue biomass production (kg/cap)
- R&D expenditure (index)
- Population 15-65 years (% of total population)
- Textile sector (employment)
- Textile sector (firms)

Figure 3 shows the employment structure of bioeconomy sectors (sectoral employment as % of total regional employment) in Swietokrzyskie Voivodeship compared to the national average (value 0 is the national benchmark value; the blue line shows how far the region deviates from the national average). A value below 0 means that the regional sector share is less than the national average; a value above 0 means that the regional sector share is higher than the national average. Similarly, Figure 4 shows the firm structure (number of firms in a sector as % in total regional firm number) of the bioeconomy sectors in Swietokrzyskie Voivodeship.

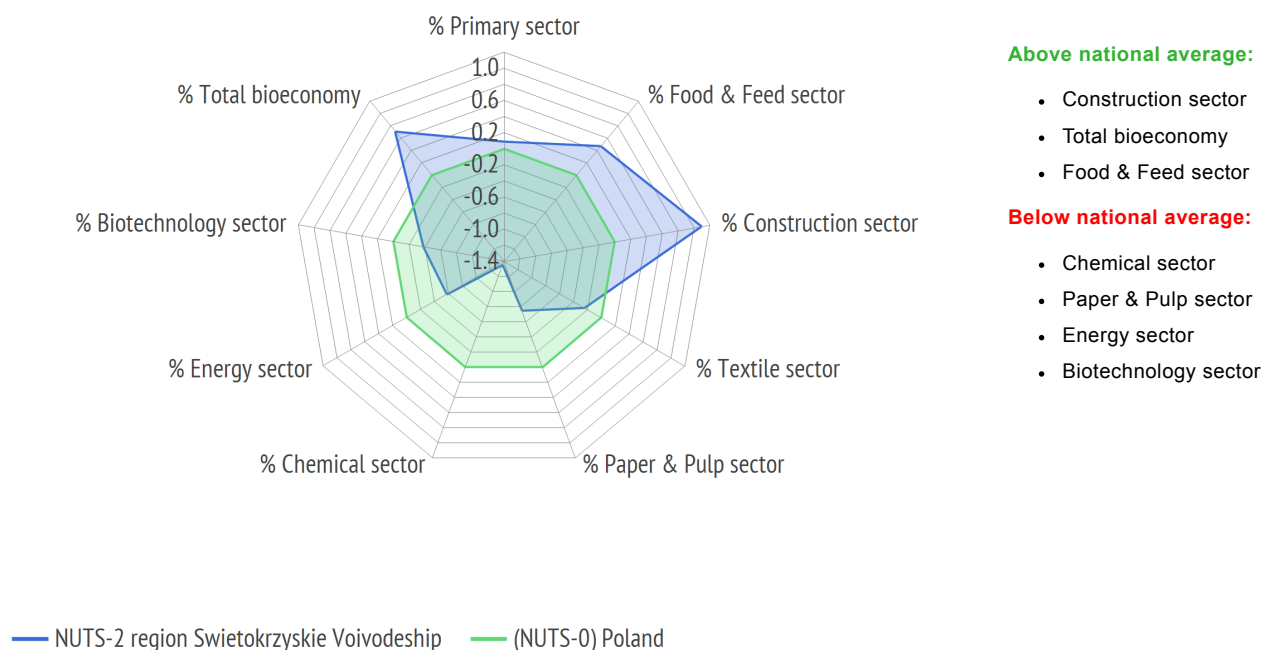


Figure 3. Employment structure (%) in Swietokrzyskie Voivodeship in 2016 compared to Poland

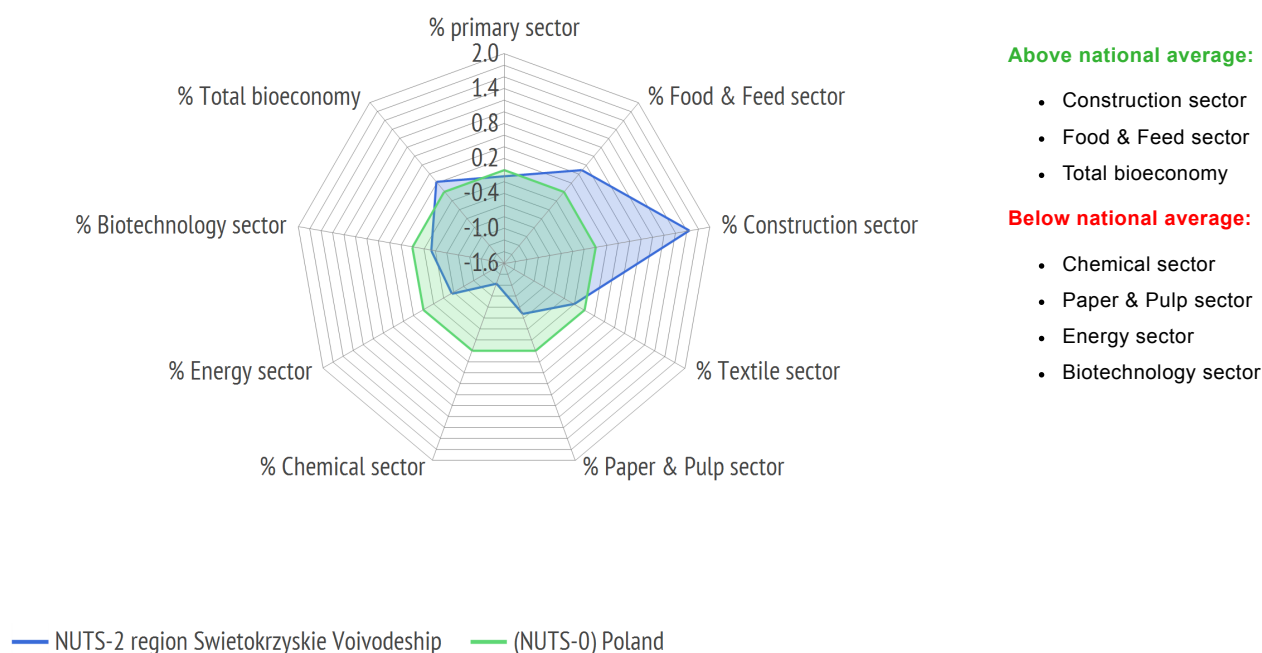


Figure 4. Firm structure (%) in Swietokrzyskie Voivodeship in 2016 compared to Poland

3.2. Assessment of the qualitative indicators

The focus of the regional profiles relates to exploring bioeconomy clusters, which originates in one of the following sectors: chemicals, energy, paper & pulp and textiles. A series of qualitative indicators in Swietokrzyskie Voivodeship must be valued by regional stakeholders for one or two of these potential bioeconomy clusters (see Table 2).

Table 2a. Scores for qualitative indicators of the bioeconomy cluster in the chemical sector in Swietokrzyskie Voivodeship

	Swietokrzyskie Voivodeship
1 Biomass availability - presence of continuous supply of biomass with constant quality (incl imports)	moderate
2 Infrastructure - attractiveness of region as place to settle for entrepreneurs and researchers?	moderate
3a Cluster management - presence of RIS3 with bioeconomy focus?	
3b Cluster management - presence of cluster organisation?	weak
3c Cluster management - presence of incubator?	moderate
4a Innovation - biocluster integrated in science park	weak
4b Innovation - presence of innovative bioeconomy milieu?	weak
5a Availability of funding - access to private funds?	weak
5b Availability of funding - access to public funds?	moderate
6 Policy setting - policy commitment?	moderate

Table 2b. Scores for qualitative indicators of the bioeconomy cluster in the energy sector in Swietokrzyskie Voivodeship

	Swietokrzyskie Voivodeship
1 Biomass availability - presence of continuous supply of biomass with constant quality (incl imports)	moderate
2 Infrastructure - attractiveness of region as place to settle for entrepreneurs and researchers?	moderate
3a Cluster management - presence of RIS3 with bioeconomy focus?	
3b Cluster management - presence of cluster organisation?	weak
3c Cluster management - presence of incubator?	moderate
4a Innovation - biocluster integrated in science park	weak
4b Innovation - presence of innovative bioeconomy milieu?	weak
5a Availability of funding - access to private funds?	weak
5b Availability of funding - access to public funds?	moderate
6 Policy setting - policy commitment?	moderate

Table 2c. Scores for qualitative indicators of the bioeconomy cluster in paper & pulp sector in Swietokrzyskie Voivodeship

	Swietokrzyskie Voivodeship
1 Biomass availability - presence of continuous supply of biomass with constant quality (incl imports)	moderate
2 Infrastructure - attractiveness of region as place to settle for entrepreneurs and researchers?	moderate
3a Cluster management - presence of RIS3 with bioeconomy focus?	
3b Cluster management - presence of cluster organisation?	weak
3c Cluster management - presence of incubator?	moderate
4a Innovation - biocluster integrated in science park	weak
4b Innovation - presence of innovative bioeconomy milieu?	weak
5a Availability of funding - access to private funds?	weak
5b Availability of funding - access to public funds?	moderate
6 Policy setting - policy commitment?	moderate

Table 2d. Scores for qualitative indicators of the bioeconomy cluster in the textile sector in Swietokrzyskie Voivodeship

	Swietokrzyskie Voivodeship
1 Biomass availability - presence of continuous supply of biomass with constant quality (incl imports)	moderate
2 Infrastructure - attractiveness of region as place to settle for entrepreneurs and researchers?	moderate
3a Cluster management - presence of RIS3 with bioeconomy focus?	
3b Cluster management - presence of cluster organisation?	weak
3c Cluster management - presence of incubator?	moderate
4a Innovation - biocluster integrated in science park	weak
4b Innovation - presence of innovative bioeconomy milieu?	weak
5a Availability of funding - access to private funds?	weak
5b Availability of funding - access to public funds?	moderate
6 Policy setting - policy commitment?	moderate

Source: Own elaboration based on [BERST report 3.2 'A representative set of case studies'](#).

4. Further development of the bioeconomy cluster in Swietokrzyskie Voivodeship

RDI2CluB especially focuses on the potential of bioeconomy clusters that starts in one of following sectors: chemicals, energy, paper & pulp and textiles. In the bioeconomy, these sectors process biomass and waste resources from the primary sectors (agriculture, horticulture, fishery, forestry) into new biobased materials and products by using knowledge from the R&D sector (Figure 5).

From the analysis above, the size of the construction and food and feed sectors in the Świętokrzyskie Voivodeship is above the national average, its primary sector is similar, and its energy, paper & pulp and textile sectors are smaller. In the chemical sector there are quite many companies, probably in production of paramedical products, including food supplements and cosmetics. The (cosmetic and paramedical) chemical sector, which uses minerals, healing sulphide and iodide-bromide waters, undergrowth, herbs and seeds of fibre plants, has also a considerable development potential.

It needs also to be stressed that the primary sector, with processing and energy industry, as elements of bioeconomy, have - apart from their natural values - also a positive effect on the defined regional smart specialisations, like e.g. health tourism and agritourism.

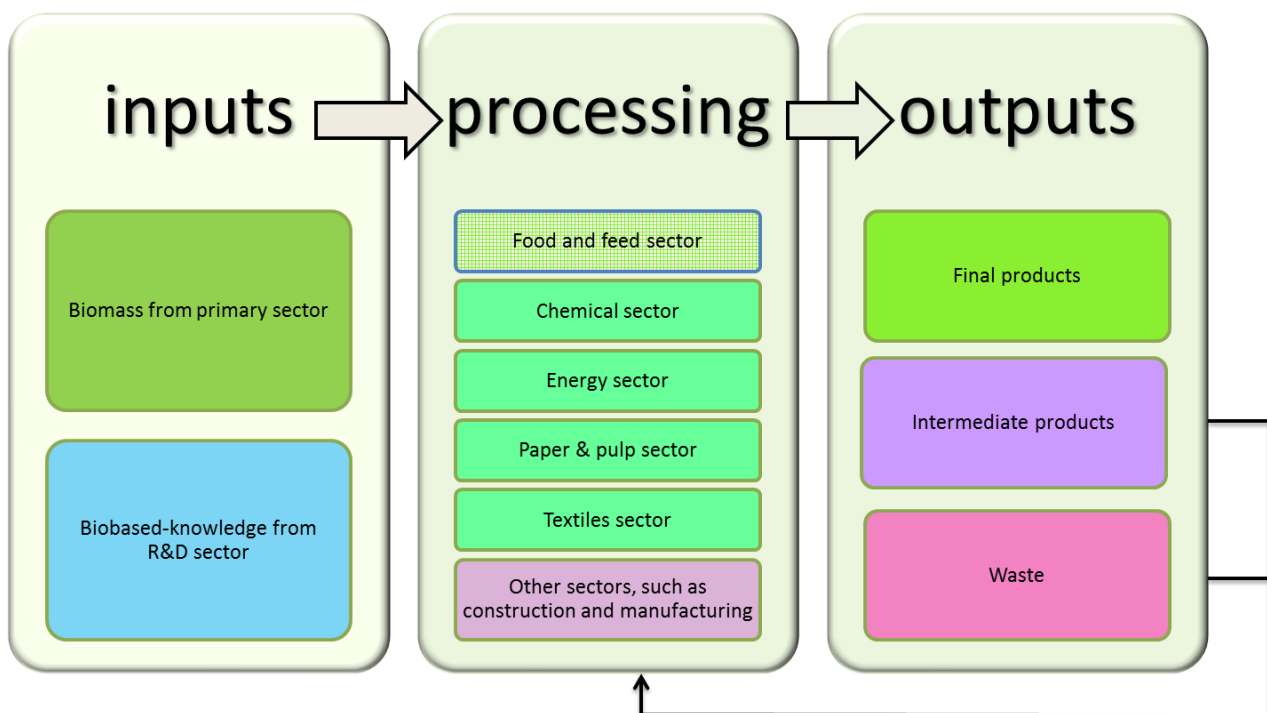


Figure 5. Linkages among economic sectors in biobased economy in RDI2CluB (source: BERST, 2015)

4.1. Lessons for the development of a bioeconomy cluster from Good Practice regions

Europe has examples of regions where the bioeconomy cluster is already in a mature stage. These bioeconomy clusters can serve as 'Good Practices' for other regions that want to develop their bioeconomy cluster. From the analysis of the development path of the Good Practices' bioeconomy clusters (BERST report D3.2), it appeared that a bioeconomy cluster usually starts its activities in one economic sector. By making crossovers to other sectors over time, the cluster will develop to a mature stage covering several economic sectors. Table 3 lists a number of Good Practice regions and the sector in which their bioeconomy cluster has started.

Table 3. Good Practice regions in BERST and the economic sector in which their bioeconomy cluster started

Regions with mature biocluster	Start sector of biocluster
Toulouse (FR), Manchester (UK), North Rhein Westfalen (DE)	Chemical sector
Keski Suomi (FI), Ghent (BE)	Energy sector
Keski Suomi (FI)	Paper & pulp sector
Ghent (BE)	Textile sector

Source: BERST report 3.1 'Good Practices in selected bioeconomy sector clusters; a comparative analysis'

From the analysis of the development path of the bioeconomy clusters in the Good Practices, a number of key findings emerged that can be considered as enabling factors for bioeconomy clusters:

- active actors organize the cluster as a bottom-up process and keep it moving by intensive networking;
- the presence of a cluster board that takes care of the organization of the cluster and communication;
- the cluster makes use of the strong points of the region;
- first, the cluster is mainly supported by public funds; later private funds become also available; the cluster starts with activities in one economic sector;
- biomass resources may originate from both local and external supply.

These enabling factors may serve as lessons for developing the bioeconomy cluster in Swietokrzyskie Voivodeship.

4.2. Supportive instruments and measures to develop the bioeconomy cluster

The BERST project found that Good Practices have used specific instruments and measures in order to stimulate its bioeconomy cluster. Table 4 gives examples of such effective instruments and measures.

Table 4. Useful Instruments and Measures for developing the bioeconomy cluster in the energy sector in Swietokrzyskie Voivodeship (select the I&Ms that refer to the bioeconomy cluster(s) the region want to develop)

Measures directed at	Start sector of biocluster
<i>Chemical sector</i>	
Getting access to public funding	Bavarian Research Alliance, Unit Environment, Energy & Bioeconomy: https://berst.vito.be/node/787
Getting access to private funding	Biocat: https://berst.vito.be/node/34
Support for setting up a science park	Centre of Excellence for Companies is the Renewable Raw Materials sector: https://berst.vito.be/node/470
Support for setting up an incubator	BioCubator- Business Incubator for Companies is the Renewable Raw Materials sector: https://berst.vito.be/node/470
Support for financing the cluster board	Matchmaking events: https://berst.vito.be/node/480
Support for infrastructure	Centre of Excellence for Renewable Resources Straubing: https://berst.vito.be/node/476

<i>Energy sector</i>	
Getting access to public funding	Bavarian Research Alliance, Unit Environment, Energy & Bioeconomy: https://berst.vito.be/node/787
Support for setting up a science park	Shared Research Centre Biorizon: https://berst.vito.be/node/763
Support for financing the cluster board	Biotech Umea: https://berst.vito.be/node/33
Support for infrastructure	Regional land use plan (Central Finland): https://berst.vito.be/node/753
Support for the improvement of the supply of biomass	Entrepreneurs Platform: https://berst.vito.be/node/483
<i>Paper & Pulp sector</i>	
Support for the improvement of the supply of biomass	Action plan for the use of renewable raw materials: https://berst.vito.be/node/21
Support for setting up a science park	Center of Excellence for Renewable Resources Straubing: https://berst.vito.be/node/476
Support for setting up an incubator	BioCubator-Business incubator for Companies in the Renewable Raw Materials sector: https://berst.vito.be/node/47
Support for financing the cluster board	Biotech Umea:
Support for infrastructure	Center of Excellence for Renewable Resources Straubing: https://berst.vito.be/node/476
Support for improving human resources	BioCon Valley: https://berst.vito.be/node/468
<i>Textile sector</i>	
Support for the improvement of the supply of biomass	Action plan for the use of renewable raw materials: https://berst.vito.be/node/21
Support for setting up a science park	Center of Excellence for Renewable Resources Straubing: https://berst.vito.be/node/476
Support for setting up an incubator	BioCubator https://berst.vito.be/node/33 -Business incubator for Companies in the Renewable Raw Materials sector: https://berst.vito.be/node/470
Support for financing the cluster board	Biotech Umea: https://berst.vito.be/node/33
Support for infrastructure	Center of Excellence for Renewable Resources Straubing: https://berst.vito.be/node/476
Support for improving human resources	BBioCon Valle: https://berst.vito.be/node/468

Source: Catalogue of Instruments and Measures

4.3. Recommendations for the further development of the bioeconomy cluster in Świętokrzyskie Voivodeship

In RDI2Club we especially focus on the potential of bioeconomy clusters, that originate in one of the four following sectors: chemicals, energy, paper & pulp and textiles. In the bioeconomy, these sectors transform biomass resources from the primary sector into new biobased competitive products by using knowledge from the R&D sector (Figure 5).

Sectors of considerable development potential:

Food and feed sector. The primary sector of the Świętokrzyskie Voivodeship (particularly agriculture, horticulture, forestry) has a considerable potential for bioeconomy growth. The decisive factors for the Świętokrzyskie potential are: the largest area of legally protected natural qualities in Poland (67%), the quality of agricultural land above the national average (the best soils constitute 25.8% of the area while the national average is 14.2%) and an established position of a national leader in production of fruit, including stone fruit, and open-field vegetables. To preserve this potential it is necessary to implement appropriate policy for management of limited water resources and take actions to maintain adequate productivity of land. Additionally the region is characterized by considerable, in Polish conditions, forest cover (331 thousand ha, i.e. 28.3% of the region's area), growing abundance of timber for 1 ha of forest land (from 249 cubic meters in 2014 to 251 cubic meters in 2016) and a strong tradition of use of forest undergrowth produce and game in food industry (93 tons of forest fruit and mushrooms and 383 tons of game acquired in 2016) as well as in paramedical and cosmetic industries.

Construction and chemical sector. The above analysis confirmed the big potential of the voivodeship for development of the construction sector. There is an enormous opportunity for development of the construction sector combined with the chemical sector due to regional traditions in fibre plant cultivation (especially hemp and flax), dynamic growth of interest in industrial use of fibre plants and the construction boom resulting in increased demand for construction materials (especially insulation materials) when compared to the supply. In the region there are companies interested in starting cooperation with academia and regional authorities to develop this bioeconomy sector for the benefit to the environment. The region has also the adequate regional and supra-regional scientific potential. The sector is also based on the enormous potential of the Świętokrzyskie forests.

The development potential is also observed in the cosmetic and paramedical sectors, which use mineral resources, healing sulphide and iodide-bromide waters, forest undergrowth and herbs as well as seeds of fibre plants. There are in the region several companies producing fertilizers and chemicals for construction and automotive industries.

Energy sector. The region has vast resources of forest biomass, in which the so-called professional energy industry is interested, among others. Additionally the region has approx. 250 thousand ha (soils of low agricultural use, set-aside land, fallow, degraded lands and lands to be recultivated), which can be used to produce energy biomass. The energy biomass resources can be increase by some additional 55 thousand tons per year - residues of fruit and vegetable processing, agricultural production, food and gastronomic production, as well as out-of-date food. Unfortunately, the current Polish law doesn't encourage development of renewable energy industry, by e.g. not allowing use of biogas in transport, which decreases opportunities of bioeconomy growth in this sector. The growing social awareness on how air quality affects human health and the proven above-norm air pollution in the voivodeship (during heating season) is slowly forcing the implementation of new and more environmental-friendly solutions (biofuels, pellet-fueled boilers). All of this creates an opportunity for growth of energy sector in the Świętokrzyskie region. Additionally the growing supply of fibre plants enables their use also in the energy sector.

Sectors of little development potential:

Textile sector. Currently the sector is below the national average. Its development was a result of operation of big national sewing companies (e.g. "Wólczanka") which since mid-20th century to the political transformation (1989) employed a few thousand of seamstresses in Ostrowiec Świętokrzyski. The employment was gradually decreased due to ownership change and at the moment there are in Ostrowiec Świętokrzyski 25 sewing companies and one big factory of Vistula Group. The sector isn't playing any significant role in development of the Świętokrzyskie bioeconomy at the moment, but the trends to return to natural fabrics (e.g. flax) may increase demand for traditional and innovative biofabrics. A growing interest in cultivation and broad use of fibre plants, especially hemp, is another opportunity for the development of the sector.

Paper and pulp sector. The sector is below the national average. In the region operate e.g. a branch of an international company DS Smith producing, e.g. packaging, as well as smaller producers of, e.g. personal care products. Due to the high impact on the environment and restrictions resulting from covering over 67% of the region with various forms of legal protection of natural qualities of the region, at the moment the sector isn't playing any significant role in the development of regional bioeconomy. However, an opportunity for its development lies in growing regional interest in cultivation and versatile use of fibre plants, especially hemp, and efforts to substitute plastic packaging with those made of buckwheat, which has been traditionally cultivated in the region for many years.

Taking into consideration weaknesses of the Świętokrzyskie Voivodeship, the following actions should be taken:

- For further development of bioeconomy and unlocking its full potential it is important to distinguish bioeconomy as a separate smart specialisation of the region, secure financing for its development and provide institutional support. At the moment bioeconomy is a part of several regional smart specialisations, but only integrated and long-term programming of its development and financing will bring measurable results. The key factor is also to engage triple helix representatives, especially business self-governments and business support institutions, in the process of shaping the policy and strategy of bioeconomy development. The region should also strive to create a whole ecosystem supporting bioeconomy growth. The development isn't also possible without business-academia cooperation for creation of innovative and competitive bioproducts and bioservices and promotion of the cooperation culture.
- A demand for regional bioproducts must also be boosted through coordinated actions for promoting regional bioproducts and bioservices in the region and outside, also within the existing programmes for regional promotion and brand building.
- An insufficient number of (road, train, airport accessibility) connections is still a barrier in regional economy (and bioeconomy) development that decreases investment attractiveness and availability of bioproducts.
- To increase the existing potential of agricultural production it is necessary to change (where possible) the structure of farms (concentration of farms), but above all to adjust the production to soil quality and arable land configuration to obtain maximum crops from the available acreage. It is also important to carry out long-term activities to improve soil fertility and increase water availability (e.g. using rain water) to water agricultural and horticulture crops.
- Further growth of construction and chemical sector requires creation and implementation of bioeconomy programmes for the fibre plant and organic farm sector, as new strong trends of agricultural development in the region, as well as introduction of a long-term cooperation policy with regional wood suppliers.
- The energy sector faces first and foremost the challenge connected with establishment of a biomass buying-in, storage and standardization scheme (providing constant biomass quality and supply), combined with a biomass standardization and certification scheme.

To implement all the above-mentioned activities it is crucial to increase awareness on bioeconomy potential among the society, RDI2CluB regional stakeholders and target groups, and to create environmental-friendly approach in inhabitants, by running educational, informational and promotional activities in the field of bioeconomy. The message must present bioeconomy in a most practical manner, giving examples from a daily life.

5. Roadmap for developing a strategy for a bioeconomy cluster

The information on strengths and weaknesses of the regional bioeconomy, the lessons from the Good Practice regions and the overview of supportive measures and instruments may serve as input for further steps in developing the bioeconomy cluster in Swietokrzyskie Voivodeship. The roadmap in Table 5 can be used as starting point in the discussion on developing such a strategy in a **regional Community of Practice of entrepreneurs, R&D institutes and policy makers**. Guidelines for the regional CoPs and questions to be answered, see box in Table 5.

Table 5. Roadmap for further development of the bioeconomy cluster in

Target	Activities needed to achieve the target	By whom?	Timeline-when?
E.g. Increase the capacity of local actors by learning them to cooperate, to use networks, and to assess their situation in the broader local and global context			
e.g. Improve the cooperation and trust among firms and R&D institutes			
etc.			

Source: Regional CoPs

Guidelines for the Regional CoPs and questions to be answered in order to fill table 5

For developing a Regional Profile structure that is applicable in practice, regional exercises are organised to test and discuss the RDI2Club tools and the regional profile in the partner regions and to get to know how to use the tool in the processes of strategic decision making.

It is advised to do this in a small, but diverse group, including cluster managers, regional government (preferably one public officer, one politician) and some entrepreneurial representatives (from biomass producers, from biomass processor, or representatives of the entrepreneurs). Duration of the meeting is approximately 1,5 hour and the meeting should be organized in October or November 2018.

Here are examples of questions to be addressed at the workshop. Please answer them and **make a short report immediately after workshop**:

Strengths, weaknesses, strategic choices

- Do the data help you in detecting the strengths of the region?
- Which comparative advantages can be detected, and how could they be transferred to strategic decisions on the smart specialization?
- How to deal with weaknesses – make connections with certain aspects of the value chain or resources outside the region
- What is missing in the Bioeconomy Readiness test – how can we improve?

Instruments, measures, cluster management

- What I&Ms are you using?
- What are interesting I&M from the database?
- What can you learn from wp2 analysis and the good practice regions?
- how to improve the cluster management?

Regional profiling

How do you use the assets of SWOT and I&M to show yourself (in the regional profile) the way you wish to profile yourself as a “certain” biobased region (e.g. biochemical region, bioenergy region, etc.), your organization and the way you are operating?

Annex 1. Indicators used in BERST for describing bioeconomy potential

Environmental criteria	Indicators	Unit/metrics	Reason for indicator choice	Quality of indicator
Biomass availability	Domestic production of biomass (agriculture & horticulture, forestry, blue, waste)	Kg/capita	In most regions biomass is produced domestically, rather than imported	Fair, indicator gives very good insight into criteria, but data is estimated from national data using regional employment, rather than directly observed
	Presence of continuous supply of biomass with constant quality	qualitative *)	Addresses issue of sustainability and is ambiguous about source of supply	Good, indicator is a direct observation of regions' biomass supply, although qualitative rather than quantitative
Land use	Forestry land (as % of total land area)	%	Land use for primary biomass purposes most relevant to bioeconomy suitability	Good, indicator gives good quantitative insight into bioeconomy-relevant land use
	Agricultural & horticultural land (as % of total land area)	%		
Infrastructure	Attractiveness of region as place to settle for researchers and entrepreneurs	qualitative	Attractiveness of place is outcome of state of infrastructure; perhaps better than quantitative measure of networks	Good, very relevant indicator, although qualitative rather than quantitative

*) A qualitative indicator is valued by regional stakeholders as weak, moderate or strong

Economic criteria	Indicators	Unit/metrics	Reason for indicator choice	Quality of indicator
Cluster size	Firms in total bioeconomy sector as % of total firms in region	%	Where the number of firms in relevant part of bioeconomy sectors is high it suggests a strong degree of potential clustering. This includes firms in the 'traditional' non-biobased sector as well as bioeconomy firms; the 'traditional' base is key to future development of the sector, particularly in the chemical and energy sectors, as they have the most potential to substitute fossil fuel inputs with bio-based equivalents.	Good, quantitative indicator which is strongly related to overall size/strength of cluster
	Firms in chemical sector as % of total firms in region	%		
	Firms in energy sector as % of total firms in region	%		
	Firms in paper & pulp sector as % of total firms in region	%		
	Firms in textile sector as % of total firms in region	%		

Economic criteria	Indicators	Unit/metrics	Reason for indicator choice	Quality of indicator
Employment structure	Employment in total bioeconomy sector as % of total employment in region	%	Detailed employment data shows current size of potential bioeconomy. This includes firms in the 'traditional' non-biobased sector as well as bioeconomy firms; the 'traditional' base is key to future development of the sector, particularly in the chemical and energy sectors, as they have the most potential to substitute fossil fuel inputs with bio-based equivalents.	Good, quantitative indicator which is perfect measure of employment structure
	Employment in chemical sector as % of total employment in region	%		
	Employment in energy sector as % of total employment in region	%		
	Employment in paper & pulp sector as % of total employment in region	%		
	Employment in textile sector as % of total employment in region	%		
Availability of funding	Availability and access of bioeconomy cluster to public funds	qualitative	Gets to centre of issues around role of government in providing funding	Good, are key questions, but only qualitative (no useful quantitative data on this criteria)
	Availability and access of bioeconomy cluster to private funds	qualitative	Is the key question around availability of funds	
Innovation	R&D expenditure	index	R&D expenditure has a direct impact on supply of innovation. The R&D expenditure index was taken from the Regional Innovation Scoreboard, produced by European Commission. The R&D expenditure in public and private sectors were calculated as a percentage of regional gross domestic product.	Good, R&D expenditure is strongly linked to innovation performance
	SME birth rate (number of starting firms in total firm number)	%	High levels of firm creation are indicative of strong innovation culture	Good, relevant indicator and quantitative measure
	Sector dynamics (% micro firms in bioeconomy subsector x as % of micro firms in all sectors in region)	index	Measures role of small firms relative to 'whole economy' tendency towards small firms – and small firms tend to be most innovative	Fair, less strongly linked to innovation performance than two indicators above but still relevant
	Number of competitive bioeconomy products brought to the market in last 3 years	number	Measures level of success in bringing innovative products to market in the sector	Good, direct measure of innovation outcomes rather than just supply-side
	Presence of an innovative milieu directed at the bioeconomy cluster	qualitative	Environment can help to foster innovation supply and demand	Good, very relevant to criteria, but only qualitative measure

Social criteria	Indicators	Unit/metrics	Reason for indicator choice	Quality of indicator
Cluster management	Presence of a RIS3 with bioeconomy focus	qualitative	Demonstrates a public-sector focus on bioeconomy	Good, although does not reflect quality of public sector strategy/focus
	Presence of a cluster organization which coordinates, manages and facilitates the biocluster	qualitative	Incubators are likely to lead to more business start-ups and higher survival rates	Good, reflect quality of cluster management, although no indication of incubator quality
	Presence of an incubator	qualitative	Incubators are likely to lead to more business start-ups and higher survival rates	Fair, less clearly related to cluster management
	Biocluster is integrated or closely tied to a science/technology park	qualitative	Links to existing parks likely to make business expansion easier	Fair, less clearly related to cluster management
Demographics	Population growth (% per year)	%	Key indicator of demographic movements	Good, closely related to key demographic trends
	Population between 15-65 years (share of total population)	%	Key indicator of size of potential workforce	Fair, data does not distinguish based on skill level of population
	Income per capita	Euro/capita	Higher income owner can lead to greater demand for bioeconomy outputs	Good, reflects ability of population (regardless of size) to pay for outputs of bioeconomy
Quality of workforce	Population with secondary & tertiary education	%	More skilled workforce more likely to be able to perform high value-added roles in bioeconomy	Good, very strong measure of workforce quality
	Access to know-how index (good <i>indicator is missing</i>)	qualitative	Reflects specific knowledge needs of the bioeconomy workers	Fair, the indicator shows how the quality of workforce reflects on the needs of businesses, but it is only qualitative data
Policy/regulation setting	Commitment of regional policy makers and regional biocluster policy	qualitative	Indicates their willingness to adapt policy/regulation to make business easier for the bioeconomy	Good, the indicator demonstrates the policy/regulation setting, although it is only qualitative

Where are indicator (data) gaps (white areas in Figure 1)? Figure 1 gives a flavour of the data gaps faced in developing the BERST toolkit. A white area means that EU and national statistics do not provide a useful measurable indicator (missing). Such an indicator is however needed in the provision of evidence how it's corresponding criterion contributes to describing the regional bioeconomy.

Especially, BERST faces problems in retrieving meaningful and measurable indicators for the criteria infrastructure, access to know-how centres and access to financial funds. Useful indicators for these criteria are not available in statistics at the EU NUTS2 and NUTS3 levels. Alternatively, BERST has solved this omission by asking regional stakeholders to give qualitative scores to the aforementioned indicators. However, that method was only applied to the 7 BERST regions, meaning that the data gap problems remain for the rest of the European regions.

Annex 2. What are Z scores?

Z score: a measure to calculate the deviation of indicator value(s) in a specific region, e.g. Biobased Delta (NUTS3), compared to the average value(s) of the same indicator(s) in a region at a higher geographic level, e.g. North Brabant province (NUTS2) or the Netherlands (NUTS0). With this transformation the unit of the specific indicator disappears, which enables the comparison of indicators with different units.

Example 'percentage employment of energy sector in total regional employment'

In the Netherlands the share of the energy sector in total employment is 49%. At the NUTS3 level the share of energy sector in total employment differs and shows a big spread. Suppose that the average deviation per NUTS3 region compared to the Dutch national average (49%) is 22% (22% is the standard deviation). This means that as long as the share of energy sector in total employment in a NUTS3 regions is 22% more or 22% less than 49%, it is seen as an 'average deviation'. In other words, in the Netherlands the share of the energy sector in total employment per NUTS3 region lies between 27% and 71%.

Suppose that the share of the energy sector in total employment in 'North Limburg' (NUTS3) counts 85%. We use the z score to indicate whether this percentage is an average, more than average, or less than average level. The z score is calculated as $(85\% - 49\%) / 22\% = 1.7$. Alternatively, in 'Utrecht' (NUTS3) the share of energy sector employment counts to 50%, which means a z score of 0.1 $(50\% - 49\%) / 22\% = 0.1$.

In case that the share of energy sector employment is more or less the Dutch average, the z score is around 0.

A specific NUTS3 region with a 27% share of energy sector employment, has an average deviation of the share of energy sector in total employment. The z score value is calculated as $(27\% - 49\%) / 22\% = -1$. A negative z score means that the share of energy sector in total employment is below the Dutch average level. At a 71% share of energy sector employment, the z score counts to 1, which is above the Dutch average level.

Qualification (disclaimer)

The BERST tool helps to recognize the current status of the regional bioeconomy (what are enabling factors? What are barriers?), with help of a catalogue with Criteria and Indicators and a catalogue with Case Study regions (i.e. Good Practice regions and the BERST regions).

BERST also provides tools that could support the making of smart specialization strategies for developing the future regional bioeconomy, like a catalogue with instruments and measures that could be effective to smooth the barriers or to stimulate innovation, and a catalogue with lessons from Good Practice bioclusters.

The BERST toolkit is a combination of quantitative and qualitative data and information. It is a valuable concept to provide a quick, global bioeconomy readiness check for in principle any region. The BERST project ended in December 2015. The RDI2Club project has been used to further improve and extend the BERST toolkit.

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