



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



Review of bioeconomy strategies at regional and national levels

January 2016

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This project has received funding from the European Union's Horizon 2020
research and innovation programme under grant agreement No 652682.

Document information	
Project name:	BioSTEP
Project title:	Promoting stakeholder engagement and public awareness for a participative governance of the European bioeconomy
Project number:	652682
Start date:	1st March 2015
Duration:	36 months

Report:	D2.3: Review of bioeconomy strategies at regional and national levels
Work Package:	WP2: Making existing information accessible
Work Package leader:	LEI
Task:	Task 2.2: Overview of bioeconomy strategies at regional and national level, actors and activities in the bioeconomy domain
Task leader:	LEI
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Internal peer review:	Annette Doerfel (BIOCOM)
Planned delivery date:	M7
Actual delivery date:	M11
Reporting period:	RP1

Dissemination level of this report		
PU	Public	x
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CO	Confidential, only for members of the consortium (including the Commission Services)	

ACKNOWLEDGMENT & DISCLAIMER

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EXECUTIVE SUMMARY

This report presents a list of national and regional bioeconomy strategies across Europe. National and regional bioeconomy strategies operate at different levels and vary in terms of their specific characteristics. Here, it is understood that national strategies are more closely related to bioeconomy policy-making, while regional strategies may be developed by bioeconomy clusters and tend to be shaped by several actors and networks in a specific region, often in less formal ways. In order to explore bioeconomy strategies at the regional level in Europe, BioSTEP has focused on the cases of 14 regional 'bioeconomy clusters' across 10 different countries:

1. Stara Zagora (Bulgaria)
2. Veneto Porto Marghera bio-refinery (Italy)
3. The Lombardy Green Chemistry cluster (Italy)
4. Norwich Research Park (UK)
5. York Biovale (UK)
6. North Rhine-Westphalia (Germany)
7. Saxony-Anhalt (Germany)
8. Northeast (Netherlands)
9. Biobased Delta (Netherlands)
10. Industries and Agro Resources (France)
11. Food+i La Rioja (Spain)
12. Satakunta (Finland)
13. Västra Götaland (Sweden)
14. Ghent Bioeconomy Valley (Belgium)

The results of our study suggest that initiatives for participative governance in the bioeconomy are rare and that involvement of civil society is only just starting. The examples of participative governance within national bioeconomy strategies are interesting because they indicate explicit strategies and guidelines that encourage public participation. These strategies are easy to trace and this also applies to the main actors that are involved.

At the level of regional bioeconomy strategies are less easy to trace because explicit strategies and guidelines are lacking or not publicly available. The activities aiming at participative governance at this level are limited both in number and in terms of their main objective, i.e. that of raising public awareness by providing information. Nevertheless, attempts and several intentions to move towards participative governance can be identified.

Several case studies that we assessed as being in a later phase of development did often not reveal much activities of public engagement. So, a later phase of cluster development cannot be related in a linear way to a higher level of participative governance. This is something to take into account for the further development of the national and regional case studies that will be developed in BioSTEP.

Interaction with a broad group of stakeholders and publics is critical to increase mutual understanding, also about value conflicts that may be difficult to solve. Therefore, it is important to consider participatory stakeholder dialogue methodology that can facilitate deliberative practices. We will return to these issues in Deliverable 2.4 of BioSTEP. Here, we will also pay attention to tools that can open up debates with the publics and/or with Civil Society Organisations.

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Abbreviations

BbD	Biobased Delta
BBSRC	UK's Biotechnology and Biological Sciences Research Council
BDC	Biorenewables Development Centre
BE	Bioeconomy
BERST	BioEconomy Regional Strategy Toolkit
BioSC	Bioeconomy Science Center
BMBF	Germany's Federal Ministry of Education and Research
CLIB2021	Cluster Industrielle Biotechnologie 2021
CBP	Chemical Biotechnology Process Centre
CPS	Concentrated Solar Power
EU	European Union
FECYT	Spanish Foundation for Science and Technology
FERA	Food and Environment Research Agency
GBEV	Ghent Bioeconomy Valley
GM	Genetically Modified
GNCD	Greater Norwich City Deal
IAR	Industries & Agro-Resources
ISCC	International Sustainability & Carbon Certification
JKI	Julius Kühn Institute
LEP	Local Enterprise Partnership
LGCA	Lombardy Green Chemistry Association
MLU	Martin Luther University Halle-Wittenberg
MOU	Memorandum Of Understanding
NAFICY	National AgriFood Innovation Campus York
NRP	Norwich Research Park
OECD	Organisation for Economic Co-operation and Development
RWTH	Rhine-Westphalian Technical University Aachen
TIS	Technological Innovation Systems
TOE	Tonnes of Oil Equivalent
UEA	University of East Anglia
UoY	University of York
VeLiCa	Vegetables Flax Hemp ("Vegetali Lino Canapa")
YNYER	Area of York, North Yorkshire and East Riding
ZMF	Zeeuwse Milieu Federatie

1. Introduction

BioSTEP draws on the idea that a participative governance of the bioeconomy, which could be defined as the engagement with a broad group of stakeholders and publics through communication, consultation, and deliberative practices, helps connecting the developing bioeconomy more strongly to society. Such a connection with society is fundamental for the transition from an economy based on fossil resources to a bioeconomy preferably based on renewable biological resources. This report (Deliverable 2.3) presents a list of national and regional bioeconomy strategies across Europe. It is part of Work Package 2, that aims to make existing information accessible that is relevant for supporting a more participative governance of the European bioeconomy. It is also complementary to a database that presents an overview of existing bioeconomy products and processes and provides an assessment of their social, environmental and economic impacts (Deliverable 2.1) and a report that analyzes and summarizes this information (Deliverable 2.2).

National and regional bioeconomy strategies operate at different levels and vary in terms of their specific characteristics. Here, it is understood that national strategies are more closely related to bioeconomy policy-making, while regional strategies may be developed by bioeconomy clusters and tend to be shaped by several actors and networks in a specific region, often in less formal ways. Due to these characteristics, the state of participative governance in regional strategies is more difficult to grasp than in national strategies. Whereas participative governance in national bioeconomy strategies can be identified in political guidelines and policies that actively encourage stakeholder/citizen participation, this is less so the case in regional strategies that evolve around multiple, networked groups or teams who seek to accomplish organisational objectives that can be characterized as clusters. The concept of clusters expresses that the days of big enterprises ruling the innovation processes are over and that nowadays the starting point of these processes should be seen as 'a network of agents interacting in the economic/industrial area under a particular institutional structure' (Hekkert et al., 2007, 416; Bonaccorso, 2014).

In order to explore bioeconomy strategies at the regional level in Europe, BioSTEP has focused on the cases of 14 regional 'bioeconomy clusters' across 10 different countries:

1. Stara Zagora (Bulgaria)
2. Veneto Porto Marghera bio-refinery (Italy)
3. The Lombardy Green Chemistry cluster (Italy)
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13. Västra Götaland (Sweden)
14. Ghent Bioeconomy Valley (Belgium)

In these regional clusters, concerns and activities with respect to stakeholder and, especially, public engagement (e.g. information transmission, consultation or participation activities) are not well-specified or only sparsely documented. This points out the main limitation of our assessment of regional bioeconomy strategies, which was mainly based on desk research. It might be the case that more activities around participative governance are going on in the clusters than those documented and publicly available. However, the identification and appraisal of such activities would demand more empirical work. As we conclude, this is an important aspect to be considered when analysing the actors and network activities (subsequent Deliverable 2.4), as well as for the

further development of the national and regional case studies that will be developed in subsequent work packages in BioSTEP.

This document is structured as follows. The next chapter (chapter 2) describes the analytical approach and methodology that guided our research. Chapter 3 provides an overview of national bioeconomy strategies. Chapter 4 describes the regional strategies of the fourteen bioeconomy clusters that were studied (see Annex II for the full case studies). Finally, in chapter 5 we outline some conclusions and suggest issues that deserve further discussion.

2. Approach and methodology

Mintzberg and Quinn (1996:3) define a strategy as 'the pattern or plan that integrates an organization's major goals, policies, and action sequences into a cohesive whole'. A strategy typically involves two major processes: formulation and implementation. Formulation comprises the analysis of the environment or situation, making a diagnosis, and developing guiding policies. Implementation refers to the action plans taken to achieve the goals established by the guiding policy (Mintzberg et al., 1996; Rumelt, 2011). Within the limits of the desk research we conducted, we compiled information on national and regional strategies that covered both processes. Our comparative analysis of existing national and regional strategies in Europe, with a focus on participative governance, builds on previous work and existing networks in which different members of the consortium are involved.¹ All partners of the consortium took part in this work and provided information on national and regional strategies. As mentioned above, a total of fourteen regions among ten different Member States were selected and studied to get an overview of strategies that seemed to have more potential for participative governance in Europe. These case studies can be found in Annex I.

2.1 National bioeconomy strategies

Several countries have developed bioeconomy strategies which differ, sometimes considerably, in range and content focus. These strategies are often documented and available for download; the website of BioSTEP shows a selection of bioeconomy strategies in Europe and other parts of the world.² Analysis of national strategies can also build on some good reviews already available. Indeed, the analysis presented here was largely informed by the recent review of the German Bioeconomy Council (*Bioökonomierat*, published in January 2015), that provides an overview of bioeconomy strategies and important policy measures adopted by the members of the G7, including the EU. We thankfully took notice of this report and its discussion on similarities as well as differences in political approaches. These findings provide valuable insights for BioSTEP that are worthwhile summarizing in this report. This is done in chapter 3.

2.2 Regional bioeconomy strategies

Grasping the state of the art of participative governance in regional bioeconomy strategies was a much more difficult endeavour because of the following reasons:

- the local practices of bioeconomy are numerous and diverse;
- information or overviews on stakeholder and citizen engagement are not readily available;
- the information that can be found (by desk research) is sparse and not very specific.

Given that bioeconomy strategies at this level are numerous and diverse, it is important to decide upon a method that is broadly applicable and able to help shedding light on (a) the structure and assets these strategies build on, (b) their phase of development, and (c) the processes involved in them (i.e. the dynamics of bioeconomic innovations). One appropriate model that seems to meet these methodological requirements is the *Technological Innovation Systems* (TIS) approach, which can be combined with the BioEconomy Regional Strategy Toolkit (BERST, 2015).

¹ The IQ-Net consortium of EPRC in 13 EU countries, the BERST network coordinated by LEI, and the Biotechnology Platform facilitated by BIOCOM.

² Link to the BioSTEP-website: <http://bio-step.eu/background/bioeconomy-strategies.html>

2.2.1 Technological Innovation Systems (TIS)

Technological change and innovation should not be seen as linear processes driven solely by technology and economy: such a techno-economic approach misses the broader context of 'societal subsystems, actors, and institutions contributing in one way or the other, directly or indirectly, intentionally or not, to the emergence or production of innovation' (Hekkert et al., 2007, 414). The concept of 'innovation system' points to this broader socio-technical context. However, traditional methods of innovation system analysis mainly looked at the social structure (actors, their relations, and institutions). Less attention has been given to the analysis of the dynamics of these systems. This explains why most analyses of innovation systems done in this traditional way are quasi-static in character.

'Since technological change is a dynamic process, which requires a transformation of the innovation system in which changes take place, a dynamic innovation system is needed to understand and better be able to guide its direction' (Hekkert et al., 2007, 414).

The TIS framework focuses on key processes that are highly important for innovation systems to perform well. The central idea is a systematic mapping of the *activities* that have 'the function to contribute to the goal of the innovation system, which is the generation and diffusion of innovations' (Hekkert et al., 2007, 415). For this reason, the activities are labeled as 'functions of innovation systems' (Hekkert et al., 2007, 413, 415). This special attention for activities that influence the goal of the innovation systems – in short: functions or key processes – makes it possible to gain more insight in the dynamics of technological innovation. TIS aim to account for both the structure of an innovation system and key processes that contribute to or hamper the diffusion of technology and has 'shown great progress in mapping and explaining the dynamics of technological innovation processes' (Breukers et al., 2014, 227).

In the following subsections we will pay attention to the network of interacting agents as an important starting point of TIS and the concept of clusters we will use (2.2.2), the structure and key assets in bioeconomy clusters (2.2.3), the different phases of technological innovation (2.2.4), and the key processes (or functions) that are at the heart of TIS (2.2.5).

2.2.2 Bioeconomy clusters: networks and production chains

The TIS approach does not start from an industrial sector or a specific country, but from 'a network of agents interacting in the economic/industrial area under a particular institutional structure' that is involved in the generation, diffusion, and utilization of technology (Hekkert et al., 2007, 416). This starting point of analysis shows a close affiliation with the vision that the European path to bioeconomy runs through clusters (Bonaccorso, 2014). Clusters are forms of network structures characterised by multiple, networked groups or teams who seek to accomplish organizational objectives. The concept of clusters expresses that the days of big enterprises ruling the innovation processes are over. In early capitalism, the place of innovation processes, from basic research to the marketing of new products, was mostly within the larger companies that had a lot of control, but this conception of innovation has become obsolete.

'Nowadays such innovation processes are governed by large, complex and structured production chains, with various economic and non-economic actors, often with a local connotation, influencing their characteristics and results' (Bonaccorso, 2014).

The concept of clusters has become commonplace in regional innovation policy.³ It clarifies that the role of complex networks and production chains is pivotal for the bioeconomy and not the

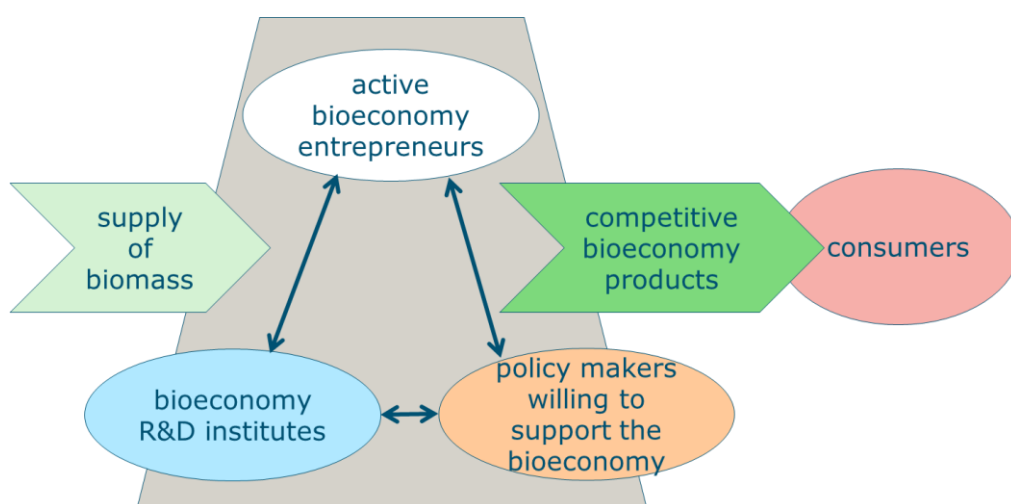
³ Current EU development strategies, such as the Europe 2020 Strategy (European Commission 2010), the Bioeconomy Strategy for Europe (European Commission 2012) and the Research and Innovation Strategies for Smart Specialisation (RIS3) (European Commission 2014) also use the term clusters when they spell out incentives to develop a bioeconomy.

region as such. Therefore, we will use the term bioeconomy clusters when referring to our regional case studies.

2.2.3 Structure and key assets

To understand the functioning of regional bioeconomy strategies, one should start with asking how they are structured and which actors they involve or engage with. These questions are given thorough attention in BERST, a research project that focuses on benchmarking and smart strategies for building regional bioeconomies. In BERST, entrepreneurs, policymakers, supportive bodies, and knowledge institutes have been considered the main actors together with a consistent provision of biomass resources and competitive bioeconomy products. Figure 2.1 provides an illustration of a well-developed biocluster (BERST, 2015). In the approach adopted by BERST, the different elements of the organisational structure are all indicated as 'key assets'. Key assets include diverse actors, but also knowledge, resources and products for the market.

Figure 1: Organisational structure of a biocluster



Source: BERST, 2015

This structural analysis proposed by BERST fits in with the first step in a later manual of TIS that also zooms in on the main actors and institutions, the constellation of the supply side and the market (Hekkert et al., 2011, 5-8). Such an analytical work can provide an (historical) construction of the paths that were chosen, give us a more clear view of the (evolving) circumstances that were crucial or beneficial and also of obstacles that hamper(ed) the innovation (e.g. regulation, lack of resources, conflicting interests or value conflicts).

The findings of the BERST project point out the following:

- Entrepreneurs, including large-scale industries and small and medium enterprises, and the presence of a certain entrepreneurial culture, play a pivotal role in driving clusters towards successful development of the bioeconomy in a region.
- Policymakers and supportive bodies who are willing to support the development of the bioeconomy by providing governance, institutional structures and financial support, are prime movers in a bioeconomy cluster.⁴
- Bioeconomy R&D institutes and educational organizations provide the technical know-how and innovation without which the development of bioeconomy products would not be possible.

⁴ Funding both from public and private sources, and policies and measures are not classified as separate assets in the framework of BERST. These activities and actions are considered to be instruments of policymakers and entrepreneurs.

Other assets relevant to the development of the bioeconomy are biomass resources and competitive bioeconomy products for the market (e.g. commercially viable products such as green chemicals, food and feed additives, and biofuels). As seen in the diagram of BERST, it does not contain any reference to Civil Society Organisations or Non-governmental organizations, but consumers are included as a key asset. However, their role is considered important mainly in the mature phase of the cluster, when the innovation is on the verge of producing competitive bioeconomy products or already producing these at an extensive scale.

Infobox 1: Questions for the regional case studies

- What are the main geographical characteristics of the region?
- What are the relevant sectors of the bioeconomy cluster?
- What is the situation with the supply of biomass (own resources, import)?
- What are the mission and objectives of the bioeconomy cluster?
- When was it established and who were the main actors?
- By which policies and measures was the cluster supported?
- How is the cluster funded?

2.2.4 Development phases of technological innovation

The influence and activities of participative governance in a bioeconomy cluster can be related to the phase of development of the cluster. For instance, at its initial stage, when the innovation is relatively unknown, consumers and civil society organisations often play a minor role, whereas their role can suddenly become important if public controversy emerges when the innovation is being commercialized. The debate in Europe on biotechnology can be seen as an exemplary case of such a shift in importance.⁵ Because of such patterns that can to some extent clarify the prominence or absence of specific actors, it makes sense to determine the phase of development of the clusters studied: how mature are they?

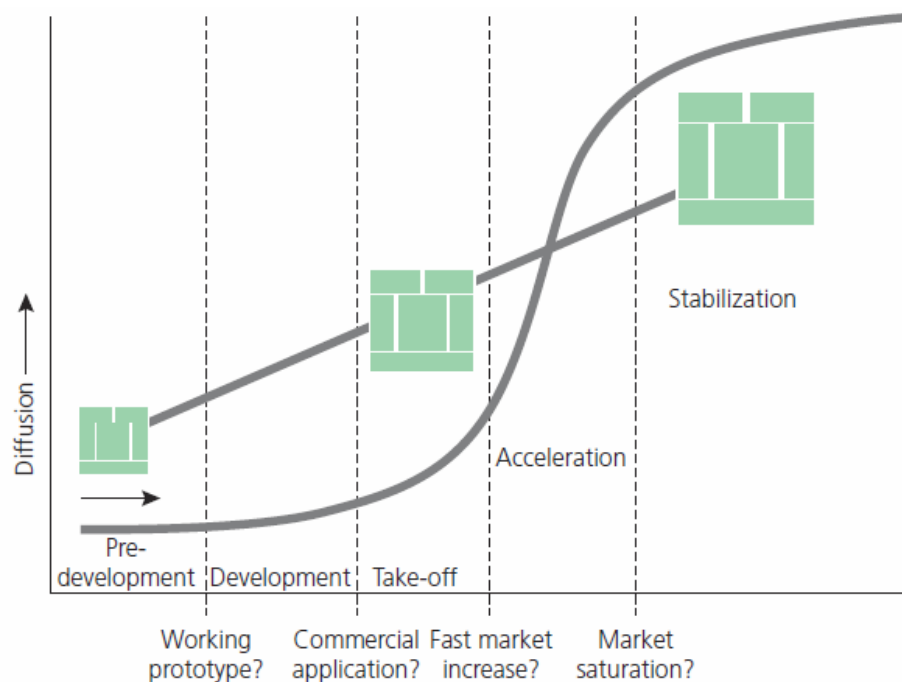
Hekkert et al. (2011, 8-9) point out that innovation systems pass through sequential development phases and that it can take years before an innovation reaches maturity. They distinguish five phases of development: (i) predevelopment, (ii) development, (iii) take-off, (iv) acceleration, and (v) stabilization (figure 2.1). In the analysis of our regional case studies we will largely follow this classification. The last phase of stabilization can be omitted, because this phase is very distant in the case of the bioeconomy. However, the first four phases proved to be useful to order the different regional bioeconomy clusters in terms of development phases.

- During the first two phases of Predevelopment (P) and Development (D) the bioeconomy is introduced in the regional planning agenda and the policy, socio-economic and R&D landscape for its establishment and operation are created. The end of Predevelopment is marked by the realization of a working prototype, and the end of the phase of Development is marked by a commercial application.
- The phase of Take-off (T) shows a substantial growth of the cluster: the first competitive bioeconomy products are sold in the market, new companies join the cluster, the infrastructure (business incubators, training centre etc.) is established, and the cluster is able to attract both private and public funding. The Take-off phase ends with a fast market growth.

⁵ The concept of constructive Technology Assessment (cTA) is an approach that emphasizes the importance of involving consumers and/or societal stakeholders in an early phase of technology development (Schot and Rip, 1997; Rip and Robinson, 2013).

- In the phase of Acceleration (A) the cluster is able to produce competitive bioeconomy products at an extensive scale and can count on an increasing demand. This phase ends with market saturation.

Figure 2: Phases of development



Source: Hekkert et al., 2011, 9.

In the TIS approach the effort is made to connect these different phases of development in a more structural manner with the functions that determine innovation systems (see 2.1.5), how one could identify certain patterns in the importance of these functions and how this can shift when one goes from one phase to the other. However, to establish such patterns and shifts requires more intensive research and goes beyond the scope of the desk research planned for our case studies. Our reference to these phases has therefore a more general purpose and mainly serves to characterize the current state of the regional case studies.

Infobox 2: Question for the regional case studies

- Is the bioeconomy cluster in the phase of Predevelopment, Development, Take-off or Acceleration?

2.2.5 Key processes: seven functions

At the heart of TIS are seven functions (see table 2.1) that have been defined based on different literature on functions and several empirical studies (Hekker et al. 2007, 421-425). These functions refer to key processes that contribute to the goal of the innovation system, which is the generation and diffusion of innovations. Unraveling and describing these functions for a specific bioeconomy cluster will give more insight into the dynamics of technological innovation. According to Hekkert et al. 'the structure presents insight in who is active in the system, the system functions present insight in what they are doing and whether this is sufficient to develop successful innovations' (2011, 4).

Infobox 3: The seven TIS functions

F1: Entrepreneurial Activities

Activities that aim at proving the usefulness of the emerging technology in a practical and/or commercial environment, e.g. experiments, demonstrations and business ventures.

F2: Knowledge Development

Learning activities, mostly related to the emerging technology, but also related to markets, networks, users etc.

F3: Networks and Knowledge diffusion

The primary function of networks is to facilitate the exchange of knowledge between all the actors involved. Knowledge diffusion can occur in the formation of partnerships, or in meetings like workshops and conferences.

F4: Guidance of the Search

Activities that shape the needs, requirements and expectations of actors with respect to their support of the emerging technology. It also refers to the promises and expectations expressed by various actors. Important is the convergence of signals – expectations, promises, policy – in a particular direction of technology development, which may work out positively or negatively for the technology concerned.

F5: Market Formation

Emerging technologies usually cannot compete with incumbent technologies. Therefore the creation of artificial (niche) markets is needed. This function involves activities that contribute to the creation of a demand for the emerging technology.

F6: Resource Mobilisation

The allocation of sufficient financial, material and human capital to make the emerging technology viable, e.g. investments and subsidies; the deployment of generic infrastructures such as educational systems, large R&D facilities, the mobilisation of natural resources like biomass.

F7: Lobbies, Support from advocacy coalitions

The rise of an emerging technology often meets with resistance from established coalitions with stakes in the incumbent energy system. This function involves political lobbies and advice activities on behalf of interest groups and can be regarded as a special form of Guidance of the Search, because such pleas in favour of particular technologies are attempts to shape expectations.

Source: Breukers et al., 2014, 228.

However, it should also be acknowledged that the empirical work needed to obtain a full-frame view of these processes can be quite intensive and would require substantial research budgets. Given the limitations of the desk research performed, it is not possible to map all these functions in-depth. Rather, they are used as guiding lines in our analysis of the current situation of our regional case studies. A critical observation is that TIS, in spite of its broad framework, fares less well in grasping societal controversies and different underlying stakeholder perspectives (Breukers et al., 2014, 228). Though F4 and F7 do point to political issues and different interests, the focus lies on economic stakeholders.⁶ Overall, one can say that the attention given to public engagement only scratches the surface.⁷ That is why will look carefully at activities of public engagement and possible value conflicts to overcome this weakness of TIS.

⁶ This is consistent with the definition of a technological system quoted by Hekkert et al. (2007, 416) that concentrates on a network of agents interacting in the economic/industrial area.

⁷ In Deliverable 2.4 we will return to this issue when we discuss the combination of TIS with participatory stakeholder dialogue methodology.

Infobox 4: Questions for the regional case studies

- What are in the current situation the main missions and objectives?
- What are in the current situation the main actors and which activities do they undertake?
- What are the current activities of supportive bodies and (knowledge) institutions?
- Which activities contribute to the creation of a demand for the emerging technology?
- Are consumers and civil society networks engaged? If absent, why?
- Is the guidance of the search (F7) influenced by societal actors?

2.2.6 Bioeconomy sectors, case study regions and questions

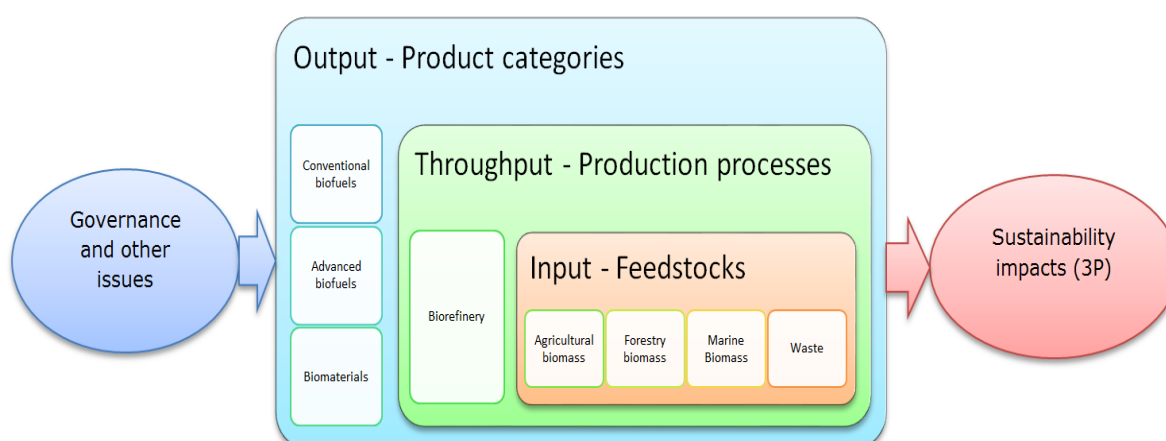
The BioSTEP project recognises eight bioeconomy sectors, namely the biofuels sector and seven biomaterials sectors.

Infobox 5: The eight bioeconomy sectors of BioSTEP

1. Biofuels (conventional and advanced)
2. Bioplastics, including wood-plastic-composites
3. Industrial, aircraft and automotive parts
4. "Green" chemicals, including industrial solvents
5. Lubricants
6. Personal care and home care
7. Fibre products, including textiles, pulp and paper, insulating material
8. Food and feed additives

Biorefineries are not separately considered, but seen as a process innovation across all sectors:⁸

Figure 3: Taxonomy of the main bioeconomy product categories



A total of 14 regional bioeconomy clusters across the European Union have been selected for our review of regional bioeconomy strategies. The main criteria for case study selection were (a)

⁸ See Deliverable 2.1 for further details.

availability of information on the development phase and (b) the perceived potential for public engagement. Furthermore, in order to share experiences and to develop a common perspective, also the regions relevant for the living labs within work package 6 of BioSTEP have been included. The selection based on these criteria has been facilitated by existing networks in which the partners of the consortium participate. The list below shows which participant of the BioSTEP consortium was responsible for accomplishing each of the regional case studies.

1. Stara Zagora (Bulgaria)	BIA
2. Veneto Porto Marghera bio-refinery (Italy)	AGHETERA
3. The Lombardy Green Chemistry cluster (Italy)	AGHETERA
4. Norwich Research Park (UK)	UNOTT
5. York Biovale (UK)	ERPC
6. North Rhine-Westphalia (Germany)	BIOCOM
7. Saxony-Anhalt (Germany)	BIOCOM
8. Northeast (Netherlands)	LEI
9. Biobased Delta (Netherlands)	LEI
10. Industries and Agro Resources (France)	EI
11. Food+i La Rioja (Spain)	UNOTT
12. Satakunta (Finland)	ERPC
13. Västra Götaland (Sweden)	ERPC
14. Ghent Bioeconomy Valley (Belgium)	LEI

Adding up the questions indicated in the previous sections for the regional case studies, we arrive at the following list that was used as general guideline for analysing and presenting the information related to the selected bioeconomy clusters.

Infobox 6: List of questions for the regional case studies

DESCRIPTION, HISTORY and PHASE OF DEVELOPMENT

- What are the main geographical characteristics of the region?
- What are the relevant sectors of the bioeconomy cluster?
- What is the situation with the supply of biomass (own resources, import)?
- What are the mission and objectives of the bioeconomy cluster?
- When was it established and who were the main actors?
- By which policies and measures was the cluster supported?
- How is the cluster funded?
- Is the bioeconomy cluster in the phase of Predevelopment, Development, Take-off or Acceleration?

CURRENT SITUATION OF CLUSTERS AND PARTICIPATIVE GOVERNANCE

- What are the main missions and objectives?
- What are the main actors and which activities do they undertake?
- What are the activities of supportive bodies and (knowledge) institutions?
- Which activities contribute to the creation of a demand for the emerging technology?
- Are consumers and civil society networks engaged? If absent, why?
- Is the guidance of the search influenced by societal actors?

Chapter 4 contains a summarised description of the fourteen bioeconomy clusters that were studied (see Annex I for the full case studies). Before that, however, we present in the following chapter (chapter 3) an overview of the national bioeconomy strategies.

3. National bioeconomy strategies⁹

In recent years, the bioeconomy has become an important component both of innovation and economic policy. The different political approaches share many common measures to promote technological innovation, economic growth, ecological sustainability and resource efficiency. Furthermore, the political focus has increasingly changed from promoting bioenergy as a stand-alone solution to fostering the value-added, cascading use of biological resources. However, there is a great variation in the political aims and measures of the individual countries. They are characterized by the prevailing industrial and economic profiles of the countries and by the amount of resources they have, especially by their natural resources potentials. Their underlying motivations range from a desire to secure access to raw materials through to comprehensive regeneration of the innovation system and the ecological transformation of the economy. This results in basic differences within the national approaches.

3.1 Top-down or bottom-up

Finland, Germany, Japan, the Netherlands, Norway and the US have developed what we considered as “top-down” strategies to foster the use of biomass and biosciences for different purposes. Here, the development of the bioeconomy is mainly driven by government policy that develops visions, strategies and action plans to promote and shape the biobased economy. Germany, for example, has its ‘Bioeconomy 2030’ strategy coordinated by the Federal Ministry of Education and Research outlining the national approach towards a post-oil economy, and created the National Bioeconomy Council, responsible to develop relevant proposals for consideration by the national government. In this context, industry and R&D institutions often build strategic alliances along the whole production chain of bioeconomy in order to receive federal funds – a configuration known as the ‘triple helix’. Other countries that adopted this top-down approach to the development of the national bioeconomy organise research programmes based on public funding or a mix of public and private funding. Examples include ‘The Finnish Bioeconomy Strategy’ (Finland), and ‘Bionaer’ (Norway). In the Netherlands, there is a quadruple helix cooperation (governments, research & development, businesses and NGOs) that develops sustainable industrial biobased solutions (Be-Basic).

Conversely, countries like Italy, Belgium, France or Canada seek to leverage existing private sector and public research initiatives (bottom-up). They are relying primarily on industry led (and funded) or regional initiatives and governments limit themselves to designing framework conditions at the national level by means of seed financing for clusters, legal and regulatory interventions or demand-side stimuli (green procurement, feed-in tariffs for bioenergy etc.). For instance, in Belgium, the Government of Flanders developed a strategy with the aim of incentivising existing and future stakeholders within the bioeconomy to detect and seize opportunities themselves.

3.2 Industrial leadership or primary production based

Countries with few natural resources and a strong industrial structure, such as Germany, Japan, France and Italy, mainly focus on their industrial and technological leadership, which is also strongly promoted by the EU. ‘In order to secure access to raw materials, Germany, Japan and the UK are also trying to establish international technology and resource partnerships with emerging countries, which have a plentiful supply of biomass’ (German Bioeconomy Council, 2015, 52). The UK seeks to build on its highly developed services sector and its excellence in biosciences to develop high-value industries, and is pursuing a reindustrialization strategy, which consists of developing extensive production capability (e.g. for biofuels). Similarly, France

⁹ This chapter is largely based on the recent review of the German Bioeconomy Council (2015) that provides useful and valuable insights for BioSTEP.

developed the “Green Chemicals and Biofuels” initiative to modernise industrial facilities for biofuels.

US, Canada, Finland, the Netherlands and Norway, that can be considered resource-rich in comparison with the countries mentioned above, the extensively fund innovation activities in the primary production sector, and regard the bioeconomy first of all as an opportunity to capitalize on these strengths to develop science-based, high-value industries. Secondly, they are pursuing a reindustrialization strategy, which consists of developing extensive production capability, for instance, by converting decommissioned industrial facilities for biofuels.

3.3 Regional Stakeholders

Within some counties, regional stakeholders and policy-makers play a considerable role in the development of the bioeconomy. In Italy, regional green clusters have been launched in Sardinia, Piedmont and Lombardy. France is backing regional competitiveness clusters with an ecological focus, especially concerned with biobased chemistry. In Germany, two federal states have produced their own bioeconomy strategies. Apart from the chemical industry, North Rhine-Westphalia is primarily focusing on medical biotechnology; Baden-Württemberg has also issued a tailor-made bioeconomy research strategy (for biogas, lignocellulose-based value chains, and algae utilization).

3.4 Global Stakeholders

Together with the OECD, the EU is the only supranational organisation with a bioeconomy strategy (European Commission, 2012). Elements of the bioeconomy, however, do play an important role in the World Bank initiated Green Growth Knowledge Platform (Green Growth Knowledge Platform, 2014). The EU has already been promoting the bioeconomy for about ten years and is therefore internationally regarded as a pioneer. Alongside numerous research projects, which are anchored in the respective framework programmes, the primary aim is to establish new value chains between industries that have not previously seen themselves as economic partners. Because of the competition policy in Europe, individual nations have to content themselves with promoting precompetitive areas, whereas the EU is also able to fund close-to-market projects.

3.5 Societal Stakeholders

The national bioeconomy strategies indicate that there are plans and ambitions for establishing a greater connection between the development of the bioeconomy and society. However, there are hardly any activities reported or documented in this regard, i.e. activities aimed at public engagement and/or monitoring activities to measure the impact of the bioeconomy upon society, the environment, the economy and the scientific sector.¹⁰ Looking at examples from the UK and Germany, the bioeconomy is mainly framed as the products and processes (and related businesses) of that part of the industrial biotechnology that uses non-fossil based feedstocks.¹¹ This suggests that participative governance activities and the involvement of diverse actors in the bioeconomy are still happening on a minor scale (or that they are practically absent). However, it should also be said that the desk research approach on which our study was based might have been limited for identifying such activities.

¹⁰ Germany is promoting public engagement and social dialogue as part of its bioeconomy strategy (Bioeconomy Council, 2015). As part of that, BIOCOM has organized a public dialogue on the bioeconomy.

¹¹ The UK government published a key policy paper, delivered by the Government’s Department for Business, Innovation and Skills (BIS), in which the bioeconomy is defined in this way (BIS, 2015).

4. Regional bioeconomy strategies

This chapter summarizes and compares the findings from the case studies of bioeconomy clusters in 14 regions (see Annex I) guided by the questions listed at the end of chapter 2 under the headings 'Description, history and phase of development' and 'Current situation and participative governance'. It should be noted that the dimensions of our analytical framework were in many cases difficult to assess. Therefore, the descriptions of the clusters presented below should be seen as indicative, not as hard facts. We first describe the regional strategies separately, following the headings of our questions. The chapter concludes with an overview.

4.1 Description, history and phase of development

Stara Zagora (Bulgaria)

The Stara Zagora region (355,000 inhabitants; a cluster in a phase of predevelopment) is situated in the central part of Bulgaria. The region is also included in the "living lab" activities carried out by BioSTEP as part of work package 6. It did not yet organise a cluster, and tries to observe from other regions how to develop a strategy henceforth (with R&D, industrial associations, etc.). At present, the regional authorities do not have a vision about the bioeconomy and the necessary investments. The region has a leading energy sector, provides important resources, i.e. fertile farmlands (cereals, oil-seed sunflowers, vegetables, orchards etc.) forests and springs, and has the largest deposits of lignite on its territory. For biopharming, the Stara Zagora strategy promoted the development of plants for biodiesel derived from the processing of sunflower seeds in the near future. The agricultural faculty of Stara Zagora's Thracian University played an important role in the national strategy for sustainable agricultural development and might play a role in the predevelopment of a bioeconomy cluster.

The Lombardy Green Chemistry (Italy)

The Lombardy region (10 million inhabitants; a cluster in a phase of acceleration with new developing sectors) in the northwest of Italy has an increasing electricity production from renewable resources from hydroelectric production, biomasses and biofuels. The regional plan for sustainable development and subsequently the agreement of the region with the Ministry of Education, Universities and Research to allocate budget for eco-innovation, resulted in the Lombardy Green Chemistry Association (LGCA), established in 2011. The LGCA includes aggregations of companies, universities and other public and private research/innovation bodies to create good conditions for the regional development of the bioeconomy, and acts as an interlocutor of national and regional authorities. The LGCA project took off with the downstream biomass producers, such as agricultural and forestry holdings, but also industrial processes (food, textile, paper) and municipal waste managers; and then addressed the chemical companies able to potentially transform these raw materials into substances and products allocated to other manufacturing sectors. An important pilot project is VeLiCa, which assessed the reintroduction of traditional hemp and flax farming by enhancing their profitability through the exploitation of all biocomponents (oil and fiber for biodiesel, biolubricants, biopolymers, and bioplastics).

Veneto Porto Marghera bio-refinery (Italy)

The Veneto region (4.9 million inhabitants; a cluster in a take-off phase) in the northeast of Italy has many biogas plants, biodiesel plants, biomass and hydroelectric production that contributed to renewable resources of energy. The petrochemical complex with the ENI company (established in 1917) was an important chemical pole, which after serious crises – both economic, social as well as environmental – tries to transform into a green chemical hub and the start-up of the biorefinery. The biorefinery – reconverted from a traditional refinery – will fulfil half of ENI's annual requirement of bio diesel and will be used by ENI to comply with the EU regulations on the minimum bio content in fuel. The site has been integrated in the local context and its reconversion has the local support due to its favourable employment conditions.

Norwich Research Park (UK)

The *Norwich Research Park* (NRP; a cluster in a phase of take-off regarding the bioeconomy) is located in the east of England on the south of the city of Norwich (130,000 inhabitants). NRP was founded by a partnership between the UK's Biotechnology and Biological Sciences Research Council (BBSRC), University of East Anglia, the Norfolk and Norwich University Hospital, the John Innes Foundation charity and four independent research institutes in 1995. The cluster has a broad mission towards sustainability. Currently, about 45 companies are based in NRP and collaborate with the founding institutions in sectors ranging from agri-food to renewable energy and the pharmaceutical and medical sectors. In 2011, through an UK government award, the BBSRC invested in the further development of NRP to attract new companies and to support new infrastructure.

York Biovale (UK)

The Local Enterprise Partnership (LEP) Area of *York, North Yorkshire and East Riding* (YNYRE) includes 1.14 million inhabitants (a regional cluster in a phase of development). In the region there have been bioeconomy businesses (in different sectors) for decades with well-established products and markets etc, but it seems that it is only recently that some businesses have started working together and/or with local researchers. The strategic economic plan of YNYER LEP – a partnership between local government and businesses to support the regional bioeconomy – draws on agri-based biomass and combines food manufacturing, agritech, energy and biorenewables. R&D expertise is in biorenewables and agritech. Regional agrifood sector developments have been accompanied by the creation of several research and enterprise bodies. The BioVale initiative was launched in 2014 and has been driven by the regional agrifood research and other bodies, local and regional authorities, and industry.

North Rhine-Westphalia (Germany)

The industrial *North Rhine-Westphalia* (NRW) region in western Germany (17.6 million inhabitants; a cluster in a phase of acceleration with new developing sectors) includes the plastics and chemical sector and engineering. Most marketed biobased products include enzymes for the grain ethanol industry or bulk amino acids produced via fermentation. Several green chemicals and biofuels are in a development phase. Bioeconomy is part of the regional and national government's bioeconomy strategy and has been supported by regional and national government funding. Wood, energy crops, biogenic residues and algae are (limited) biomass options for green chemicals and biofuels. In 2007 the "Cluster Industrielle Biotechnologie 2021" (CLIB2021) emerged as top cluster to transform the chemical industry towards renewable, sustainable resources. The initiative received national funding with additional commitment from the private sector. Today, the cluster – with its more than 100 regional and international partners – aims to initiate R&D cooperation projects that cover the entire value chain. The funding will advance projects on the reutilisation of biomass and material streams from industrial waste gases in NRW, Belgium and the Netherlands. Research institutes and universities in the region joined forces in 2010 to found the Bioeconomy Science Center (BioSC). Today, more than 50 institutes cooperate in interdisciplinary research projects conducted under the virtual roof of the BioSC, which will receive a ten-year period funding from the regional and the national government.

Saxony-Anhalt (Germany)

The *Saxony-Anhalt* region in central Germany (2.2 million inhabitants; a cluster in a phase of acceleration with new developing sectors) has a highly developed chemical industry, plant research and plant breeding companies. Wood and wooden residues are biomass options as a basis for future green chemicals and fibre products. Crops and sugar beets are used for the production of bioethanol. Several green chemicals, fibre products and wheat varieties as well as a second generation biofuel are in a development phase. Future potential for the production of biofuels lies within the utilisation of agricultural residues. The Chemical Biotechnology Process Centre (CBP) was introduced in 2010 with funding from the regional government, the Federal Ministry of Education and Research (BMBF) and the Fraunhofer Society. Within CBP, partners from research and industry develop and scale up commercially relevant biotechnological and chemical processes for the utilisation of renewable raw materials in the chemical industry. CBP also forms the scientific core of the 'top cluster bioeconomy' in central Germany with more than

90 regional partners from industry and science. Since 2012 it has been funded by the BMBF, the cluster's industrial partners, and the regional government with the objective of the production and cascade utilisation of non-food lignin-based biomass from beech trees in order to generate chemicals, new materials and energy. The network connects chemical, paper and pulp, agriculture, forestry, energy and engineering sectors. In addition, it reflects the entire value chain. Besides CBP, cluster partners include several research institutes and companies.

Northeast (Netherlands)

The region of *Northeast Netherlands* includes four provinces (Groningen, Friesland, Drenthe and Overijssel with in total 2.85 million inhabitants) with substantial biomass resources (carbohydrates, grass and wood). Although, there are many chances identified to connect the agrofood industry with the chemical industry and to develop a market for (protein-rich) animal feed, bioplastics and other biobased materials, the bioeconomy is still in the phase of predevelopment. The goal of commercial applications is still distant, and several bottlenecks are identified: lack of shared vision, lack of transparency in chains, lack of resources, and lack of a clear profile as biobased economy region.

Biobased Delta (Netherlands)

Biobased Delta (BbD with 1 million inhabitants in the provinces of Zeeland and the western part of Noord-Brabant; a cluster in a phase of development) in the southwest of the Netherlands was set up as a collaboration of the aforementioned provinces in 2010 that became a foundation in 2014 (the province of South Holland joined in 2014). BbD is financed by provincial funds to promote refining and conversion of biomass to chemicals, including bulk, platform and specialty chemicals, fuels and polymers. BbD combines agriculture, agro-food industry, and chemical industry. Most current biobased products in BbD involve niches. BbD aims to use locally-produced biomass where possible, though imported biomass will be essential for scaling up. As the agro and chemistry sectors historically have little common ground on which to build new, explicitly biobased, activities, BbD organises the common business agenda 'Agro meets Chemistry', in which many R&D institutes and firms in the regions express their willingness to participate in bioeconomy activities. The big companies in this region have the capacity to develop and market new bioeconomy products themselves, while for small companies that lack relevant networks, BbD plays a role in a guiding them getting involved in bioeconomy activities.

Industries and Agro Resources (France)

The *Industries and Agro Resources* (IAR) cluster consists of two regions characterised by a highly mechanized and productive agriculture in northern France: Picardy and Champagne-Ardenne (3.2 million inhabitants; a cluster in a phase of acceleration). In 2004, the Champagne-Ardenne region decided to join up with the Picardy region in the IAR bioeconomy cluster, which is based on a bottom-up approach involving agriculture, industries, regional and national governments and research Institutes. The two regions are major producers of wheat, rapeseed, sugar beet, barley and potatoes, and offer considerable capacity in terms of local biomass resources for the biorefinery to transform biomass (beetroot, wheat, lucerne) into sugar, glucose, starch, nutritional alcohol, surgical spirit, ethanol and active ingredients for cosmetics. Relevant bioeconomy sectors are biofuels, biorefineries, biotechnology, and "green" chemicals. The main competitive products are biofuels, agromaterials, biomolecules, and ingredients.

Food+i La Rioja (Spain)

Food+i is a cluster in a phase of development, which includes companies, research centres and other institutions related to the agri-food sector in the Ebro Valley in the northeast of Spain. The association responsible for the cluster is located in La Rioja (320,000 inhabitants). Traditionally, the agri-food sector (cereal crops, oleaginous crops, fruit crops, vegetables and forage crops) has been an important development driver for the region. Food+i was created in 2009 to explore the potential, create synergies and promote the cooperation in science and technological development among the different actors of the agri-food sector that are based in the valley.

Satakunta (Finland)

The *Satakunta* region on the southwest coast of Finland (225,000 inhabitants; a region with several clusters in an acceleration phase) is an industrialised province with abundant forest resources. In the region there are established businesses in various sectors which are active in different parts of the bioeconomy. The main sectors associated with the bioeconomy are (i) agri-food production and processing and (ii) power generation, including the production and utilisation of bioenergy supported by a considerable amount of forest- and agri-based raw material. There is also R&D on biorefineries, exploitation of forest resources, cleantech, and environmental and energy technologies. The bioeconomy is extensively covered by major strategic documents developed by the Regional Council of Satakunta, which provides the general regional policy framework, articulates long-term development goals and coordinates regional strategies. According to the regional rural development strategy bioenergy production serve as national examples of energy use in primary production, industry and housing.

Västra Götaland (Sweden)

The region *Västra Götaland* on the west coast of Sweden (1.6 million inhabitants; a cluster in an acceleration phase) prioritises the development of sustainable energy and biogas, green chemistry and green industries, sustainable urban development and transport. The region is a world leader in biogas production, and has industries to increase the production and use of renewable energy and bio-based products further. Västra Götaland has the petrochemical industry and a large chemical and materials cluster in Stenungsund, which involves cooperation between business, universities and the public sector actively working towards a fossil-free region. In 2010, Stenungsund's five major chemistry companies formulated a vision for Sustainable Chemistry 2030 to become fossil free, regarding both energy supply and raw materials. Oil and gas are to be replaced with biomass from agriculture, forestry, the sea and waste. Although companies share goals, cooperation is not based on formal contracts. Västra Götaland is seen uniquely suited to steer development in green chemistry and bio-based products cluster by leading representatives from policy, research and business. The development of green chemicals is supported by several regional strategic documents.

Ghent Bioeconomy Valley (Belgium)

Ghent Bioeconomy Valley (GBEV) located in northwest Belgium in the province Flanders (1.4 million inhabitants; a cluster in an acceleration phase). The awareness and commitment of the local authorities have all been strong assets for the development and successful operation of GBEV, which concentrates on energy (bioenergy, biofuels) since 2005. The cluster is within close proximity to the port of Ghent and has strong infrastructures for biomass supply options that include both local supply and imports. The cluster was founded through a public-private partnership between the university, city, and port of Ghent, the development agency East-Flanders and a number of industrial companies. The initial phase was based heavily on efforts and strong personal commitment from Prof Soetart and his immediate collaborators, while there was no public funding. At a later phase, GBEV applied successfully for competitive, project-based research funds. The most helpful policy drive for GBEV has been the EU target for liquid biofuels and the implementation of the Renewable Energy Directive. As a consequence, two biodiesel companies have been established and grown. Moreover, this success attracted attention and support from government and public funds. In 2008, GBEV obtained a legal identity becoming a non-profit organization, supporting all biobased activities, including bioenergy.

4.2 Current situation of clusters and participative governance

The bioeconomy clusters that are still in a phase of predevelopment (Stara Zagora, Northeast Netherlands) hardly showed any form of collaboration and main actors that are fundamental for chances of participative governance. For this reason these clusters in predevelopment phase are less interesting for BioSTEP and have been omitted in this section where we picture the current situation of the clusters and pay attention to experiences with participative governance.

Veneto Porto Marghera bio-refinery (Italy)

Eni (mainly businesses) in the region of Veneto and its subsidiary Eni Trading & Shipping have implemented a procurement scheme for palm oil, which only procures oil that is ISCC certified (International Sustainability & Carbon Certification, one of the voluntary schemes recognized by the European Union)¹². Eni intends to gradually introduce the use of second and third generation feedstocks in biofuels. A Memorandum Of Understanding (MOU) is aimed at re-launching the petrochemical complex to become an integrated hub of green chemistry, and is based on the partnership with the American company Elevance Renewable Sciences (for the technology). Additionally, initiatives have been defined to collaborate with public sector waste collection companies operating in the Venetian mainland to increase the collection of used household oil as a feedstock for the biorefinery to be returned to the municipal companies for use in their collection vehicles.

The Lombardy Green Chemistry (Italy)

In the *Lombardy* region, the four founding members of LGCA who currently form the Steering Committee are: Innovhub SSI, Italbiotec, Milan Polytechnic and Milan University. They are consulted in defining the regional initiatives supporting research, development and innovation, participate in programs co-financed by public funds and play an important role in representing the Lombardy interests at national and European levels. The Lombardy Region supports additional and functional activities for the start-up and development of regional clusters by allocating annual funding to each of them (and also the LGCA).

Norwich Research Park (UK)

In *Norwich*, with the support of national, regional and local government bodies and other partners, the strategy “Greater *Norwich* City Deal” was produced in 2013. Among many actions planned to increase economic growth in the region, the strategy aims to generate new high value jobs in NRP, to increase the number of businesses and to attract further private-sector investments to the area. The strategy indicates that the UK government is committed to support further development of the cluster through its different departments and agencies. NRP’s core is made of six partner institutions. Three of them receive strategic funding from the BBSRC. The main actors work collaboratively in integrated and multidisciplinary teams including the businesses located in the cluster (mostly small and medium-sized enterprises) to contribute to achieving the different objectives of NRP.

In *Norwich Research Park* (NRP), buildings are frequently used as spaces for exhibitions and free events. Recently, NRP welcomed students to attend the New Anglia Local Enterprise Partnership’s innovation event (iEXPO 2015) and has also launched an Image Library Competition to showcase the work of researchers, clinicians and scientists. While NRP mainly engages with publics directly through communication and dissemination activities, indirect engagement with representatives of the civil society can be expected from the governance structure set by regional and local strategies to boost the development and growth of the region where the cluster is inserted.

York Biovale (UK)

The BioVale cluster in *York* is supported by the YNYER Plan for Growth and its LEP Strategic Economic Plan for further business creation and investment, as well as the upgrading of related infrastructure. Implementation of the LEP strategy – in line with the ‘smart specialisation’ approach – with regards to the bioeconomy involves different funding sources, including from businesses, local government and universities. The UK central government supports YNYER priorities. Internationally, the BDC and UoY have helped facilitate a MOU between BioVale and IAR in France, as well as with similar clusters in the Netherlands and in Germany. The LEP includes business representatives, who play an important role in helping to set local economic policy priorities. Regional bio-based firms include food and drink businesses (e.g. Nestlé, McCain, Quorn and Mars), speciality chemical companies (e.g. Croda, Seven Seas, Reckitt Benckiser and

¹² For an evaluation of the ISCC and other biofuel certifications schemes, see Natural Resources Defense Council (2014), “Biofuel Sustainability Performance Guidelines”, available online at <http://www.nrdc.org/energy/files/biofuels-sustainability-certification-report.pdf>

AAK), biofuel production facilities (Vivergo and Brocklesby), biomass-fuelled power stations at Eggborough and Drax, and agri-businesses (e.g., Cargill, Syngenta, Frontier, AB Agri, Precision Decisions). The R&D base includes several research bodies and institutes.

The development of the LEP Strategic Economic Plan also involved engagement with stakeholders in the voluntary and community sector. However, the results of the BioVale stakeholder consultation indicated that there was weak communication between the cluster and end-users, and that this could limit end-users' understanding of the potential of the bioeconomy sector. Neither the LEP strategic documents, nor the BioVale Vision foresee a specific role for civil society networks in the regional bioeconomy, which is mainly business- and R&D institutions-driven. In addition, it is possible that there were no (sufficient) efforts at translating the concept of 'bioeconomy' into messages understandable for and popular among the public.

North Rhine-Westphalia (Germany)

In *North-Rhine Westphalia*, the regional government issued a regional bioeconomy strategy to promote cooperation within the triple helix. The government massively supports the BioSC, the CLIB2021 cluster as well as other bioeconomy related regional networks to enhance an intensive involvement of the humanities and social sciences for the development of "good standards" for the bioeconomy. International cooperation between NRW and its neighbours, Belgium and the Netherlands, are equally important. NRW is home to several universities and universities of applied sciences as well as non-university research facilities, which contribute to the bioeconomy. Additionally, large and small companies are important players (Bayer CropScience, Henkel, BASF and Monsanto). Within the Cologne-based German Seed Alliance, four market leading plant breeders joined forces in research, development and sales. In addition, NRW hosts around 90 biotech companies. Furthermore, more than 1200 biomass plants are located in NRW.

In *North-Rhine Westphalia* (NRW) the main activities of the stakeholders concentrate on the further establishment of cooperation's between governments, R&D institutions and businesses and educational offers. Above all, issues related to plant biotechnology have become a highly discussed topic in Germany and since 2010, when the Green Party became part of the regional government, have become a major point on the political agenda in NRW.. Today, the use of genetically modified plants is not supported by the state government's bioeconomy strategy.

Saxony-Anhalt (Germany)

In *Saxony-Anhalt* the government issued a regional innovation strategy to promote cooperation within the triple helix. The region produces most of German bioethanol and has benefited from the bioeconomy-related initiatives of the federal government and the national research strategy BioEconomy 2030. Saxony-Anhalt is home to two universities, and seven universities of applied sciences. Large world-leading as well as small companies are important players within the regional bioeconomy related to crops (Bayer CropScience, CropEnergies Bioethanol GmbH, KWS and Cargill). The French-German Global Bioenergies Corporation began the construction of an industrial demonstration plant on the site of the Chemical Biotechnology Process Centre (CBP) to transform renewable raw materials into the hydrocarbon isobutene. The region is also home to Germany's largest pulp factory and several companies utilise wood as raw material. Furthermore, more than 100 biogas plants are located in the region and a wide range of smaller companies are active in agrobiotechnology or traditional plant breeding.

The Science Campus Halle In *Saxony-Anhalt* aims to initiate a dialogue between scientists and to promote educational advertising of politics and public on the importance of plant production and the opportunities for plant-based bioeconomy. The main activities of the stakeholders aim to strengthen the educational basis to further enlarge the regional bioeconomy cluster. Above all, issues related to plant biotechnology are a highly discussed aspect within the region, which is also a result of the widely spread criticism with regard to genetically modified (GM) crops in Germany as a whole.

Biobased Delta (Netherlands)

In the Netherlands, the *BbD* initiative is mainly led by governmental bodies that try to create the preconditions for the development of business, human resources and a good infrastructure of top locations. The triple helix of the *BbD* includes governmental bodies (the provinces Brabant,

Zeeland, and Zuid-Holland, in particular the economic departments, the regional development companies and some municipalities). The regional policy is supported by the national policy, but not financially. Furthermore several knowledge institutes and expertise centres are included (e.g. Technical University of Delft, Center of Expertise Biobased Economy Breda; Green Chemistry Campus in Bergen op Zoom). There are strong collaborations with the University of Ghent. Companies of all sizes are already included in the agro and chemistry sectors, such as farmers in their sector organisation ZLTO. Large companies like Royal Cosun (sugar beet), Cargill (mostly wheat), Lamp Weston Meijer and McCain (both mostly potatoes) are important innovators for non-food applications. Many of them are direct members of the BbD. Furthermore, port authorities are included. The provincial environmental NGO ZMF creates some urgency to use less fossil fuels. BbD signed a MOU with IAR for further collaboration.

In the *Biobased Delta* some urgency has been created in a wider sense to use less fossil fuels. The provincial environmental NGO ZMF (Zeeuwse Milieu Federatie) has bilateral contacts with the biggest chemical company DOW to enhance more carbon neutral innovations. Furthermore, the ZMF aims to get a more environmental friendly economy in the Zeeuwse-Vlaamse kanaalzone.

Industries and Agro Resources (France)

The *IAR* cluster unites stakeholders from research, education, industry and agriculture around a shared goal: to optimize added value from biomass. It has 250 members, including major corporations, SMEs, start-ups, universities, and local authorities. 64% of IAR's budget is financed by the French government and the Champagne-Ardenne and Picardie regions. The remaining 36% comes from private funding. Over the next ten years, the French government will provide one third of the total cost of the PIVERT project in Picardy, which focuses on the development of third-generation biorefineries for the added-value use of oil seed crops and forest biomass in a range of applications. Relevant bioeconomy R&D institutes and educational organizations are the French National Institute for Agricultural Research, AgroParistech, Ecole Centrale Paris, University of Reims Champagne-Ardenne, Université de Technologie Compiègne, CER-Ensam, etc. The IAR rewards companies that have developed an innovative bio-based product. The IAR cluster has signed several MOUs with neighbouring countries (e.g. BioVale & BbD), and is globally well connected and has established partnerships in several countries.

Food+i La Rioja (Spain)

Food+i supports agri-food businesses and liaise with research centres and government bodies to promote the development of collaborative projects between these actors (businesses). It aims at fostering knowledge transfer, the creation of spin off and start-ups, and at establishing regional, national and international networks. The cluster is mainly a technology platform since it coordinates collaboration between research institutes and companies in the Ebro region. However, it is not a cluster where partners are concentrated in a very specific location and are very close to each other. The cluster's strategy is supported by the Spanish Association of Innovative Companies, the Spanish Ministry of Industry, Energy and Tourism and the European Regional Development Fund. The cluster counts more than 80 partners and is working on attracting more companies and research centres to expand its portfolio of projects and services.

Satakunta (Finland)

The regional council of *Satakunta* is responsible for coordinating regional strategies in cooperation with municipalities and other public and private actors. Key business support organisations are: Prizztech Ltd, the largest public business development company in Finland, which is owned by Satakunta's municipalities and has a strong focus on renewable energy technology; ProAgria Satakunta, which provides services and know-how to rural businesses, including in the agriculture, food and bioenergy sectors; and ENTER, an association which supports start-up businesses in the region. In the biomass/biofuel sector, some firms are located on the Peittoo recycling park, other forestry-related businesses are situated on the Lakari logistics and industrial near Rauma. In the food production/processing sector, two key entities are the Satafood Development Association and the Pyhäjärvi Institute, both of which work with a range of businesses and other associations. Satakunta does not have an independent university, but higher education is provided by the University Consortium of Pori (a network of four universities).

Satakunta also has a university of applied sciences, and local research centres which work in close connection with business.

Satakunta's regional strategic plan was prepared through a bottom-up process involving up to 2000 participants, and including the following methods: street polls, forums for youth, interviews among unemployed people, children's crafts, internet inquiries and stakeholder/expert workshops. Similarly, the plan's implementation involved social and cultural societies, local action groups and residents'. In addition, consultations with regional stakeholders and the public were involved with the strategic choices of the Regional Programme. The draft Climate and Energy Strategy was presented at four public events and was open to public comment. Two overarching themes of the core regional strategies ("Encouraging community" and "People-oriented solutions") aim to increase the ability of local people to participate in regional decision-making, planning and implementation activities.

Västra Götaland (Sweden)

Cooperation between actors from industry, academia and the public sector is an important part of the Sustainable Chemistry 2030 vision and the chemicals cluster in *Västra Götaland*. Cluster members include business actors, public actors, research and educational institutions with strong environmental profiles. Environmental organisations are present, some of them are concerned with green chemicals-relevant activities. Moreover, strong synergies across bioeconomy sectors are actively promoted, i.e between chemicals and forestry for the exploitation of forest-based second generation biofuels. The cluster's strength is seen to lie in interactions between the chemical, energy, recycling, pulp and paper and forest industries, as well as cooperation with customers in the automotive, textile, pharmaceutical and packaging industries and with engineering companies. Major funding sources for green chemicals projects and the cooperation for Sustainable Chemistry initiative include the ERDF and EU research and innovation funding in tandem with regional and national funding as well as from businesses.

Regarding participative governance, actors in social economy and community mobilisation are seen important for strategy implementation according to the *Vastra Gotaland 2020* strategy. Some bioeconomy-related projects have taken into account the views of user groups and various societal actors. For instance, the Green Chemistry project encouraged interaction between manufacturers and users to promote environmentally friendly alternatives to a range of chemical products. Societal actors were also seen important in the long-term planning of a sustainable energy system within a large research project carried out jointly by Chalmers University and Göteborg Energi, which explored the design of indirect gasification for green syngas production and integration into existing systems. Moreover, as noted by the EU-funded PLACES project (www.openplaces.eu), Stenungsund's focus on regional development via innovation in local chemical industries has also aimed to change public perceptions of and engagement with this sector.

Ghent Bioeconomy Valley (Belgium)

In *Ghent*, GBEV's activities include collaborative programmes, joint initiatives and synergy creation between the partners in the fields of research & development, structural measures and policy, logistics and communication towards the general public. Throughout its operation, GBEV benefited from both public and private funds. GBEV took advantage of the favourable legislation for biofuels at EU level, combining existing capacities and enabling the development of large scale biodiesel plants through a strong cluster organisation from the beginning, with the leadership being experienced both in academic and industrial research. Though the focal activities of bioenergy and biodiesel have reached the stage of acceleration, crossover interactions with the chemicals & polymers and textiles to develop new economic value chains have only started. A partnership with BiotechCorp, the lead development agency for the biotech industry in Malaysia, has been set up by GBEV to broaden its outreach. GBEV has mainly an active participation of big industrial companies, but has not been very effective in stimulating SMEs or start-ups.

4.4 Overview of case studies

The overview in Table 2 presents the bioeconomy sectors that were involved in each case study region and the development phases of each concerned sector. It shows a wide variety of cluster experiences with sectors/regions either in a still (pre)development phase as well as other regions in a phase of acceleration. The bioeconomy sectors biofuels, “green” chemicals, and food & feed additives are reported most frequently. In most cases, regions within a (pre)development phase are agriculture-based and hence show the importance of food and feedstock connected to the bioeconomy sector. Contrary to this, regions already in a phase of acceleration are often fossil-based and try to transform themselves further into a green chemical hub and bio-refineries. An exception to the latter are the region of Lombardy that already started from an eco-innovation perspective and the Picardy and Champagne-Ardenne cluster that took advantage of their abundant agri-based resources.

Table 1: Bioeconomy sectors by case study region and development phase (Predevelopment (P), Development (D), Take-off (T) or Acceleration (A))

Region	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Bioeconomy sector														
1. Biofuels	P	T	A		D	D	A		D	A		A	A	A
2. Bioplastics			T	T		D		P						
3. Industrial, aircraft parts														
4. "Green" chemicals		T	D	T	D	T	D		D	A			A	
5. Lubricants			D											
6. Personal & home care				T		A								
7. Fibre products			A				T		D					
8. Food & feed additives			A		D	A		P			T	A		

Regions: 1. Stara Zagora (Bulgaria), 2. Veneto Porto Marghera bio-refinery (Italy), 3. The Lombardy Green Chemistry cluster (Italy), 4. Norwich Research Park (UK), 5. York Biovale (UK), 6. North Rhine-Westphalia (Germany), 7. Saxony-Anhalt (Germany), 8. Northeast (Netherlands), 9. Biobased Delta (Netherlands), 10. Industries and Agro Resources (France), 11. Food+i La Rioja (Spain), 12. Satakunta (Finland), 13. Västra Götaland (Sweden), 14. Ghent Bioeconomy Valley (Belgium)

Biomass resources and biofuels

In some regions the availability of biomass resources has been rated “low” with the urgency to improve it (Veneto), while in other regions biomass resources have been rated “high” thanks to eco-innovation (Lombardy, Satakunta), and abundant agro-resources (IAR). Furthermore, in some regions the availability of resources has not been discussed with the public due to the use of first generation biofuels. It should be kept in mind that the first generation of biofuels may create a bad image, while the stakeholders actually aim to gradually/incrementally transform their use of resources in advanced generation biofuels (BbD, Västra Götaland, Ghent Bioeconomy Valley). Several regions reported procurement for biofuel resources (Veneto, Saxony-Anhalt, Ghent Bioeconomy Valley).

Constellation of the clusters

While it is quite evident for large companies to join a cluster in a development phase, this has been less the case for small and medium sized enterprises, which are more interested to be included in a take-off or acceleration phase. A number of clusters manage to organize the cluster as a bottom-up process (York Biovale, North-Rhine Westfalen, Saxony-Anhalt, Biobased Delta, IAR, Food+i, Västra Götaland and Satakunta). In other regions, bioeconomy clusters were set up mainly by business sectors and R&D institutes (Ghent Bioeconomy Valley), business sectors and policy makers (Veneto, Lombardy) or (public and private) R&D institutes and policy makers (Norwich Research Park).

Collaboration actors and participative governance

With the exception of Veneto, governments, businesses and research institutes collaborate on the development of the regional bioeconomy. Civil society is hardly involved. Only few examples of concrete activities for open dialogue could be identified. Considering the main assets (entrepreneurs, policymakers and supportive bodies, bioeconomy R&D institutes and educational organizations, consumers and civil society networks, biomass resources, and market) consumers and civil society networks have been rated low in all case-study regions. In fact, currently public participation would be seen more and more as a potential obstacle to these mostly top-down processes of bio-based innovation and/or re-industrialisation reported. In some case-study regions the dialogue with civil society and consumers is more science and local development driven (Norwich Research Park, York Biovale, Satakunta) to show the education and employment opportunities. In other case-study regions the dialogue with civil society and consumers is more “inspired” by business sectors and policies to discuss their impacts on the use of renewable resources in order to get a license to produce (North-Rhine Westfalen, Saxony-Anhalt, Biobased Delta, Vastra Gotaland).

5. Conclusions and discussion

5.1 Public engagement is there, but just starting

BioSTEP aims at promoting stakeholder engagement and public awareness for a participative governance of the bioeconomy. This broad perspective on participative governance implies that stakeholder and public engagement can be facilitated through information transmission, consultation and more deliberative practices (participation). The results of our study, initially based on desk research only, suggest that initiatives for participative governance in the bioeconomy are rare and that most of these initiatives, particularly on a regional level, tend to focus on information transmission that is featured by one-way communication. However, this rather overwhelming conclusion is also an outcome of the limitations of the approach adopted in the study. This means that we might have been unable to grasp other forms of undocumented engagement activities. More robust conclusions on experiences with public engagement by these clusters would therefore depend on in-depth analyses of empirical data gathered, for example, through interviews or other forms of consultation with key actors. For now, we will draw some conclusions assuming that the picture resulting from our study renders by and large the actual situation, though it is possible that we need to adapt this picture when our insight into participative governance in the bioeconomy progresses.

- The examples of participative governance within *national bioeconomy strategies* are interesting because they indicate explicit strategies and guidelines that encourage public participation. These strategies are therefore easier to trace and this also applies to the main actors that are involved. Particularly interesting is the interplay between (inter)national organizations and regional stakeholders and the evolvement of interlocutors that align national and regional strategies. In the case of our clusters, The Lombardy Green Chemistry Association (Italy), the Norwich Research Park (UK), the Chemical Biotechnology Process Centre in Saxony-Anhalt (Germany), and the Ghent Bioeconomy Valley (Belgium) can count as examples in this direction, playing a considerable role in the promotion of the biobased economy within countries. However, our results indicate that the involvement of other publics (e.g. civil society) in the bioeconomy has just started.
- More complex is the matter of participative governance at the level of *regional bioeconomy strategies*. Clear strategies for public engagement are missing or might not be publicly available. Moreover, the rationales and designs of activities in this context seem to be limited to a one-way flow of information, i.e. from stakeholders to the public, aimed at increasing public awareness of the potential benefits of the bioeconomy. The involvement of civil society, in an active way, is still in its infancy. In sum, the activities aiming at participative governance in regional bioeconomy strategies are limited both in number and in terms of their main objective, i.e. that of raising public awareness by providing information. Nevertheless, attempts and several intentions to move towards participative governance can be identified.
- At the level of regional bioeconomy strategies the following examples of concrete activities for open dialogue could be identified: Biobased Delta in the Netherlands, in Finland, Västra Götaland in Sweden, and (more indirectly) Norwich Research Park in the UK (through regional and local development strategies that can be linked to bioeconomy). Whereas Satakunta and Götaland were in the development phase of Acceleration, Biobased Delta and Norwich Research Park were respectively in the phase of Development and Take-off. Several case studies that we assessed as Take-off and Acceleration did not reveal activities of public engagement. So, a later phase of cluster development cannot be related in a linear way to a higher level of participative governance. Such a socio-technical ‘innovation law’ could not be established, and this is something to take into account for the further development of the national and regional case studies that will be developed in BioSTEP.

5.2 Discussion: TIS, or something more?

The question arises whether the TIS approach we followed in our assessment of national and regional bioeconomy strategies is able to capture participative governance sufficiently. Indeed, the key processes/functions that are at the heart of TIS are useful categories to explore bioeconomy clusters and can serve here as a heuristic tool, triggering our sensitivity for the networks and social processes that can be hidden behind structures and policies, including the involvement of societal actors. The fourth and seventh function of TIS, 'guiding search' and 'lobbies, support from advocacy coalitions', do not exclude the involvement of consumers or civil society. But as we already noticed in section 2.2.5, TIS fares less well in grasping societal controversies and different underlying stakeholder perspectives, because its focus still lies on economic stakeholders. For the further development of the national and regional case studies we need an approach that goes beyond the surface of public engagement. An important issue to consider here is how stakeholder and public interaction could be started in clusters that only show prototypes of public engagement.

We agree with Breukers et al. (2014) that the TIS approach has heuristic value, but that something more is needed for bringing into scope the whole dimension of public engagement – particularly the more interactive forms of engagement that exceed information transmission. It is a well-known fact that one-way communication that focuses on the benefits of new technologies does not always work to gain public support (see e.g. Stenekes et al., 2006; Flynn and Bellaby, 2007; Gupta et al., 2012). In fact this can even lead to scepticism and distrust. Interaction with a broad group of stakeholders and publics is critical to increase mutual understanding, also about value conflicts that may be difficult to solve. Therefore, the challenge is to combine TIS with a participatory stakeholder dialogue methodology that can facilitate deliberative practices. In Deliverable 2.4, where we take a closer look at the actors and network activities in the bioeconomy domain, we will return to these issues and also consider tools that can open up debates with the publics and/or with Civil Society Organisations. Such tools could be meaningful or even necessary for the further work in BioSTEP.

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Annex I. Case study papers

1. Stara Zagora region (Bulgaria)

Region

Stara Zagora is situated in the central part of Bulgaria. The region is included in the BioSTEP project to share and observe experiences from the development of bioeconomy sectors and clusters in other countries. The experiences will be used in WP6, which concerns Stara Zagora as a living lab. Currently Stara Zagora does not have a developed regional bioeconomy cluster.

The geographical position is one of the competitive advantages for the enterprises in the region: Highways, first class roads and railway lines cross the region. The tracks of three European transport corridors cross here.

Figure 1.1 Location of Stara Zagora Region



The Stara Zagora region comprises 11 municipalities with Stara Zagora (capital), Kazanlak, Radnevo, Chirpan, Gulabovo, Pavel Bania as the main cities. In 2015, the region has a population of 355,176 inhabitants.

Main sectors

The energy sector contributes significantly to the leading role of Stara Zagora in the Bulgaria's economy. Stara Zagora has good communications and infrastructure allowing the use of natural gas as an energy source of the main production enterprises. The largest deposits of lignite on the Balkan Peninsula are on its territory. They are used as raw material for the production of electricity from four thermal power plants.

The fertile farmlands, forests and springs are important natural resources of the region. The mild climate and rich soil are favorable for producing varied strains of agriculture. Cereals, sunflowers, cotton, and vegetables, as well as fruit orchards and grapevines are grown mainly in the southern plains. Roses (in the Kazanlak and Pavel Bania municipalities to obtain high-quality rose-oil to

export for the world market), lavender, mint and valerian are produced in the valley to the north. Of the total 210,000 hectares, arable crops occupy 80,000 hectares (mainly wheat), oil-seed sunflower areas 42,000 hectares, orchards 8,000 hectares (mainly plums, peaches and cherries) and vineyards 4,500 hectares. The large pastures in the plains and foothills are conducive for superior cattle and sheep breeding. Cattle breeding for milk production is an important part of the Region's agricultural sector.

The biofarming development lays down in the Stara Zagora strategy for development. Plants for biodiesel, derived from the processing of sunflower seeds will be built in the municipal center of Opan by a local company. The land around Opan is suitable to produce biofuel feedstocks.

Stakeholders

Stara Zagora's Thracian University (established in 1995) has animal-nutrition, veterinary-science, and agro-economics programs and research activities. One of the important faculties is agriculture with an experimental station and accredited scientific specializations of genetics, biochemistry, microbiology, and reproductive biotechnologies. Academicians were involved in the development of a national strategy for sustainable agricultural development. The Institute for Cattle and Sheep Breeding Research enhances livestock production. Chirpan's Research Institute of Wheat and Cotton has developed new strains of wheat and cotton grown worldwide. Kazanlak's Institute of Roses conducts research in the field of roses and other extracts for the fragrance, pharmaceutical, and herbal industries. The main local authorities are the regional administration of Stara Zagora and the municipality of Stara Zagora. The main business associations are the Industrial Association of Stara Zagora and the Chamber of Commerce of Stara Zagora.

2. Veneto Porto Marghera bio-refinery (Italy)

Region

Veneto is a region in the northeast of Italy (4.9 million inhabitants). The region has airports, a developed road and rail network and four ports (Lido-San Nicolò, Malamocco, Chioggia and Venice). In 2013 Veneto had 225 biogas plants, 172 biodiesel plants and 29 biomass plants and their total installed capacity is 349 MW (statistica.regione.veneto.it), 12% of the energy consumption comes from renewable sources of energy (biogas and biomass, fotovoltaic, hydropower)¹³.

Figure 2.1 Location of Veneto



History of the bioeconomy cluster and current situation

The Veneto petrochemical complex has always been concentrated in the resort of Porto Marghera, Venice. It was created in 1917 and became one of the most important chemical poles of Europe. In 1971 the industries touched the all-time record of employees (35.724), but soon they began a slow but progressive crisis¹⁴. This crisis has continued in the next years, even for serious damage to the health of workers as well as for environmental problems.

Among the many projects for the industrial areas requalification, the Eni case (www.eni.com) represents the first step towards the establishment of a green chemical hub. To address the challenges presented by the crisis, Eni identified the opportunity to reuse the catalytic hydrodesulfurization section in the Porto Marghera refinery, reconfiguring it into a biorefinery using a patent filed by Eni in 2012. In 2014, the startup of the bio-refinery of Porto Marghera was achieved with green diesel produced from refined vegetable oil using the Eni technology (EcofiningTM). The production will fulfill half of the Eni's annual requirement of green diesel, and

¹³ http://www.arpa.veneto.it/temi-ambientali/energia/file-e-allegati/BER_ARPAV.pdf

¹⁴ <http://www.internazionale.it/reportage/2015/06/04/porto-marghera-piano-rilancio>

will be used by Eni in order to comply with the European regulations on the minimum bio content in fuel (10% by 2020). The main final product is a high-quality diesel with increased efficiency owing to reduced residues build-up in the combustion chambers. Eni intends to gradually introduce the use of second and third generation feedstocks.

This is the first bio-refinery in the world reconverted of traditional refineries. The reconversion at the Porto Marghera site (90 kilotonnes of biodiesel produced in 2014) entailed investment costs that were much lower than building a new refinery. The site has been integrated into the local context and its reconversion has the full support of local economic players since it has made it possible to keep employment at pre-crisis levels. The process used and the final product are made possible by applying innovative technological solutions, i.e the proprietary Ecofining™ technology under development since 2005 in partnership with the American company Honeywell-UOP . This technology allows for broad flexibility with regard to the biological feedstocks to be used as raw materials, which can be made up of various types of oil-based biomass: vegetable oil, second generation feedstocks (animal fat, used cooking oil) and advanced feedstocks (for example, oils from algae and waste, lignocellulose material, etc.).

Main actors, cooperation and funding

Eni and its subsidiary Eni Trading & Shipping have implemented a procurement scheme for palm oil, which only procures oil that is ISCC certified (International Sustainability & Carbon Certification, one of the voluntary schemes recognized by the European Union)^{15,16}. The agreement, signed in 2014 by Eni and Versalis with institutions and the trade unions, foresees the creation of new plants for the production of high-performance products for use in oil drilling and high value-added segments of the market, such as detergents and bio-lubricants. The project will involve the people of the plant, working closely with the Versalis research centres in Mantua and Novara and technicians from Elevance Renewable Sciences, the US-based company specialised in high value-added products made from vegetable oils.

The Memorandum Of Understanding (MOU) for Porto Marghera is a confirmation of Eni's commitment in Italy to the transformation of facilities operating in sectors that are no longer competitive into sustainable projects able to generate profitability, with the maximum attention to the population and the territory (www.eni.com). This MOU aimed at re-launching the petrochemical plant in Porto Marghera, which will become an integrated hub of green chemistry. The production is the result of a partnership with the American company Elevance Renewable Sciences, which will provide part of the technology. The overall investment, taking into account the operational restructuring, amounts to around 200 million euros. During the first semester of 2015 the first industrial test of second generation feedstocks was carried out (used national vegetable oils, www.eni.com).

Additionally, advanced progress for industrial restructuring and the creation of new opportunities has been made on the definition of initiatives to collaborate with public sector waste collection companies operating in the Venetian hinterland, in order to increase the collection of used household oil and use said oil as a feedstock in the biorefinery. The green diesel obtained in this way can be used to produce fuel with a high bio content, to be returned to the municipal companies for use in their collection vehicles. Thus an integrated and short supply chain is created that maximizes energy use of the locally produced waste oil, which is undoubtedly of benefit to the environment. Consideration is also being given to possibly working with oil-based biomass refineries in order to reuse the waste from said processing, such as distilled fatty acids and glycerine (third generation feedstocks).

¹⁵ <https://ec.europa.eu/energy/en/topics/renewable-energy/biofuels/voluntary-schemes>

¹⁶ For an evaluation of the ISCC and other biofuel certifications schemes, see Natural Resources Defense Council (NRDC) (2014), "Biofuel Sustainability Performance Guidelines", available at <http://www.nrdc.org/energy/files/biofuels-sustainability-certification-report.pdf>

Public participation

Eni Versalis is committed to protection the territory by reducing energy consumption and minimising emissions through the adoption of cutting edge green technologies. And this is why Eni Versalis has signed up to the global “Responsible Care” programme of the chemical industry for the spread and implementation of principles and behaviours to protect the safety and health of workers and respect for the environment. Eni works in partnership with the academic world, civil society, international organizations and other companies to achieve equitable local and global development. However, until now no concrete activities have been reported.

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3. The Lombardy Green Chemistry cluster (Italy)

Region

Lombardy is a region in the North-West of Italy, with a population of 10 million people. The main city is Milano. The region has one of the best airport systems of the nation (4 airports: Malpensa, Linate, Orio al Serio and Montichiari) and also a well-developed road and rail network.

Figure 3.1. Location of Lombardy



Lombardy is the Italian region with greater electricity production from renewable sources, covering almost 20% of national electricity production (www.energialombardia.eu/fer). In Lombardy the total electricity produced from renewable energy sources, both electrical and thermal, is around 2.36 million TOE (tonnes of oil equivalent) in 2012, representing approximately 9.4% of gross final consumption in the region. Compared to 2005, the production from renewable sources has increased by 29.5%, caused by photovoltaic and biogas plants in the electricity sector, district heating in the thermal sector and the increased percentage of biofuels in the transport sector.

According to the percentage distribution of renewable sources, the largest share of energy produced in Lombardy in 2012 comes from hydroelectric production with about 37%. Solid biomasses, in particular those used in small scale installations, follow with about 30%. Worthy of attention is the proportion reached by biofuels, about 11% of the total renewables.

History of the bioeconomy cluster and current situation

The main regional tool to support growth and innovation by leveraging the Green Economy was the *Plan for Sustainable Lombardy* approved in 2010 (Dgr. 11th of February, 2010, n. VIII/11420),

which is a regulatory framework for integrated planning of all areas of regional governance and involves ten general directorates¹⁷.

The eco-innovation theme has a major role in the actions promoted by the agreement between Ministry of Education, University and Research and the Lombardy Region signed in 2010 (DGR n. 1134 23rd December 2010). This agreement has allocated € 20 million to Research and Development for energy and environmental issues, with special attention to the building sector, the development of materials with high thermal-acoustic performances, on-site energy production systems: micro-generation, photovoltaic and concentrated solar power (CPS), systems for converting thermal energy into electricity or cooling and storage systems. In Lombardy, there are high skills and diverse specializations useful to create an eco-innovation and eco-industry chain; existing supply chains (energy and environment) appear rather dynamic, despite the presence of many small companies.

At the end of 2011, with the announcement of the Lombardy Region, the Lombardy Green Chemistry Association (LGCA) was established. This technologic cluster means organized aggregations of companies, universities and other public and private research/innovation bodies. The LGCA has the goal of creating the best conditions for the development of the bio-economy at the regional level, acting as an interlocutor of national and regional authorities. It will concentrate its efforts on the bio-economy in order to create a critical mass, facilitating regional intervention and creating a codetermination system between private and public sector essential to support innovation, maintain and increase the competitiveness of the region. The LGCA-project took off with the biomass producers, such as agricultural and forestry holdings, but also industrial processes (food, textile, paper) and municipal waste managers; and then addressed the chemical companies able to potentially transform these raw materials into substances and products allocated to other manufacturing sectors (food, animal feed, chemical, cosmetic, pharmaceutical, textile); it is important therefore to involve all of these downstream sectors, logistics, plants engineering, energy and all the knowledge centers necessary to advance this new sector (www.innovhub.it/cluster).

Regarding the availability of biomass resources. The Lombardy Region has an important quantity of resources coming from agriculture, forestry (Alps) and waste production. To improve the utilisation of woody resources LGCA has an active collaboration with the Valtellina innovation pole. Lombardy has a well-developed waste management system with a high level of separate collection. In Milan, there is a well-developed system for the collection of organic waste sent to a biogas plant (in the Bergamo Province) that produces biogas and compost.

An important pilot project, focusing on a possible branch of bioeconomy and the possibility to create a sustainable supply chain, is VeLiCa (www.velica.org). VeLiCa - acronym of the words Vegetables Flax Hemp that in Italian are "Vegetali Lino Canapa" - assessed the reintroduction of traditional hemp and flax farming in Lombardy by enhancing their profitability through the integrated and rational exploitation of all biocomponents (fibers, chemicals, energy) obtained by the various parts of the plant. The 5 million euros is co-financed by the regional government and it is prevalently used for formation and education of young people.

Flax and hemp can produce both oil and fiber. Once the more suitable and more productive genotypes will have been selected, the oil obtained from the seeds will be used for the production, through innovative heterogeneous and homogeneous catalytic techniques, of biodiesel, bio-lubricants with high flash point, polyols to be used as intermediate for the synthesis of polyurethanes and other biopolymers. On the other hand, selected enzymes will be used to isolate ω -3 and ω -6 components from the oil thus obtaining valuable oils for the nutraceutical market. By growing the plant till seed maturity a low quality fiber will be obtained, namely technical fiber. This kind of fiber can be used to produce insulating boards, but VeLiCa will concentrate on the production of composites with PET or other plastic materials. This kind of composites are already known and used in the automotive and aviation industry due to their high

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crash resistance and lightness. In this project formulations will be studied suitable for the production of fruits and vegetables crates that will be more resistant, therefore long lasting, lighter, recyclable and more easily disposable with respect to analogous composites with glass fiber¹⁸.

The more innovative part of the project is represented by the exploitation of all the residues of these transformations. The meal, residue of oil pressing, is rich in proteins and therefore a valuable feed. However, the project will look for a new application of protein hydrolysates obtained from such meals. In particular, these hydrolysates as cosmetic ingredients will be tested looking for other bioactive molecules, such as antimicrobial, antioxidants and maybe anticancer agents: flax seeds e.g. are rich in lignans (phytoestrogens) able to slow down the growing of some hormone-dependent tumor. Glycerol, the residue of biodiesel and bio-lubricants production, will be used for the preparation of hyper-branched polymers potentially useful for drug delivery.

Main actors, cooperation and funding

The four founding members of LGCA who currently form the Steering Committee are: Innovhub SSI, Italbiotec, Milan Polytechnic and Milan University, which participates directly with its Agriculture department. The LGCA members will be consulted in defining the regional initiatives supporting research, development and innovation, participate in programs co-financed by public funds and play an important role in representing the Lombardy interests at national and European levels. The Lombardy Region support additional and functional activities for the startup and development of regional clusters by allocating to each of them (and also the LGCA) an annual funding between 50'000 and 100'000 euros.

Public participation

The LGCA aims to increase the participation of enterprises, involving all actors of the bio-economy, namely those using renewable raw materials for the creation of products and energy. Within the LGCA, the thematic groups will make up the operating meeting point between production companies and research institutes, and develop concrete proposals of activities to achieve LGCA objectives. There are no activities with consumers and citizens reported. LGCA in this phase did not look for local support, because the cluster is composed by small and medium enterprises and the investments are so minimal that is not necessary to involve the society for the moment. A communication and involvement strategy will be adopted when the green chemistry cluster will be more developed.

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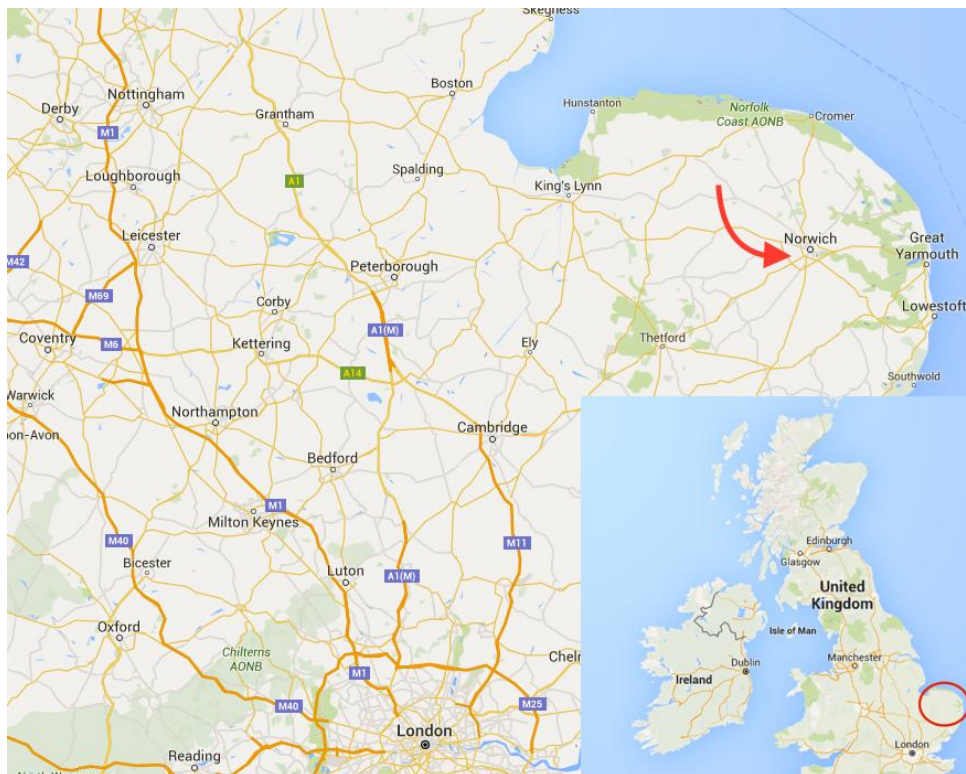
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4. Norwich Research Park (UK)

Description of the cluster

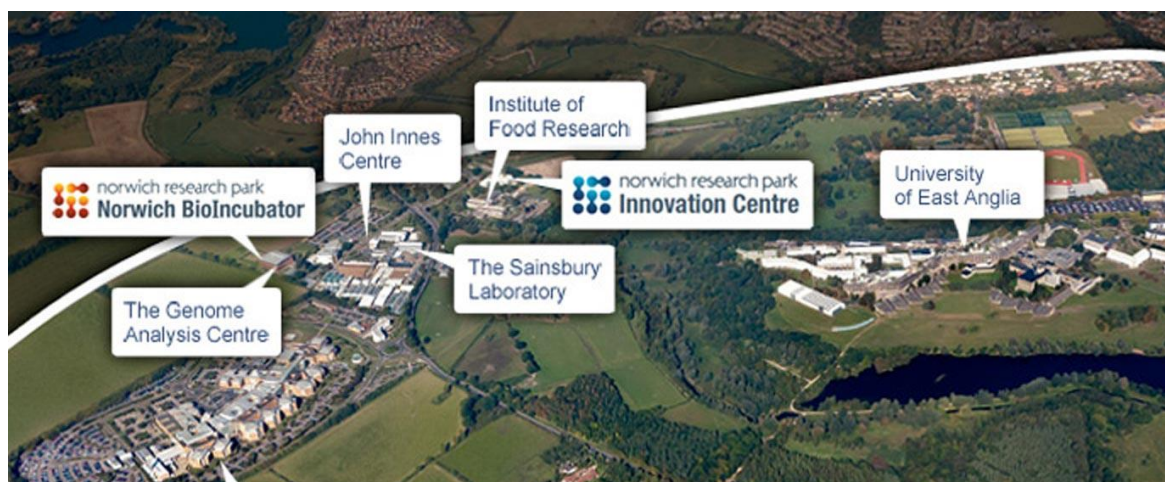
The **Norwich Research Park (NRP)** Cluster is located in the East of England (NUTS1), in the area of East Anglia (NUTS2), county of Norfolk (NUTS3). NRP is situated on the south of the city of Norwich. Norwich has a population of around 130.000 inhabitants and an unemployment rate of 9,4% (Eurostat data, 2012). Currently, about 51% of workers in Greater Norwich, i.e. Norwich and its surroundings, are employed in knowledge intensive industries, being the NRP one of the main catalysts for economic growth in the region (GNCD policy paper, 12 December 2013).

Figure 4.1 Location of NRP



The cluster has been recently pointed out as one of the most “vibrant” regional bioeconomy clusters in the UK and was founded by a partnership between the UK’s Biotechnology and Biological Sciences Research Council (BBSRC), University of East Anglia (public), the Norfolk and Norwich University Hospital (public), the John Innes Foundation charity (private, non-profit) and four independent research institutes (private, non-profit). Currently, about 45 companies are based in NRP and collaborate with the founding institutions. The cluster occupies an area of 230 hectares and hosts over 12.000 people (Figure 4.2).

There is a range of sectors within which actors in the cluster develop their activities. These range from agri-food to renewable energy and the pharmaceutical and medical sectors. According to NRP’s mission and vision, the cluster “aims to deliver solutions to the global challenges of healthy ageing, food and energy security, sustainability and environmental change” (norwichresearchpark.com). Because the scope of its mission is very broad, so are the sectors involved in the activities of NRP.

Figure 4.2 Aerial photo of NRP

History of the bioeconomy cluster

NRP is part of the on-going development of science research in Norwich, which has its roots in the 1960s. It was then when the founding partners of the cluster, i.e. University of East Anglia (UEA), John Innes Institute and the Institute of Food Research began their activities in the site where NRP is located today. It was not until the mid-90s, however, that NRP was established. A few years later, in 2001, the Norfolk and Norwich University Hospital was opened. Other centres and units were added more recently, such as the Genome Analysis Centre, the Norwich Energy Laboratories and the Low Carbon Innovation Centre (norwichresearchpark.com).

In 2011, through an UK government award, the BBSRC invested £26M in the further development of NRP in order to boost economic growth and job creation in the region. The investment aimed at attracting new companies and supporting new infrastructure for the cluster (www.bbsrc.ac.uk).

Current situation

With the support of national, regional and local government bodies and other partners, the strategy “Greater Norwich City Deal” (GNCD) was produced in 2013. Among many actions planned to increase economic growth in the region, the strategy aims to generate 3.000 new high value jobs in NRP by 2020, to increase the number of businesses and to attract further private-sector investments to the area. The strategy indicates that the UK government is also committed to continue to support further development of the cluster through its different departments and agencies (Department for Business, Innovation and Skills, Department for Environment, Food and Rural Affairs, Technology Strategy Board and the 7 Research Councils) (GNCD policy paper, 12 December 2013). Further investment in NRP is also a priority under the first objective (‘enterprise’) of the “Greater Norwich Economic Strategy 2009-2014”, developed by the Greater Norwich Development Partnership (www.gndp.org.uk).

Main actors

NRP’s core is made of six partner institutions. Three of the main actors of NRP are among the institutes that receive strategic funding from the BBSRC. These are the Institute of Food Research (IFR), The John Innes Centre (JIC) and The Genome Analysis Centre (TGAC). The other three main actors responsible for the partnership are the University of East Anglia (UEA), the Norfolk and Norwich University Hospital (NNUH) and The Sainsbury Laboratory (TSL). The different actors work collaboratively in integrated and multidisciplinary teams including the

businesses located in the cluster (mostly small and medium-size enterprises). They all contribute to achieving the different objectives of NRP, being their activities deeply interconnected. There is no evidence of engagement with civil society networks from the literature analysed (focused on activities promoted by NRP as a cluster). However, evidence of engagement activities promoted by the cluster's specific actors could be identified in further research. For involvement of 'consumers', see the next section.

Good governance

NRP buildings are open to the 'publics' and are frequently used as spaces for exhibitions and free events. Recently, NRP welcomed students to attend the New Anglia Local Enterprise Partnership's innovation event (iEXPO 2015) and has also launched an Image Library Competition to showcase the work of researchers, clinicians and scientists. While NRP mainly engages with publics directly through communication and dissemination activities, indirect engagement with representatives of the civil society can be expected from the governance structure set by regional (such as East Anglian) and local strategies (Norfolk and the Norwich area) to boost the development and growth of the region where the cluster is inserted.¹⁹ However, further information would be needed to confirm and characterize this potential engagement.

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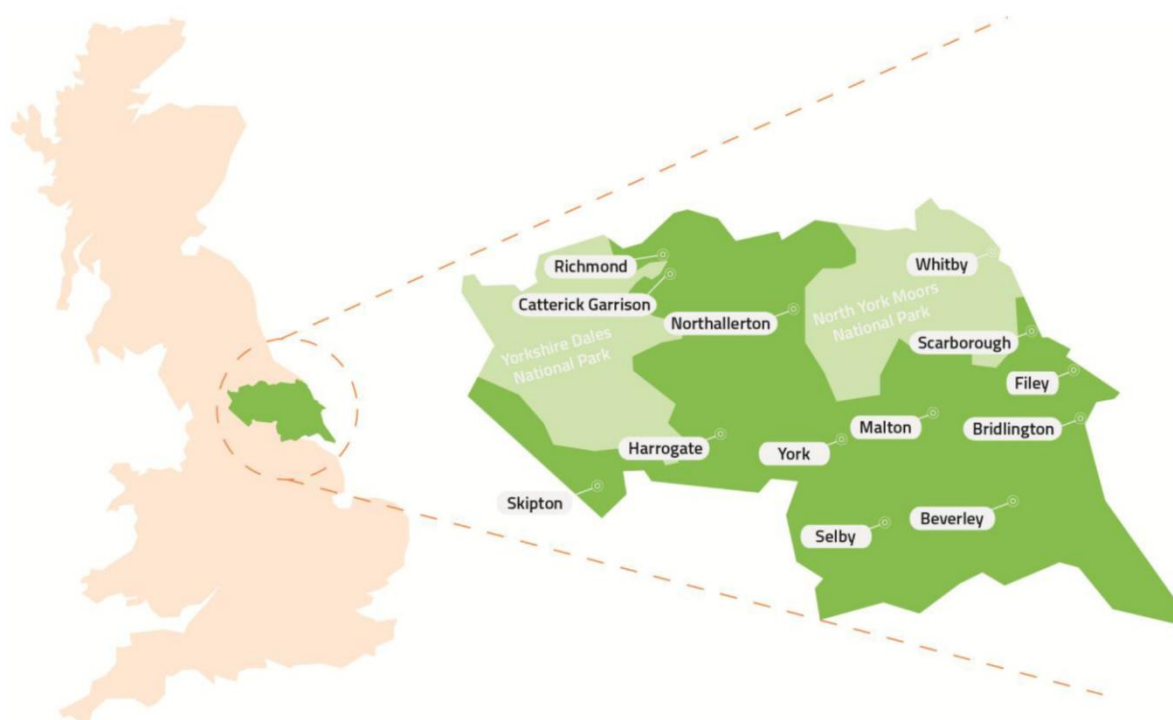
¹⁹ This is suggested in a passage of the 'Great Norwich City Deal' strategy (GNCD, 2013): "The governance structure will ensure local democratic accountability and also include representatives from the New Anglia LEP and the wider scientific, academic and private business interests in the Greater Norwich functional economic area" (GNCD, page 9).

5. York Biovale (UK)

Location and infrastructure

The Local Enterprise Partnership (LEP) Area of York, North Yorkshire and East Riding (YNYER) has a population of around 1.143 million people (ONS, 2014). The region is well-connected to the rest of the UK, with good rail links to Leeds, London, Manchester and Edinburgh. Most businesses are located along the A1/A19 road corridor.

Figure 5.1 Location of LEP



The Strategic Economic Plan of YNYER LEP – which is a partnership between local government and businesses (in the context of a UK government framework for LEPs) aims to support the area to become a national and international centre in food, agritech and biorenewables. The bioeconomy (BE) accounts for 10% of the regional economy - higher than any other LEP area. Around 45,000 people are employed in BE, with c.2800 in R&D (LEP, 2015). The regional BE draws on agri-based biomass and combines food manufacturing, agritech, energy and biorenewables. R&D expertise is in biorenewables and agritech. “Bioeconomy” is a recent concept in the region but relevant businesses and R&D institutions have existed for some time.

Businesses are focused in agri-food, bio-fuels and biomass, bio-based chemicals.²⁰ Businesses selling BE products have different degrees of outreach. Some of them sell their products globally, others mainly target the UK market or are more locally-oriented.

²⁰ Examples of businesses selling bioeconomy products:

1. Biofuel production, e.g.:

- Vivergo (vivergofuels.com): produces bioethanol and animal feed for the UK and EU market. Based in the East Riding of Yorkshire, formed in 2007. (i) One of the largest bioethanol producers in Europe and the biggest in the UK (420 million litres every year), produces enough bioethanol to meet up to one half of the UK’s current demand; (ii) The UK’s largest single source supplier of animal feed, delivers into the market every day enough high protein animal feed to feed c.20% of the UK dairy herd.

- Brocklesby Ltd (www.brocklesby.org): Recycles used cooking oils and fatty acids into products for use in the UK’s *biodiesel* industry. Based in East Yorkshire. Founded in 1997, but established itself as a leader in the

History of the bioeconomy cluster

Regional agrifood sector developments have been accompanied by the creation of research and enterprise bodies. The Stockbridge Technology Centre was launched in 2001 to support technological development in the horticultural industry. The Food and Environment Research Agency (FERA) was formed in 2009 and links agriculture to agritech and biorenewables-based expertise. The Biorenewables Development Centre (BDC) at the University of York (UoY) was set up in 2012 via collaboration between the Green Chemistry Centre of Excellence and the Centre for Novel Agricultural Products. Yorkshire's first Food Enterprise Zone was established in March 2014, helping local food and farming businesses to open and expand.

The BioVale initiative was launched in July 2014 to support the BE cluster. This has been driven by the City of York, the BDC, the Centre for Novel Agricultural Products and the Green Chemistry Centre at the UoY and FERA, in collaboration with industry. Other partners include the YNYER LEP, Leeds City Region, the Humber LEP, Science City York and Askham Bryan College (www.biovale.org).

Current situation

BioVale is supported by the YNYER Plan for Growth and its LEP Strategic Economic Plan (one of the priority areas) to become a global leader in BE and grow the BE sector by 40%, creating a £12 billion industry and 40,000 new jobs by 2025 (LEP, 2014a). Three objectives are “world class innovation in agritech and biorenewables”, “agriculture and food business connected to new opportunities”, and “low carbon businesses”. The cluster's strategy focuses on supporting further business creation and investment, as well as the expansion/upgrading of related infrastructure (especially oriented towards R&D and business start-ups/development). Core BioVale projects include:

- Transformation of FERA into the National AgriFood Innovation Campus York (NAFICY) with the aim of improving scope for business investment and encouraging development in agrifood/agritech.
- The BioHub at UoY, which foresees the expansion of the BDC and creation of a BE Support Centre with business space and open-access R&D facilities focused on biorenewables. It aims to link new SMEs in high-tech industrial biotechnology and agritech with the science base at UoY, and to provide access to finance and business support.

The relevant regional strategy supporting the BE development and the BioVale initiative is the YNYER Plan for Growth, which is comprised of the LEP Strategic Economic Plan, the Local Growth Deal Implementation Plan (which sets out investment needs) and the EU Structural & Investment Funds Implementation Plan. Within this strategy, the focus on the BE sector is pursued in line with the ‘smart specialisation’ approach. In addition, a dedicated vision document for the BioVale cluster (2013) has been developed by the Centre for Novel Agricultural Products,

renewable field more recently. Through collaboration with the Green Chemistry Centre, received “Innovator of the Year Award” for developing processes for converting crude glycerine into commercial products.

2. Power generation from biomass, e.g.: Drax (www.drax.com) (electricity production, electricity sales to business customers and sustainable biomass processing for use in electricity production; responsible for meeting around 7-8% of the UK's electricity demand); Eggborough (biomass co-firing).

3. Chemical industry companies using bio-based raw materials, e.g.: Croda (www.croda.com) (a global leader in natural based speciality chemicals – around 70% of raw materials coming from natural, renewable sources; founded in 1925, headquarters in East Yorkshire; offices in over 30 countries); Seven Seas (www.seven-seas.com) (a leading supplier of vitamins, minerals and supplements in the UK, products also sold in more than 100 countries worldwide; formed in 1934 in East Yorkshire).

4. Food manufacturing: regional food manufacturers (e.g., Wensleydale Cheese (www.wensleydale.co.uk) – North Yorkshire-based, with world-wide sales, stretching to countries such as Kuwait, Singapore, Dubai and Australia (<https://www.linkedin.com/company/wensleydale-dairy-products-ltd>); Quorn – North Yorkshire-based company with a global presence, primarily the UK, Ireland, and the US); international brands with presence in the region such as McCain, Mars and Nestle having global outreach.

5. Agri-businesses, e.g. Limagrain UK Ltd (www.limagrain.co.uk) (part of the international Limagrain Group), a leading producer and exporter of forage brassica and fodder beet seeds, supplying customers in over 25 different countries.

the Green Chemistry Centre and the BDC at the UoY in collaboration with City of York Council and Science City York. It defines the features and opportunities offered by BioVale as an innovation cluster across Yorkshire and the Humber.

Implementation of the LEP strategy, including with regards to the BE, involves different funding sources, including from businesses, local government and universities. UK central government funding supports YNYER priorities e.g. loans and EU grants for infrastructure; finance for coordination and business support; grants for business investment (LEP, 2014a, 2014b).

In terms of international cooperation, the BDC and UoY have helped facilitate a Memorandum of Understanding between BioVale and Industries & Agro-Resources in France, as well as a collaboration agreement with similar clusters in the Netherlands and Germany (involving joint research, facilities sharing and new market development; HM Government, 2015).

Main actors

The LEP includes business representatives, who play an important role in helping to set local economic policy priorities. Regional bio-based firms include: food and drink businesses (e.g. Nestlé, McCain, Quorn and Mars), speciality chemical companies (e.g. Croda, Seven Seas, Reckitt Benckiser and AAK), biofuel production facilities (Vivergo and Brocklesby), biomass-fuelled power stations at Eggborough and Drax, and agri-businesses (e.g., Cargill, Syngenta, Frontier, AB Agri, Precision Decisions; LEP (2014a).

The R&D base in YNYER includes FERA and NAFICY, the Stockbridge Technology Centre, the BDC and two internationally recognised research groupings at the UoY (the Centre for Novel Agricultural Products and the Green Chemistry Centre of Excellence). Bishop Burton agricultural college and Askham Bryan College provide training in land-based disciplines and agritech.

Public participation in the guidance of the search

The development of the BioVale strategy included consultation with stakeholders (between September 2013 and July 2014), including a survey of businesses and public sector organisations, as well as meetings with businesses, academics, Askham Bryan College, the BDC and government representatives (BioVale, 2014). However, there does not seem to have been dialogue with the general public.

Development of the LEP Strategic Economic Plan involved engagement with stakeholders in the private and public sectors, as well as the voluntary and community sector. The third sector organisation Your Consortium provided a voice for the sector with strategy preparation. Third sector groups engaged in the consultation process (e.g. local charities and community trusts, local LEADER groups, Rural Action Yorkshire and CVS groups; LEP, 2014b).

The results of the BioVale stakeholder consultation indicated that there was weak communication between the cluster and end-users, and that this could limit end-users' understanding of the potential of the BE sector (BioVale, 2014). Neither the LEP strategic documents, nor the BioVale Vision foresee a specific role for civil society networks in the regional BE. The reason is that BioVale initiative is mainly business- and R&D institutions- driven. It emanated to a great extent from regional business concerns. The government side was mainly represented by LEPs, which are also largely business-driven entities. The focus thus has been mainly on the triple, rather than quadruple, helix, and the vision did not foresee any specific role for social partners or end-users. In this regard, end-users arguably have not been among priority groups targeted by BioVale activities, including communication and dissemination-related. In addition, it is possible that there were no (or no sufficient) efforts at translating the concept of 'bioeconomy' into messages understandable for and popular among the public (as noted in Yorkshire and Northern Lincolnshire Group 2014, "the concept of the 'bio-economy' is a hard sell to the public"; if the messages are not translated at the level that people want to hear, there might be a communication gap).

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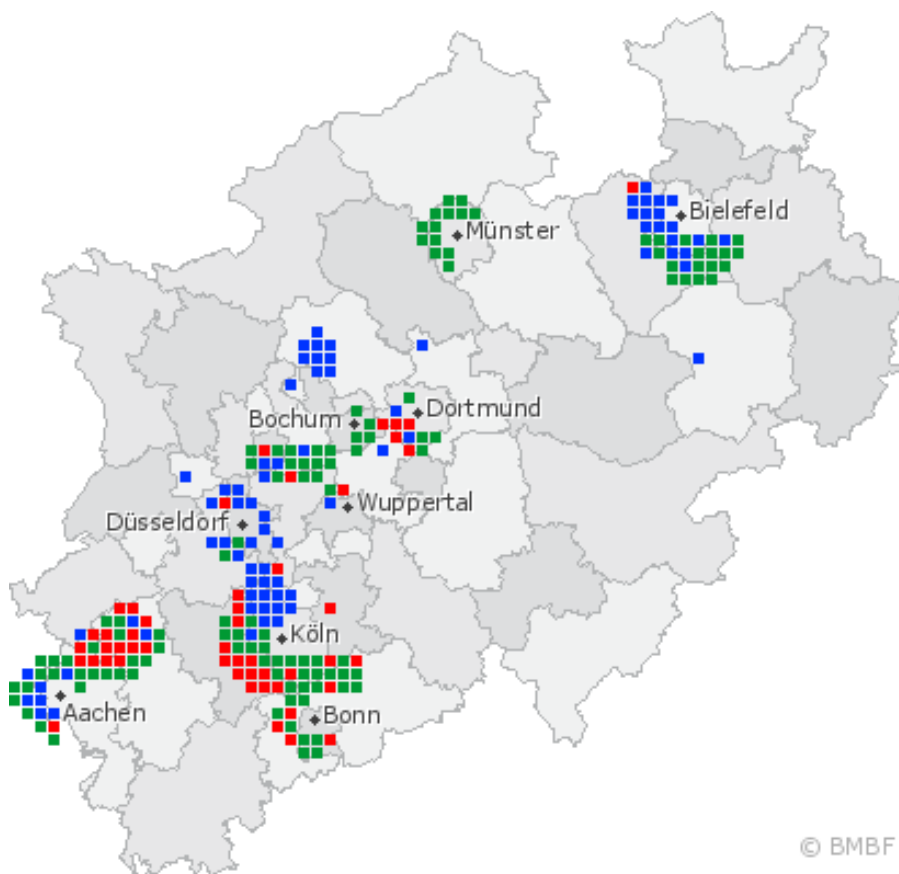
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6. North Rhine-Westphalia (Germany)

Region

North Rhine-Westphalia (NRW) is located in Western Germany, encompasses an area of 34,100 square kilometres and has a population of 17,6 million, including the biggest cities Cologne, Düsseldorf, Dortmund, and Essen. A dense network of motorways, long distance and urban train services and two airports ensure a good regional infrastructure in Germany. Today, main industries include the plastics and chemical sector and engineering. Despite its industrial areas and urban agglomerations most parts of the region are used for agriculture (arable farming) and forests. A publicly supported research landscape with numerous universities and non-university research institutes backs these industries. In recent years, several bioeconomy related networks between science and industry have been initiated. In 2010, the Bioeconomy Science Center (BioSC) was founded. On the political level, bioeconomy is part of the regional government's bioeconomy strategy. Supported by regional and national funding the region has established itself as one of the most important bioeconomy clusters in Germany. Wood, energy crops, biogenic residues and algae are biomass options as a basis for future green chemicals and biofuels. As these supplies are limited, biomass imports are an option.

Figure 6.1 Location of North Rhine-Westphalia



History

Bioeconomy related activities date back to the year 2007, when the “Cluster Industrielle Biotechnologie 2021” (CLIB2021) emerged as top cluster. Overall, the transformation of the chemical industry away from petrochemicals, towards renewable, sustainable resources was defined as a major goal of CLIB2021 (www.clib2021.com). Spread over five years, the initiative received 20 million euros of national funding with additional commitment from the private sector. Today, the clusters main objective – with its more than 100 regional and international partners – is to initiate R&D cooperation projects, which cover the entire value chain from biomass via intermediates to final consumer products. Cluster partners include the Research Centre Jülich, the Fraunhofer Institute for Molecular Biology and Applied Ecology (IME) in Aachen, the University of Bielefelds’ Center for Biotechnology and companies such as Bayer, chemicals firm Lanxess, as well as small and mid-sized biotech enterprises such as Artes Biotechnology and Direvo Industrial Biotechnology. In addition, other European partners such as the Dutch Bioprocess Facility in Delft or Finnish pulp and paper manufacturer Stora Enso are involved in the clusters activities. As part of the cross-border Bio Innovation Growth Mega-Cluster (BIG-C), CLIB2021 just recently secured a further four million euros in subsidies from the German Federal research ministry (www.biotechnologie.de). The funding will advance projects on the reutilisation of biomass and material streams from industrial waste gases not only in NRW, but also in Belgium (Flanders) and the Netherlands. Additionally, the Research Centre Jülich (plant research and biotechnology), the universities of Bonn (agriculture) and Düsseldorf (genetic sequencing), and the Rhine-Westphalian Technical University Aachen (RWTH, process engineering) joined forces in 2010 to found the Bioeconomy Science Center (BioSC) (www.biotechnologie.de; www.biosc.de/start_en). Today, more than 50 institutes cooperate in interdisciplinary research projects – both technical and socio-economical - conducted under the virtual roof of the BioSC. BioSC will receive more than 58 million euros over a ten-year period from the regional and the national government. .

Current situation and main actors

The regional government issued a regional bioeconomy strategy in 2013 as part of their research strategy “Fortschritt NRW” to further promote cooperation between industry, academia and the public sector along value chains in several industry and technology sectors e.g. in biotechnology, chemistry and nutrition (www.exzellenz.nrw.de). In contrast to definitions of the EU and the German government, healthcare is included as an important pillar of the regional biobased economy. Chemicals and pharmaceuticals, energy, medicine and medical devices as well as agriculture have been identified as the top priorities. However, the cultivation and use of genetically modified crops are a no-go. Instead, an intensive involvement of the humanities and social sciences is seen as essential to the development of "good standards" for the bioeconomy. Bearing this in mind, the regional government massively supports the BioSC, the CLIB2021 cluster as well as other bioeconomy related regional networks. International cooperation between NRW and its neighbours, Belgium and the Netherlands, are equally important.

NRW is home to several universities and universities of applied sciences as well as non-university research facilities. The RWTH in Aachen is a partner in the cross-border Aachen-Maastricht Institute for Biobased Materials (AMIBM) and a founding member of the BioSC (see before). The same is true for the universities of Bonn and Düsseldorf. Another key player with regard to sequencing and genome research is the University of Bielefeld and its Center for Biotechnology (CeBiTec). Bioeconomy related research at the University of Münster is devoted to new applications for plants such as dandelions or unused wood resources. Three of the most prominent non-university organisations, the Max Planck Society, the Fraunhofer Society and the Helmholtz Association have established major research facilities in NRW. As part of the Helmholtz centres, the Research Center Jülich also has a strong focus on bioeconomy related research. It’s home to the Jülich Plant Phenotyping Centre (JPPC) as part of plant research activities. Recently a large algae research facility was established there to help advance biofuels for aircrafts. Jülich was also a founding member of the BioSC.

Additionally, large and small companies are important players within the bioeconomy clusters. Bayer CropScience is based with its global headquarters in Monheim. The company is involved in high value seeds, innovative chemical and biological crop protection solutions, and services for modern, sustainable agriculture. Another big player is consumer goods and industrial technologies firm Henkel, most known for its washing powder Persil. In 2015, they committed five million euros to an innovation campus (HICAST) at the RWTH in Aachen. Based on natural, renewable raw materials, neighbour BASF manufactures a large variety of ingredients for body care products as well as household and industrial cleaners and has several activities with a focus on industrial biotechnology. Together with its US-partners, BioAmber and Genomatica Lanxess is working on biobased plasticizers and the processing of sugar-based 1,4 Butandiol (BDO). Globally leading agriculture company Monsanto has its German head office in the region and operates a breeding station there. Within the Cologne-based German Seed Alliance four market leading plant breeders joined forces in research, development and sales (www.german-seed-alliance.de). Other industrial concerns with large bioeconomy related activities are Evonik, focusing on feed additives such as amino acids, and food producer Oetker in Bielefeld. In addition, NRW hosts around 90 biotech companies, among them several firms with strong activities in the industrial or plant business such as evocatal, Direvo or Phytowelt Green Technologies. Most current marketed biobased products include enzymes for the grain ethanol industry or bulk amino acids produced via fermentation. Several green chemicals and biofuels are in a pre- or late development phase. Furthermore, more than 1200 biomass plants are located in NRW delivering 725 MW of energy.

Public participation

With regard to consumers and civil society networks or other experiences with public participation, no explicit experiences with bioeconomy issues were recorded for this region. But players within the field follow an open process of dialogue. The main activities of the stakeholders concentrate on the further establishment of cooperations and educational offers. Above all, issues related to plant biotechnology have become a highly discussed topic in Germany and since 2010, have become a major point on the political agenda in NRW. In this year the Green Party became part of the government for the first time. Up until 2008, plant researchers in the field conducted several field tests but were often threatened and attacked by environmental activists. Today, the use of genetically modified plants is not supported by the regional governments bioeconomy strategy.

7. Saxony-Anhalt (Germany)

Region

With a population of 2.2 million, Saxony-Anhalt geographically takes a centre field position in Germany. Magdeburg and Halle are the two largest cities.

Figure 7.1 Location of Saxony-Anhalt



The region of Halle/Leipzig is known for its highly developed chemical industry, with major production plants at Leuna (BASF) and Bitterfeld. The area of Magdeburg Börde is a hot spot for plant research and plant breeding companies. Motorways, railways and the airport Leipzig-Halle ensure a good accessibility of the most important regions. On the political level, bioeconomy is part of the lead market policy of the Saxony-Anhalt government. In addition, local authorities committed themselves to renewable resources. With financial funding from the regional and the national government, the region has established itself as an important bioeconomy cluster in Germany (www.bioeconomy.de). Wood and wooden residues are Sachsen-Anhalt's biomass options as a basis for future green chemicals and fibre products. Here, regional forest owners are a main focus group. Crops and sugar beets are used for the production of bioethanol. Future potential for the production of biofuels lies within the utilisation of agricultural residues.

History

Bioeconomy related activities started back in 2010, when the idea of a Chemical Biotechnology Process Centre (CBP) was introduced. With funding from the regional government of Saxony-Anhalt, the German Federal Research Ministry (BMBF) and the Fraunhofer Society, it was built to bring a shift in the use of raw materials in the chemical industry – away from oil towards the use of biomass (www.bioeconomy.de). Within the facility CBP partners from research and industry develop and scale up commercially relevant biotechnological and chemical processes for the utilisation of renewable raw materials. It also builds the scientific core of the top cluster BioEconomy in Central Germany with more than 90 regional partners from industry and science started by the BMBF. Since 2012 it has been funded by the BMBF, the cluster's industrial partners, and the regional government. The objectives of the cluster are the production and cascade utilisation of non-food lignin-based biomass from beech trees in order to generate

chemicals, new materials and energy and the up scaling of processes and plants from laboratory to development demonstration scale at the onsite biorefinery. The network connects chemical, paper and pulp, agriculture, forestry, energy and engineering sectors. In addition, it reflects the entire value chain. Besides the CBP, further cluster partners include the Deutsches Biomasseforschungszentrum (DBFZ), the Helmholtz Centre for Environmental Research (UFZ) in Leipzig (Saxony) and several companies (composite-developer Tecnar, biomass saccharification expert Green Sugar, pulp manufacturer Zellstoff Stendal GmbH, French Global Bioenergies) as well as larger industrial firms (Thyssen Krupp Industrial Solutions, Linde, Total and Vattenfall).

Current situation and main actors

The regional government issued a regional innovation strategy in 2014 to position itself as one of the most innovative science and business locations in central Europe. As 77% of German bioethanol was produced in the region in 2012, the regional “energy concept 2030” assumes no more capacity build-up in this sector. The region also benefited from the bioeconomy-related initiatives of the national government such as the High-Tech Strategy (HTS) and the national research strategy BioEconomy 2030 (www.bioeconomy.de). Saxony-Anhalt is home to two universities, and seven universities of applied sciences. Otto-von-Guericke University Magdeburg (OVGU) and the Max Planck Institute for Dynamics of Complex Technical Systems established the research centre for Dynamical Systems (CDS), which focuses on processes for future algae-based biorefineries. The Julius Kühn Institute (JKI) in Quedlinburg is the Federal Research Centre for Cultivated Plants in Germany. The tasks of the JKI encompass all specialities in the biology of cultivated plants – from genetics, soil science to plant health. Additionally, two prominent German scientific players, the Fraunhofer Society and the Leibniz institutes have established major research facilities in Saxony-Anhalt. The Leibniz Institute of Plant Genetics and Crop Plant Research (IPK) in Gatersleben is an internationally renowned plant research centre, which aims to become a supplier of new and improved biomaterials especially for pharmacy. The Fraunhofer Society was the main driver for building the CBP.

Within the Martin Luther University Halle-Wittenberg (MLU), research projects with relevance for bioeconomy aspects span sectors from biorefineries, food and feed, environment and sustainability to foils made of renewable raw materials. The Interdisziplinäres Zentrum für Nutzpflanzenforschung (IZN) combines the expertise of MLU, the Leibniz institutes and the Julius Kühn Institute. Located on the MLU site is the ScienceCampus “Plant Based Bioeconomy”. Started in 2012 as a cooperation between the regional government, the MLU and the Leibniz institutes, the campus is supported by regional funding. The universities of applied sciences complement the regional bioeconomy-related research activities. Here, competence centres (KAT), e.g. in engineering and renewable raw materials, focus on the use of biomass as feedstock in industrial production processes.

Large world leading and small companies are important players within the regional bioeconomy. Bayer CropScience is involved in high value seeds, innovative chemical and biological crop protection solutions, and services for modern, sustainable agriculture. Its wheat-breeding centre has been located in Gatersleben since 2011. CropEnergies Bioethanol GmbH, subsidiary of sugar company Südzucker, operates one of Europe’s largest bioethanol plants in Zeitz utilising crops and sugar beet. KWS, founded in the region, has been breeding crops for the moderate climatic zone for more than 150 years. The French-German Global Bioenergies Corporation (GBE) began the construction of an industrial demonstration plant on the site of the CBP to transform renewable raw materials into the hydrocarbon isobutene. US company Cargill operates Europe’s largest starch plant near Magdeburg. The region is also home to Germany’s largest pulp factory and several companies utilise wood as raw material. Furthermore, more than 100 biogas plants are located in Saxony-Anhalt and a wide range of smaller companies are active in agrobiotechnology or traditional plant breeding. Several biotech companies opened their doors and new molecular biological methods created further opportunities also for the traditional plant breeders. The food network “Netzwerk Ernährungswirtschaft” aims at better competitiveness of the region’s industry, Green Gate Gatersleben (GGG) is an initiative of institutions located in Gatersleben (www.green-gate-gatersleben.de). The most important marketed biobased product is

bioethanol. Other products include plastics made of wood. Several green chemicals, fibre products and wheat varieties as well as a second generation biofuel are in a pre- or late development phase.

Public participation

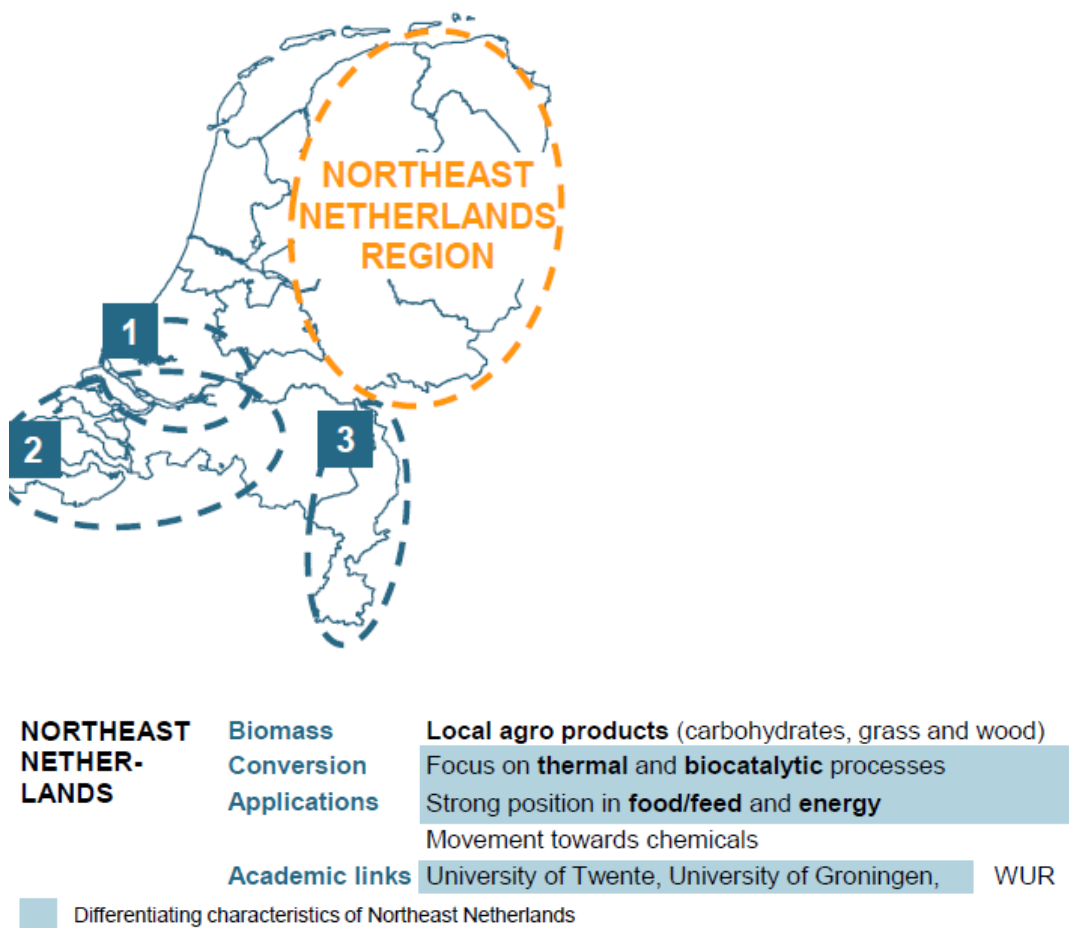
With regard to consumers and civil society networks or other experiences with public participation, no explicit experiences with bioeconomy issues were recorded. The Science Campus Halle aims to initiate a dialogue between scientists and to promote educational advertising of politics and public on the importance of plant production and the opportunities for plant-based bioeconomy. The main activities of the stakeholders concentrate on the further establishment of networks between science and industry and to strengthen the educational basis to further enlarge the regional bioeconomy cluster. Above all issues related to plant biotechnology are a highly discussed aspect within the country, which is also a result of the widely spread criticism with regard to genetically modified (GM) crops in Germany as a whole. Until 2008, plant researchers conducted several field tests with GM crops but were often threatened and attacked by environmental activists. As one of the consequences, in 2013 German company BASF finally withdrew its plant biotechnology research activities in Gatersleben (www.sungene.de).

8. Northeast Netherlands²¹

Region and bioeconomy sector(s)

The region of Northeast Netherlands covers four provinces: Overijssel, Drenthe, Groningen and Friesland. They can be characterized as rural areas that dispose over substantial biomass resources (carbohydrates, grass and wood). More bio supply options are offered by the proximity to seaports (Delfzijl, Eemshaven) and across the border to the German Weser-Ems region. According to Roland Berger Strategy Consultants the region can rely on a good knowledge base and has a strong position in food/feed and energy and in specific conversions. A recent ex ante evaluation on the possibilities for a biobased economy in the most northern provinces (Drenthe, Groningen and Friesland) saw many chances to connect agro with chemistry and to develop a market for a diversity of applications, particularly for (protein rich) animal feed, bioplastics and other biobased materials.²² The general picture is that the biobased economy in Northeast Netherlands is in the phase of (pre)Development.

Figure 8.1 Location of Northeast Netherlands region



History of the bioeconomy cluster

²¹ Based on website (<http://biobased-drenthe.nl/>) and 'The bio-based economy in Northeast Netherlands (report presentation, Roland Berger Strategy Consultants, Amsterdam 2013).

²² Bos, H., R. Blauw, P. Harmsen, J. Sanders, G.-J. Euverink, E. Bekkering (2015). Noord4Bio. Concrete kansen voor een biobased economy in Noord-Nederland. Wageningen UR Food & Biobased research.

Different chains and clusters have been assessed regarding their potential to build a (more) biobased economy:

Distribution of business activity by chain, Northeast Netherlands

Grass chain



- Current pilot plant in Friesland with support from the North Netherlands region
- Huge potential for grasslands in Gelderland and Overijssel

Carbohydrate chain



- Strong cluster currently around North Netherlands
- Expansion of application into chemicals and materials means the cluster can expand towards Delfzijl and Drenthe (Emmtec)

Wood chain



- Clusters around Delfzijl (e.g. Woodspirit – BioMCN) and around Enschede (e.g. BTG)
- Expansion of application into chemicals and materials means the cluster can expand towards Drenthe (Emmtec)

Waste streams



- Potential for valorization of waste streams spans the entire region

Source: Roland Berger Strategy Consultants (2013).

The goal of commercial applications and competitive bioeconomy products is still distant: the activities by chains refer to a potential future and several bottlenecks were identified: lack of shared vision, lack of transparency in chains, lack of resources, lack of a clear profile as biobased economy region.

Nevertheless, the province of Drenthe has a website that provides an overview of the activities going on to shape a biobased economy. This province seems to make the most concrete progress.

Current situation

The website of Biobased Economy Drenthe indicates some successful examples of collaboration:

- The chemical cluster attained the status of Centre for Open Chemical Innovation (COCI) that has both a national and European standing.
- The transboundary project 'Agriobiopolymers' connects small and medium business from Drenthe, Overijssel and Germany in the field of bioplastics and is a good example of cooperation between the agro and chemical sector.
- The innovation platform PlantValue connects entrepreneurs and knowledge institutions in the agribusiness sector and biobased economy that are developing business cases.

A recent event was the 'Day of Chemistry' (26 September 2015) that was organized on the Emmtec Industry & Business Park to inform citizens about the bioeconomy and possible applications such as green plastics, biocomposites, fibres and yarn. This was the first time that knowledge institutions and firms (DSM, Teijin, Innofil3D, API and Bonar) joined forces to show the potential of the bioeconomy to a wider audience. The event attracted 220 visitors.

There are provincial programs related to a more sustainable economy and research is supported by national programs or EU funding, but the sources we consulted gave no specific information on the financing of these activities (e.g. the financial share of private investors).

The main mission and current challenge in Northeast Netherlands is to connect the agro and chemical sector and develop business cases that can give the bioeconomy momentum. Directions and specific clusters are proposed in reports, but a clear biobased profile of the region is (still) lacking.

Current role and main actors

In the bioeconomy of Drenthe business and knowledge institutions are supposed to take the lead. On a provincial level policymakers see a facilitating role by initiating developments and bringing parties together, but a specified strategy is lacking or not public known.

Good governance

Most initiatives in the biobased economy of Northeast Netherlands are 'business to business'. In spite of intentions to relate more to citizens and consumers, efforts characterized by 'business to consumer' are more or less absent. Besides the 'Day of Chemistry' mentioned above there is no reporting of other experiences with public participation.

9. Biobased Delta (Netherlands)²³

Region and bioeconomy sector(s)

Biobased Delta (BbD) was set up as an informal collaboration of the provinces of Zeeland and North Brabant in 2010; the province of South Holland joined in 2014. Given these recent changes, this study focuses on the original participating regions i.e. West Brabant (main cities: Breda and Tilburg) and Zeeland (main cities: Middelburg and Vlissingen). In the BbD live 1 million people of which one third in Zeeland and two thirds in West Noord-Brabant. BbD is located in the Antwerp Rotterdam Rhine Ruhr Area which is the world's biggest chemical cluster.

BbD aims to promote refining and conversion of biomass to chemicals, including bulk, platform and specialty chemicals, fuels and polymers. BbD combines a strong agricultural sector, a large and innovative agro-food industry, a large chemical industry and extensive well-developed infrastructure, including deep sea harbours. BbD aims to use locally-produced biomass where possible, though imported biomass (via the sea ports) will be essential when operations are scaled-up.

Figure 9.1 Location of Biobased Delta



History of the bioeconomy cluster

BbD, which is financed by provincial funds since 2010 when it was set up, has become a foundation with a board and a director since 2014. Given the favourable conditions of several mature regional agro and chemistry sectors and a well-developed infrastructure, new bioeconomy activities emerge in the region, independent from support and steering from BbD as a broker to connect actors at their own request to other actors. However, the agro and chemistry sectors historically have little common ground on which to build new, explicitly biobased, activities. Establishing these new relationships in the chain from biobased feedstock like sugarbeet and woody biomass to biobased end product producers is therefore one of the tasks of the BbD. Another one is to stimulate and facilitate R&D efforts that are required along the chain. Therefore, BbD provides focus to the bioeconomy activities in the region by organizing the common business agenda 'Agro meets Chemistry', in which many R&D institutes and firms in the regions

²³ Based on BERST: Biobased Delta.

express their willingness to participate in bioeconomy activities. The big companies in this region have the capacity to develop and market new bioeconomy products themselves, while for small companies, that lack relevant networks, BbD plays a role in a guiding them getting involved in bioeconomy activities.

Current situation

Now that the organisation structure is in place, the BbD initiative should move from policy makers to industry and become further in the phase of development of new biobased activities (BERST, 2015). Most current biobased products in BbD involve niches, like natural fibres for construction material and sports equipment, biobased plastics for specific purposes, plant-based colorants, biobased cleaning products, etc. In the next five years, large scale products are expected to come to the market. A lot is expected from sugarbeet biorefinery as a major activity in the transition to a large scale biobased economy. Some products will be of the 2nd generation type, derived from the sugarbeet pulp side stream that remains after sugar refinery. But the sugar itself will also be used, resulting in 1st generation biobased products.

According to the BbD-representatives industry should set and implement the common business agenda, whilst policy makers should provide a stable policy environment and care for de-risking of large investments, e.g., by co-funding pilot facilities and R&D and reducing legislative restrictions. Besides policies and funding, the business agenda is busy with business development, human resources, and creating a good infrastructure of top locations. There are also strong collaborations with the University of Ghent (case 14).

Main actors

The triple helix of the Biobased Delta is considered an enabling factor:

- Governmental bodies: the provinces Brabant, Zeeland, and (since 2014) Zuid-Holland, in particular the economic departments; the regional development companies Impuls! (Zeeland), REWIN (West Brabant), BOM (Brabant) and Innovation Quarter (South Holland); a number of individual municipalities, including Bergen op Zoom and Terneuzen. The regional policy is supported by the national policy, but not financially.
- Knowledge institutes and expertise centres: among others: Technical University of Delft, Center of Expertise Biobased Economy Breda; Wageningen University and Research, University of Eindhoven and industry; Green Chemistry Campus in Bergen op Zoom, BE-Basic (Delft) and BioBase Training Center. Furthermore, there are laboratory, pilot and demo facilities included.
- Companies of all sizes are already included in the mature agro and chemistry sectors. The SME's – mostly farmers – are well organised in their sector organisation ZLTO (The Southern Agriculture and Horticulture Organization), which actively looks for e.g. waste stream valorization opportunities for its members in the BbD. Large cooperations like Royal Cosun (sugar beet), Cargill (mostly wheats), Lamp Weston Meijer and McCain (both mostly potatoes) are very important innovators for non-food applications. Their size makes them relatively independent of external organisation(s), policymakers and supportive bodies. The downstream subsectors chemicals & polymers and biofuels & bioenergy mainly consist of large and medium sized industries that are interested in the possibilities to use biomass in their processes and products. Many of the involved companies are direct members of the BbD. Furthermore, the relevant port authorities are included, and many SME's involved in the bioeconomy.

Consumers and civil society networks are absent. However, there is some urgency created to use less fossil fuels. The provincial environmental ngo ZMF (Zeeuwse Milieu Federatie) has bilateral contacts with the biggest chemical company DOW to enhance more carbon neutral innovations. Furthermore the ZMF aims to get a more environmental friendly economy in the Zeeuwse-Vlaamse kanaalzone.

Good governance

Currently, the funding of the BbD should shift from a fully public affair to one in which industry takes its share. Until now, BbD united parties around the common agenda, promoted the sharing of information and had an advisory role in where to spend the (provincial) subsidies and funds that are labelled for biobased initiatives. Also, it helped parties to set up project proposals for existing public/private funding programmes. However, the involvement of societal organizations and citizens is almost absent. It is to be discussed if they may become an enabling factor to be included in the take-off phase.

10. Industries & Agro-resources (France)²⁴

Region

The Industries & Agro-Resources (IAR) cluster is located in northern France and consists of two administrative regions characterised by a highly mechanized and productive agriculture: Picardy and Champagne-Ardenne. These regions are major producers of wheat, rapeseed, sugar beet, barley and potatoes.

Figure 10.1 Location of Industries & Agro-Resources (IAR)

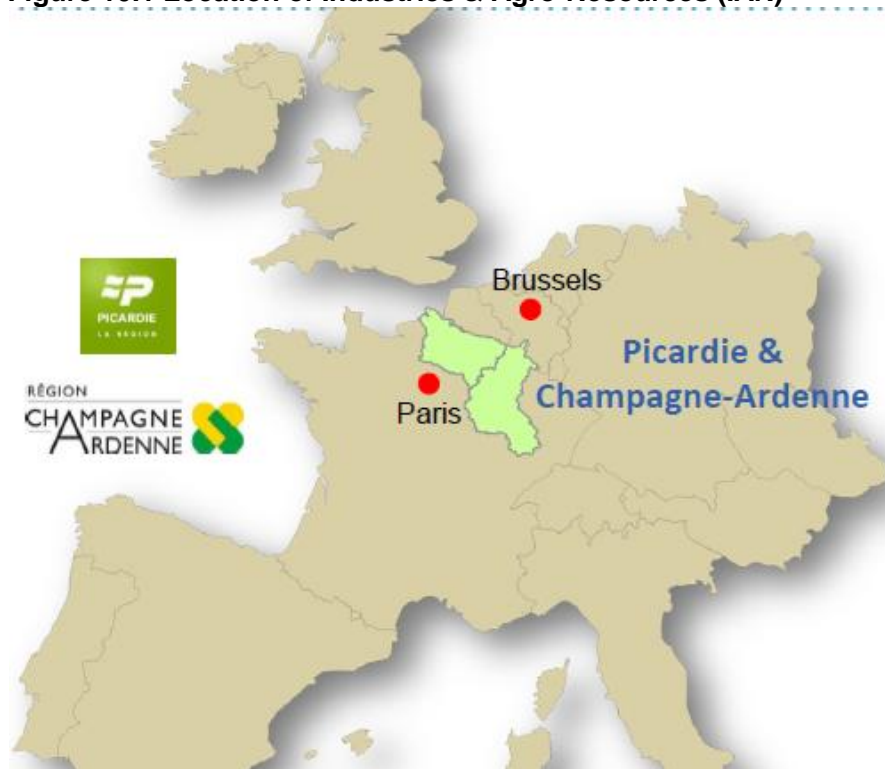


Table 1: Basic data

Region	Population	Area	GDP per capita	Main cities
Picardy	1.890.000	19.399 km ²	24.751 €	Amiens (capital), Saint Quentin, Beauvais, Compiègne
Champagne-Ardenne	1.339.270	25.606 km ²	27.813 €	Châlons-en-Champagne (capital), Reims, Troyes, Charleville-Mézières

Source: Wikipedia, accessed on 25 September 2015.

According to the three phases of diffusion as defined in section 2, the cluster is already in the phase of Acceleration and stabilization (A).

The Champagne-Ardenne and Picardie regions offer considerable capacity in terms of biomass resources: over 950,000 hectares of forest and nearly 3 million hectares of productive agricultural land. Thus, IAR is using locally available biomass resources (plant components and their co-products). Every year the biorefinery close the capital of the Champagne-Ardenne region transforms 3 million tons of biomass (beetroot, wheat, lucerne) into sugar, glucose, starch,

²⁴ The information provided in this document refers mainly to the IAR website, www.iar-pole.com/?lang=en, accessed on 29 September 2015.

nutritional alcohol, surgical spirit, ethanol and active ingredients for cosmetics (Bonaccorso 2015). Relevant bioeconomy sector(s) are biofuels, biorefineries, biotechnology, "green" chemicals.

History of the bioeconomy cluster

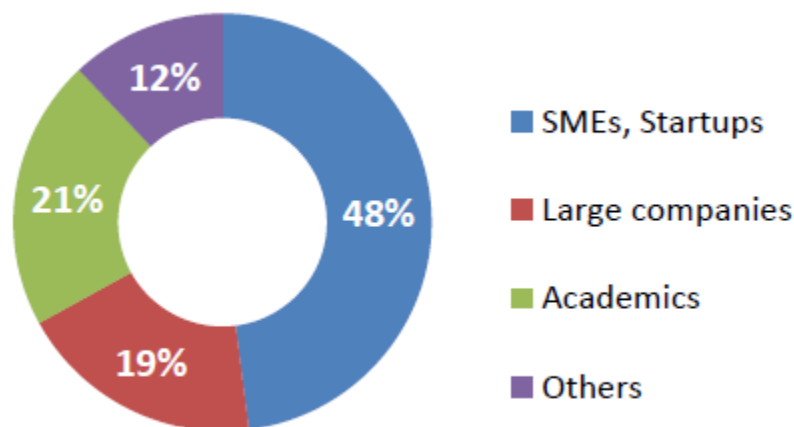
Resulting from the competitiveness cluster project launched in 2004,²⁵ the Champagne-Ardenne region decided to join up with the Picardy region in the IAR bioeconomy cluster. Until that point, the two regions had developed their activities separately from one other. The bioeconomy cluster was organized using a bottom-up approach. In the Champagne-Ardenne region, the biorefinery concept was generated by visionaries from the farming profession back in the 1990s, who were trying to find non-food added-value uses for agricultural products. This concept initiated the creation of Agro-industry Research and Development (ARD), a private research structure, owned by major players in the French agribusiness and regional farming cooperatives. In Picardy, due to the lack of research infrastructure and providers in the early 1980s, a small group of pioneers, as in Champagne-Ardenne, suggested a renewal of the collaboration between agriculture and industry in the Picardy region.²⁶ The Picardie Regional Council, the French State, businesses and universities launched jointly a biotech venture, the main goal being the production and non-food exploitation of agro-resources. Based on this, regional universities rapidly focused on agro-resource research.

Current situation

"The IAR cluster unites stakeholders from research, education, industry and agriculture around a shared goal: to optimize added value from biomass." (ECRN Secretariat 2014). The cluster has 250 members, including major corporations, SMEs, start-ups, universities, and local authorities (Figure 10.2).

64% of IAR's budget is financed by the French government and the Champagne-Ardenne and Picardie regions. The remaining 36% comes from private funding (member subscriptions, services provided, provisions).

Figure 10.2 Key stakeholders



Source: "Cross Value chain cooperation between two leading bio clusters in Europe" a presentation by Christoph Laguel, IRA, and Horst Mosler, BioEconomy Cluster, RRM Group Meeting, 5 February 2015. <http://www.errma.com/wp-content/uploads/2015/02/2015-03-IAR-BEC-1-mo.pdf>.

²⁵ IAR is part of the national initiative "pôle de compétitivité" (competitiveness cluster) that brings together SMEs, research and educational bodies, all working together in a specific region to develop synergies and cooperative efforts around a shared theme.

²⁶ The collaboration between agriculture and industry in the Picardy region has a long history and dates back to medieval times, when the Picardie region exported sheets of cloth dyed in what was known as "Amiens blue" (an indigo dyestuff extracted from locally grown wood).

The IAR Cluster actively supports the development of biorefining through innovative projects and the creation of road maps referring to them. The IAR Cluster sees its overall mission in the development of the bioeconomy sector in terms of not only scientific advances, job creation, energy and environmental efficiency, but also in promoting regions. The IAR cluster offers a Life-Cycle Analysis (LCA) specific to bio-based products by taking into account their environmental, economic and social aspects. Additionally, the IAR cluster has developed three open innovation platforms, BRI, PIVERT and IMPROVE, and is testing and developing bioeconomy training programs (German Bioeconomy Council 2015).

The IAR has launched the Agrobiobase award for innovations in the plant sector. It rewards companies that have developed an innovative bio-based product and provides financial support to the winning company. In evaluating the bio-based product, the following three criteria are considered: 1) innovative features, 2) bio-based content and 3) environmental and socio-economic impact. The main competitive products are bioenergy, agromaterials, biomolecules, and ingredients. The IAR cluster is globally well connected and has established partnerships with Europe, Canada, the USA, Japan, Brazil and India (Bonaccorso 2015). The cluster is developing and running 170 R&I projects.

Current role of the main actors

In light of the government's "Grenelle" environmental policies that are aimed at the development of green chemistry, the IAR cluster plays an important role. Over the next ten years, the French government will provide €65 million towards the total cost (€219 million) of the PIVERT project in Picardy, which focuses on the development of third-generation biorefineries for the added-value use of oil seed crops and forest biomass in a range of applications.

The French government, the Champagne-Ardenne and Picardie Regions support the IAR cluster. Among the SMEs and large-scale industries are the following companies: Arkema, Roquette, L'Oréal, Groupe Soufflet, Vivescia, Tereos Syral, Cristal Union, Crédit Agricole, Sofiproteol, Solvay, Danone, Lesieur, Faurecia, Total, GDF Suez, EDF, Clariant etc.

Relevant bioeconomy R&D institutes and educational organizations are the French National Institute for Agricultural Research (INRA), AgroParistech, Ecole Centrale Paris, University of Reims Champagne-Ardenne, Université de Technologie Compiègne, CER-Ensam, etc.

No information found about consumers and civil society networks (NGOs) and general public. Nevertheless, the IAR cluster seems to be an important player since it is very often involved in workshops and discussions on the future development of the bioeconomy alongside NGOs.

Good governance

The IAR Cluster has developed the "Agrobase" database, which provides information on more than 250 bio-based products. The overall goal of the database is to promote bio-based products and is targeted at business and industry representatives. The database includes the environmental advantages of the products, but does not mention potential negative impacts. Nevertheless, it could contribute to the better understanding of the bio-based economy by explaining detailed specifications of the products. Although not explicitly targeted at the general public, it might be a suitable tool to promote public engagement.

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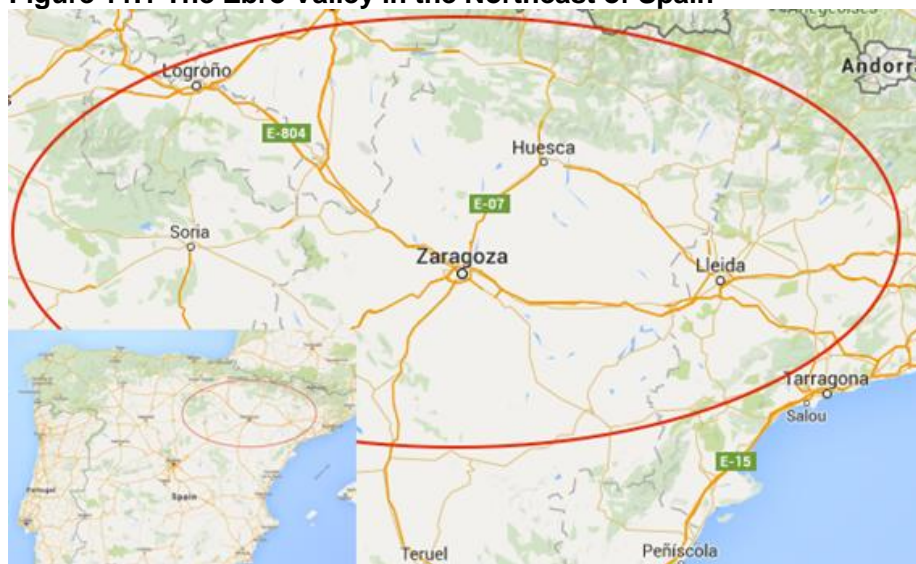
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11. Food+i La Rioja (Spain)

Description of the cluster

Food+i is a cluster that includes companies, research centres and other institutions related to the Spanish agri-food sector. It is located in the Ebro Valley (Valle del Ebro), in Spain. The Valley covers a large area of the Northeast of the country, along the river Ebro, the second largest of the Iberian Peninsula (see Figure 1). The river cuts through important Spanish cities such as Logroño and Zaragoza. The association responsible for the cluster's management is located in the autonomous community of La Rioja (capital Logroño). La Rioja has a population of 320.000 inhabitants and a GDP per capita slightly higher than most Spanish regions (GDP=102, Eurostat, 2013). Traditionally, the agri-food sector has been an important development driver for the region. The indigenous production of biomass for the sector has been possible due to the optimal conditions for irrigation along the Ebro river.²⁷ Almost half of irrigated areas are destined to cereal crops (especially maize, rice, wheat and barley), while the remaining half is occupied by oleaginous crops, fruit crops, vegetables and forage crops.²⁸

Figure 11.1 The Ebro Valley in the Northeast of Spain



History of the bioeconomy cluster

The agri-food sector is one of the most important ones for the economy of the region of La Rioja, contributing to 30% of the total GDP of the autonomous community and employing over 7.000 people. Around 25% of all Spanish companies dedicated to the agri-food sector are located in the Ebro Valley. Food+i was created in 2009 to explore the potential, create synergies and promote the cooperation in science and technological development among the different actors of the agri-food sector that are based in the valley (<http://clusterfoodmasi.es>).

²⁷ El Valle del Ebro: Problemática empresarial y social en el Valle del Ebro. Una mirada al futuro. Cámara de Comercio de Zaragoza, 2006.

²⁸ Análisis del sistema productivo agroalimentario de Aragón. Usos del regadío. Gobierno de Aragón, Servicio de Estudios, Análisis e Información, 2013.

Current situation

Food+i supports agri-food businesses and liaise with research centres and government bodies to promote the development of collaborative projects between these actors. It aims at fostering knowledge transfer, the creation of spin off and start-ups, and at establishing regional, national and international networks. Today, about 90% of the cluster's companies is represented by small to medium-size enterprises. The cluster is mainly a technology platform since it coordinates collaboration between research institutes and companies in the Ebro region. However, partners are not concentrated in a very specific location and are not very close to each other.

The cluster offers different types of services to the sector:

- Development of strategies to foster collaborative R&D projects between different actors of the agri-food sector;
- Access to funding for innovative projects;
- Support to the development of business incubators;
- Studies on consumer preferences and behaviour aimed to increase public acceptability of products;
- Awareness raising forums.

Members of Food+i are currently involved in more than ten different projects, collaborating with partners at the regional, national and international level. The topics range from biopackaging for fresh food, consumer surveys and management of biowaste at the Ebro Valley, to water efficiency techniques and wastewater treatment applied to the food industry of the region (ibid).

Main actors

The cluster's strategy is supported by the Spanish Association of Innovative Companies, the Spanish Ministry of Industry, Energy and Tourism and the European Regional Development Fund. Two entities are responsible for the management of Food+i. These are the Centro Tecnológico de la Industria Cárnica de La Rioja (CTIC) and the Agri-food Industry Association of Navarra, La Rioja and Aragón (CONSEBRO). The cluster counts with more than 80 partners and is working on attracting more companies and research centres to expand its portfolio of projects and services.

In collaboration with the regional government of La Rioja and other institutions, and funded by the Spanish Foundation for Science and Technology (FECYT) and the Ministry of Science and Innovation (MINECO), Food+i promoted the "Science and Food Innovation Week" in 2013. The objective of the event was to promote and communicate innovation in the agri-food industry of the region of the Ebro Valley among businesses, scientists, technical staff and marketing practitioners. Besides the participation of Food+i partners in different collaborative projects, (see section 3.1) no further information about national or international cooperation strategies developed by the cluster could be identified.

Good governance

From the literature available, Food+i seems to mostly focus on reaching out to businesses, experts, government bodies and other public-sector institutions. In 2012, however, in collaboration with the regional government and financial support from the FECYT, the cluster organised an educational project aimed at communicating the different activities performed within the food industry to students from the region of La Rioja. Almost 1000 students from 15 schools took part in the project's program, visiting laboratories and factories and learning about food safety technology and innovation.²⁹ There is no further evidence on the publicly available documents of engagement with civil society representatives and other publics. While a focus on regional development, rather than on national or international cooperation, could be seen by some as a disadvantage from an economic perspective, it could also be considered as a strength in terms of potential for engaging with the population. This might be regarded as an opportunity for Food+i, as the agri-food industry is very important for the region and most feedstock is

²⁹ www.larioja.com/agencias/20130616/local/casi-alumnos-participado-proyecto-flipando_201306161119.html

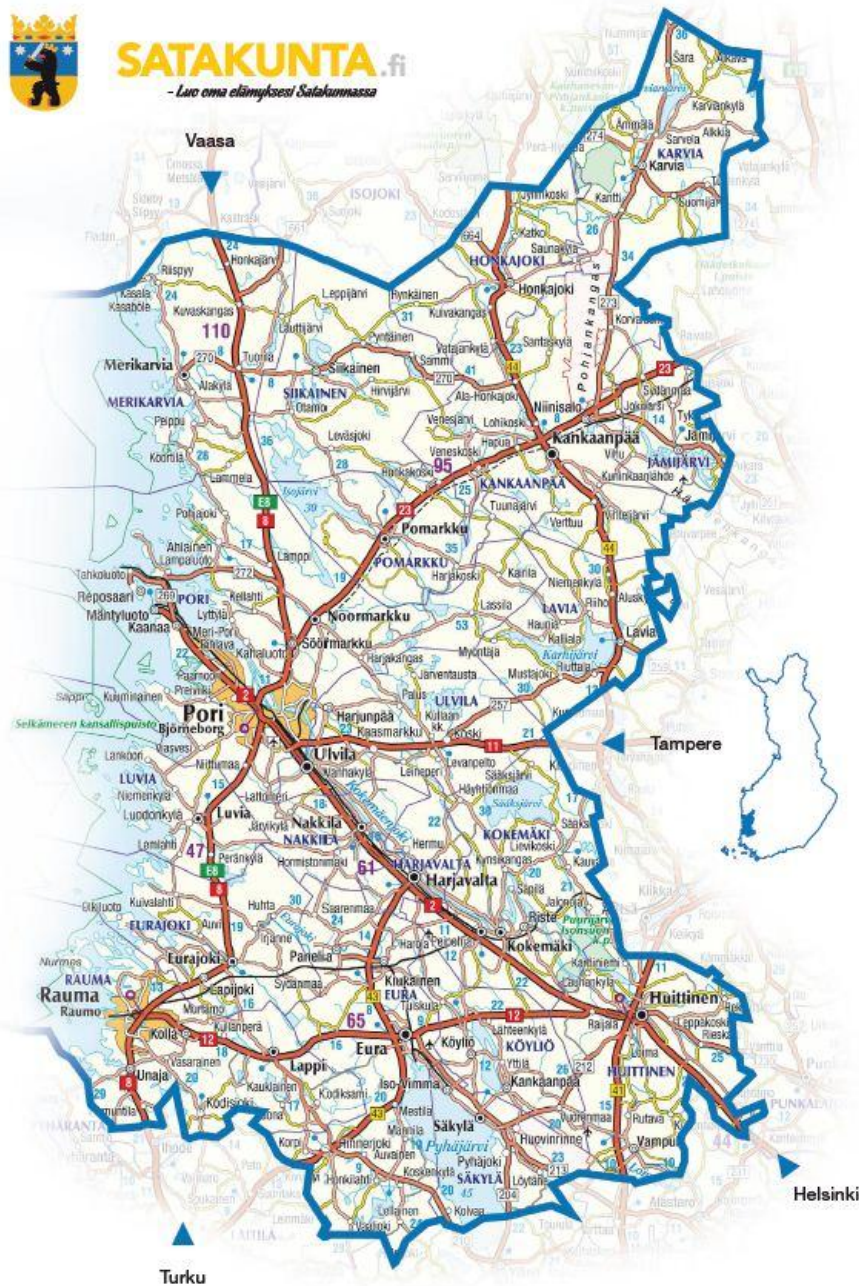
indigenous. Because of aspects such as geographical proximity and familiarity with the sector, it seems reasonable to think that the regional population may feel more inclined to take part in engaging activities promoted by the cluster. Likewise, not only the cluster, but also the regional agri-food sector may also be keener to engage with the population.

12. Satakunta (Finland)

Location and infrastructure

Satakunta is a NUTS3 region on the southwest coast of Finland, with population around 225,000 people. The key road and rail axis is along the Kokemäenjoki river valley which connects the main west coast port-cities of Pori (85,000 inhabitants) and Rauma (40,000) with other industrial centres. The region has abundant forest resources (including protected wilderness areas) yet is also Finland's most industrialised province (Satakuntaliitto, 2012). Major sectors include metal, energy production, chemicals, pulp and paper, forestry and food production/processing.

Figure 12.1 Location of Satakunta



History and current situation

The region is characterised by strong industrial heritage. There are two clusters associated with the BE: (i) agri-food production and processing and (ii) power generation, including the production and utilisation of bioenergy. There is also R&D on biorefineries, exploitation of forest resources, cleantech, and environmental and energy technologies. According to the Satakunta Regional Rural Development Strategy (Satakuntaliitto, 2012), the regional model of energy efficiency and *bioenergy* production serve as national examples of energy use in primary production, industry and housing. Bioenergy production in the region is supported by a considerable amount of forest- and agri- based raw material (Satakuntaliitto, 2012a). In terms of *agri-food* production and processing, Satakunta is one of the leading Finnish provinces, and food processing is a growing sector in the region. A significant share of people are employed in agriculture and food industry compared to the national average (Table 12.2).

Table 12.2: Potential for biomass production and biomass conversion sectors

	Number of enterprises	Number of employees
<i>Potential for biomass production sectors</i>		
Agriculture	3500	5100
Forestry	240	700
Aquaculture (public sector not included)	6	6
Waste (waste recycling & utilising enterprises)	52	400
<i>Biomass conversion sectors</i>		
Food/Feed		2300
Energy		700
Industrial incl.		
- Paper		2100
- Wood		2000
- Chemicals		2200

Source: Based on EU (2014)

BE is extensively covered by major strategic documents developed by the Regional Council of Satakunta, which provides the general regional policy framework, articulates long-term development goals and coordinates regional strategies (www.satakuntaliitto.fi). Thus, the regional strategic plan sees the success of the regional economy rooted in environmental technology, clean products and clean energy, while the Regional Programme 2014-2017 and Regional Innovation Strategy specify the regional BE strengths and encourage their further development.

Development activities with regards to BE are supported through national government funding and the EU Structural and Investment Funds in 2014-20 (Table 12.3).

Table 12.3: Funding sources for BE-related themes envisaged by the Satakunta Regional Programme 2014-2017

	<i>Theme 2 'Pure Vitality', Focus 3 'Restructuring of industry'</i>	<i>Theme 2 'Pure Vitality', Focus 4 'Strong food production chain'</i>
<i>Funding sources</i>	ERDF Priorities 1 and 2	Rural development programme, Leader
	Central Baltic programme priority 1	Central Baltic programme priorities 1, 2
	Rural development programme	Horizon 2020, EIP (ERIAFF)
	Tekes (incl. INKA)	EMFF priority axis 2
	Regional development grant (sub-regional town pilot)	Ministry of the Environment
	Horizon 2020	Life

Source: Satakuntaliitto (2014)

Main actors

The Regional Council of Satakunta is responsible for coordinating regional strategies (including the Regional Innovation Strategy) in cooperation with municipalities and other public and private actors. Key business support organisations are: Prizztech Ltd (www.prizz.fi), the largest public business development company in Finland, which is owned by Satakunta's municipalities and has a strong focus on renewable energy technology; ProAgria Satakunta, which provides services and know-how to rural businesses, including in the agriculture, food and bioenergy sectors; and ENTER, an association which supports start-up businesses in the region

In the biomass/biofuel sector, some firms are located on the Peittoo recycling park (which is an important centre for the environmental industry), including Ekokem, Lassila & Tikanoja Ltd, Stena Recycling Ltd and Kuljetus-Mäkivaara Ltd. Other forestry-related businesses are situated on the Lakari logistics and industrial near Rauma (www.lakariarea.fi).

In the food production/processing sector, two key entities are the Satafood Development Association (www.satafood.net) and the Pyhäjärvi Institute, both of which work with a range of businesses and other associations. Satafood supports food entrepreneurship, provides environmental services and facilitates cooperation between companies, education and research. The Pyhäjärvi Institute undertakes R&D and education, and provides expert services to food businesses.

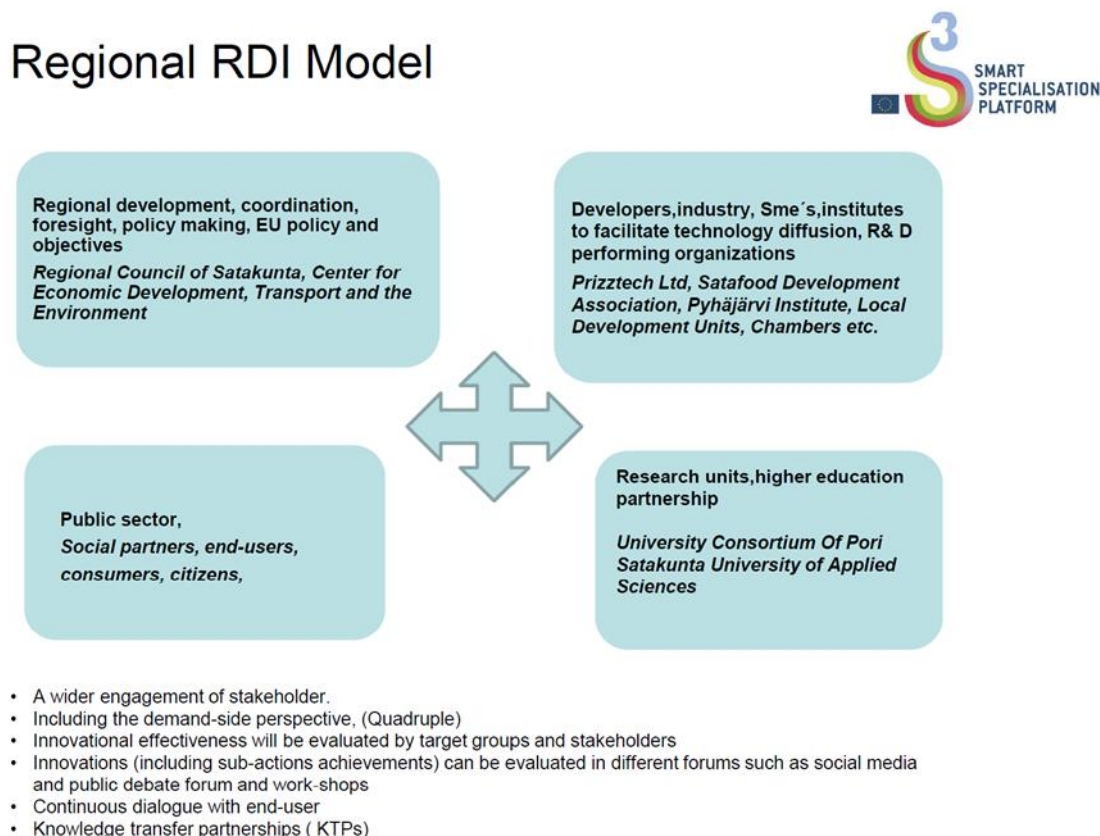
Based on desk research, it is a challenge to find information about targeted cooperation between the diverse institutes and companies in various BE sectors. There exist two separate well-pronounced BE-related clusters (agri-food and energy, incl. bioenergy). One can trace synergies between some BE sectors: e.g., agri- and forest-based raw materials are used for bioenergy production. Apart from energy, the significance of wood as a building material is increasing (Satakuntaliitto, 2012);

Satakunta does not have an independent university but higher education is provided by the University Consortium of Pori (a network of four universities), which was set up in its current form in 2004. Satakunta also has a University of Applied Sciences. In addition, there are local research centres which work in close connection with business (Satakuntaliitto, 2014a).

Public participation

Desk research has not revealed information on direct engagement of the public with BE issues. However, Satakunta's Regional Innovation Strategy states that the design and implementation of regional strategies involves not only businesses, policy-makers, research and higher education institutions, but also social partners, end-users, consumers and citizens (see Figure 12.4).

Figure 12.4: Regional RDI Model



For example, the regional strategic plan was prepared through a bottom-up process involving up to 2000 participants, and including the following methods: street polls, forums for youth, interviews among unemployed people, children's crafts, internet inquiries and stakeholder/expert workshops. Similarly, the plan's implementation involves social and cultural societies, local action groups and residents' associations (Satakuntaliitto, 2012). In addition, consultations with regional stakeholders and the public (through workshops/events/internet) informed the strategic choices of the Regional Programme (Satakuntaliitto, 2014). The draft Climate and Energy Strategy was presented at four public events and was open to public comment. Two overarching themes of the core regional strategies ("Encouraging community" and "People-oriented solutions") aim to increase the ability of the people of Satakunta to participate in regional decision-making, planning and implementation activities.

The Regional Innovation Strategy foresees continuous dialogue with all parties and suggests that innovations and their effectiveness should be evaluated by target groups and stakeholders in different forums (including public debate, social media and workshops) and that a feed-back system should be developed to measure the progress Satakuntaliitto (2014a).

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Lakari logistics and industrial park: www.lakariarea.fi/en

Peitto recycling park: http://www.m20.fi/sites/files/peitto_esite_EN_netti.pdf

Prizztech Ltd: www.prizz.fi

Satakunta Regional Council: www.satakuntaliitto.fi

Satafood Development Association: www.satafood.net

13. Västra Götaland (Sweden)

Region

Västra Götaland is a NUTS3 region on the west coast of Sweden, with a population of 1.6 million people. The main city is Göteborg with a large port, a big airport and a developed road and rail network. Västra Götaland aims to become “a resource-efficient society” (Region Västra Götaland, 2013a), 100% independent of fossil energy and fuel, and to reduce its impact on the climate. The region prioritises the development of sustainable energy and biogas, green chemistry and green industries, sustainable urban development and transport. The region is already a world leader in biogas production (County Administrative Board of Västra Götaland, 2015), and has industries to increase the production and use of renewable energy and bio-based products further (Västra Götaland, 2013).

Figure 13.1 Location of Västra Götaland



History of the bioeconomy cluster and current situation

Västra Götaland has long been home to most of the country's petrochemical industry (Region Västra Götaland, 2013), and has a large chemical and materials cluster in Stenungsund, which involves cooperation between business, universities and the public sector. At present, Stenungsund's chemicals companies largely draw on fossil raw materials but they are actively working towards a fossil-free region. In 2010, Stenungsund's five major chemistry companies (AGA, Akzo Nobel, Borealis, Ineos and Perstorp) formulated a vision for Sustainable Chemistry 2030 (Kemiföretagen i Stenungsund, 2010) to become fossil free, regarding both energy supply and raw materials, by the year 2030.³⁰ Oil and gas are to be replaced with biomass from

³⁰ It is not clear, based on desk research, whether biomass resources are sufficient. A significant part of first generation biofuel sources appears to be imported. Considerable potential is explicitly seen in an increased exploitation of advanced biofuels, particularly use of residues from forests/forest industry; there are no relevant technologies widely available/utilised yet, but opportunities for introducing them are actively studied. At the moment, activities of Stenungsund's chemical companies are largely based on fossil raw materials (Region

agriculture, forestry, the sea and waste, and the region is to become an (inter)national centre for manufacturing sustainable chemical products. The vision has led to an action plan (shared by the broader West Swedish chemical cluster, focusing on (i) renewable raw materials and energy, (ii) renewable chemical and material products, (iii) renewable vehicle fuels and (iv) resource and energy efficiency including the recycling of waste heat. Biogas, biodiesel and bio-based chemicals are produced in Stenungsund (GAME, 2014).

Although companies share goals, cooperation is not based on formal contracts. Thanks to Sustainable Chemistry 2030, which is largely aligned with the vision of 'Sustainable growth in the Göteborg region', developed by Business Region Göteborg, also collaboration of the cluster's firms with other parts of the West Swedish chemistry cluster outside the region is active. Västra Götaland is seen uniquely suited to steer development in green chemistry and bio-based products cluster by leading representatives from policy, research and business. The development of green chemicals is supported by regional strategic documents, such as the Västra Götaland 2020 strategy (Region Västra Götaland, 2013a), the Biogas Programme (Region Västra Götaland 2013b), the Environmental programme (Region Västra Götaland, 2013c) and the Action Programme for sustainable energy (Region Västra Götaland, 2013).

Main actors, cooperation and funding

Cooperation between actors from industry, academia and the public sector is an important part of the Sustainable Chemistry 2030 vision and the chemicals cluster in Västra Götaland. Cluster members include the aforementioned business actors, public actors (Business Region Göteborg, Region Västra Götaland, municipalities of Stenungsund and Lysekil), and R&D and educational institutions with strong environmental profiles (including Chalmers University of Technology, SP Technical Research Institute, Swedish Environmental Research Institute, f3 and SuMo Biomaterials).

Broader ngo representation has been identified as needed for the development of the Stenungsund chemical cluster (CIRCE, 2013)³¹. A range of environmental organisations is present in Västra Götaland, some of them are concerned with green chemicals-relevant activities, such as the non-profit organisation International Chemical Secretariat (ChemSec) based in Göteborg.³²

Moreover, strong synergies across bioeconomy sectors are actively promoted. For example, considerable opportunities for green chemicals development are seen in synergies between chemicals and forestry for the exploitation of forest-based second generation biofuels (Västra Götaland, 2013; Josefsson, 2012), which would allow increased access to biomass (Region Västra Götaland, 2013). The cluster's strength is seen to lie in interactions between the chemical, energy, recycling, pulp and paper and forest industries (Chalmers University of Technology, 2015), as well as cooperation with customers in the automotive, textile, pharmaceutical and packaging industries and with engineering companies (Västra Götaland, 2013). Cooperation with

Västra Götaland, 2013). Oil and gas currently represent about 90% of raw materials for chemical companies in the wider Göteborg region (Business Region Göteborg, 2015), while the Stenungsund chemical cluster is 17% renewable raw materials-based (GAME, 2014).

³¹ One of possible explanations can be the following. The cluster was initially mainly business-driven (so was the Sustainable Chemistry 2030 vision). Links with the region were initially weak (Andersson et al., Industrial Symbiosis in Stenungsund), and concerns over extending participation in the cluster-related activities for a broader range of regional actors (including NGOs) were thus arguably absent / not deemed a priority. As these links have been getting stronger over time (ibid), the cluster's needs have become more closely associated with broader regional concerns, and a challenge with the cluster's legitimacy (and therefore a need for a broader societal representation) has been identified.

³² ChemSec works towards a world free of hazardous chemicals and strives to reach broad acceptance in society. Making available science-based information on environmental risks of hazardous substances, it acts as a catalyst for open dialogue between business, authorities and NGOs on the necessary steps towards a toxic free environment. Chemical companies as enablers of green solutions is among the brought up topics (chemsec.org)

actors elsewhere in Sweden and Europe includes international projects and research on green chemicals.³³

Major funding sources for green chemicals projects and the Cooperation for Sustainable Chemistry initiative include the ERDF and EU research and innovation funding, as well as Region Västra Götaland, Business Region Gothenburg, Swedish Energy Agency, Sweden's innovation agency, Chalmers University and Chalmers Industriteknik, as well as businesses.

Public participation

Desk research does not show clear evidence on public engagement with the green chemicals cluster's activities. However, the Vastra Gotaland 2020 strategy , which prioritises green chemicals development, states that "a large number of actors and individuals from all parts of society" contributed actively to its design (Region Västra Götaland 2013a, p.3). Similarly, "actors in social economy" and "community mobilisation (p. 12)" are seen important for strategy implementation. In addition, some bioeconomy-related projects have sought to take into account the views of user groups and various societal actors. For instance, the Green Chemistry (*Grön Kemi*) project encouraged interaction between manufacturers and users to promote environmentally friendly alternatives to a range of chemical products. Societal actors were also seen important in the long-term planning of a sustainable energy system within a large research project carried out jointly by Chalmers University and Göteborg Energi, which explored the design of indirect gasification for green syngas production and integration into existing systems (Västra Götaland, 2013). Moreover, as noted by the EU-funded PLACES project (www.openplaces.eu), Stenungsund's focus on regional development via innovation in local chemical industries has also aimed to change public perceptions of and engagement with this sector (cordis.europa.eu/result/rcn/171981_en.pdf).

³³ E.g., the Västra Götaland region participated in the EU FP7 project R4R Chemical Regions for Resource Efficiency (www.regions4resource.eu), promoting research and cooperation in the areas of resource and energy efficiency in the chemical industry. The project ran from 2012 to 2015

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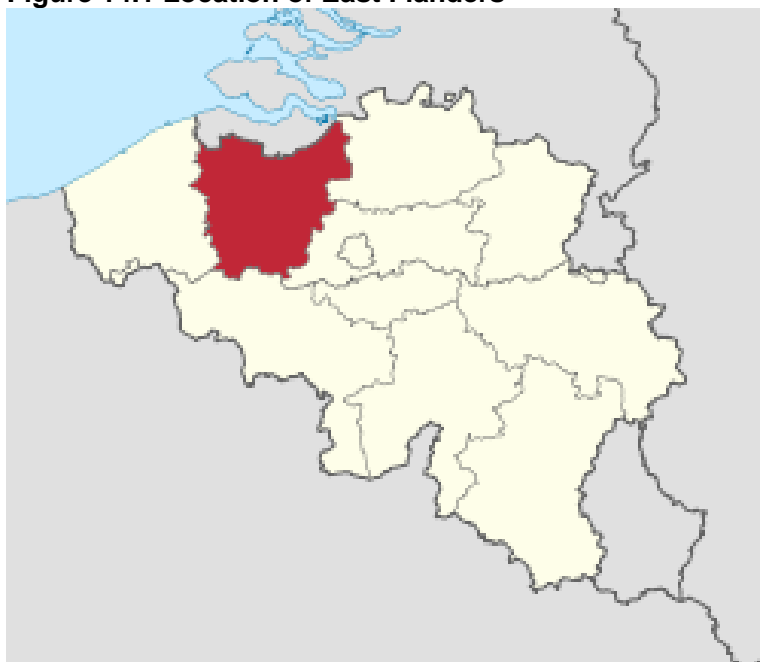
www.openplaces.eu

14. Ghent Bioeconomy Valley (Belgium)³⁴

Region

Ghent Bioeconomy Valley (GBEV) is located in East Flanders. East Flanders, an area of 2,991 km², is a province of Flanders, one of the three regions of Belgium. The provincial population is 1,408,484 and the capital is Ghent. The region of East Flanders has a good geopolitical location and the location and infrastructure (industrial zone and Port of Ghent) and the awareness and commitment of the local authorities have all been strong assets for the development and successful operation of the cluster.

Figure 14.1 Location of East Flanders



GBEV concentrates on energy (bioenergy, biofuels) and has operated since 2005. According to the BERST-project this case is in the phase of mature production. Since the cluster is established within close proximity to the Port of Ghent biomass supply options are various including both indigenous and imports making use of the strong infrastructures. However, it is not clear to what extent the biomass for GBEV is supplied by locally producers or imported, or to what extent this biomass can be qualified as conventional or advanced.

History of the bioeconomy cluster

The cluster was founded through the initiative of Prof Wim Soetaert as a Public Private Partnership between Ghent University, the City of Ghent, the Port of Ghent, the Development Agency East-Flanders and a number of industrial companies related to the Ghent region, active in the fields of generation, distribution, storage and use of bio-energy.

The most helpful policy drive for GBEV has been the EU target for liquid biofuels and the implementation of the Renewable Energy Directive. As a consequence, two biodiesel companies have been established and grown. Moreover, this success attracted attention and support from government and public funds. GBEV finally succeeded in acquiring 80% of the Flemish quota for biofuels in October 2006, representing an investment of €120m in the port of Ghent. Production at Bioro and Alco Bio Fuel started in the spring of 2008. In 2008, GBEV obtained a legal identity becoming a non-profit organization, supporting all biobased activities, including bioenergy.

³⁴ Based on BERST: Ghent Bioeconomy Valley.

Current situation

GBEV activities include collaborative programmes, joint initiatives and synergy creation between the partners in the fields of research & development, structural measures and policy, logistics and communication towards the general public. Throughout its operation, GBEV benefited from both public and private funds. At the initial phase there was no public funding; companies paid a modest fee which supported the start-up of the cluster. The initial phase was based heavily on efforts and strong personal commitment from Prof Soetart and his immediate collaborators. At a later phase, GBEV applied successfully for competitive, project-based research funds, and during recent years turnover has been approximately €1m per year.

The key bioeconomy products are bioenergy and biodiesel (totalling 500,000 tonnes per year). Most of the activities of the cluster have focused on developing these products and cross over between sectors have been low during the initial phase and limited in the drive to maturity one. The interactions with the chemicals & polymers and textiles have started only at the mature production phase and innovation became high at that point. The current project BIOCLUSTER has as key theme the development of new economic value chains around bioplastics, biosurfactants, biomaterials, biosolvents and biolubricants: 'Companies from different sectors will be brought together in thematic workshops with the aim to find new value-chains that can be implemented in a relatively short term, and that create a win-win for the participating parties.'³⁵ A partnership with BiotechCorp, the lead development agency for the biotech industry in Malaysia, has been set up by GBEV to broaden its outreach, introduce knowledge and expand its network.

Current role and main actors

According to BERST GBEV had a highly efficient central organisation with the active participation of big industrial actors, policy and knowledge providers. However, the cluster has not been very effective in stimulating small- and medium-sized business or start-up companies. These have ranked low in all development phases. A probable explanation for this is the nature and scale of production of biofuels.

- The cluster members are mostly big and small companies, mainly due to the fact that its core activities were built around large production facilities.
- Regional and local politicians have mainly a representative role but individuals are also members of the supervisory board, so they influence financing, representative, and strategic activities and are thus major actors.
- The focal R&D institute is the University of Ghent but the cluster also collaborates with several universities and research institutes across Europe.
- It also provided a platform to inform the general public about new products and technologies. However, the available sources do not provide more specific information on communication strategies, nor do they give concrete examples of information campaigns.

Good governance

GBEV took advantage of the favourable legislation for biofuels at EU level, combining existing capacities and enabling the development of large scale biodiesel plants through a strong cluster organisation from the beginning, with the leadership being experienced both in academic and industrial research. The most important difficulty in this whole undertaking was raising awareness among the stakeholders in industry and policy and convince them to join efforts and intensify activities. This was mostly due to lack of technical knowledge, access to information, lack of trust in academic research outputs and credibility. Though this case is considered by the BERST-report as a best practice in the phase of mature production, it can be said that the involvement of societal organizations and citizens is almost absent. The role of the general public was mainly passive, being the receiver of information about new products and technologies by a platform that GBEV provided.

³⁵ <http://www.gbev.org/en/what-does-gbev-do/technological-innovation/biocluster>