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# Deconstructing the attractiveness of biocluster imaginaries

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## ABSTRACT

In this paper, we investigate the promises that are employed within and around clusters that were formed in the evolving bioeconomy: bioclusters for short. Our paper aims to provide a conceptual clarification of the biocluster concept. To that effect, we employ the prism of sociotechnical imaginaries. We argue that both industrial clusters and the bioeconomy constitute separate, but partly overlapping sociotechnical imaginaries that shape stakeholder attitudes towards bioclusters. We applied a Q-methodology study in two bioeconomy clusters, one in Germany and one in The Netherlands, to investigate the resonance of different imaginaries in the cluster regions. Five distinct narratives, combining specific elements of cluster and bioeconomy imaginaries, are shared by different stakeholder groups. We revealed bioeconomy imaginaries at large to be far more contested than different cluster imaginaries. The latter mobilise overwhelmingly positive associations across diverse stakeholder groups. From this perspective, the popularity of biocluster promotional policies can be explained as they support some of the contested elements of bioeconomy imaginaries in gaining traction.

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Bioeconomy; cluster policy; innovation policy; sustainability; Q-methodology; regional development

## 1. Introduction

The bioeconomy has come up as a way to promote the production of renewable biological resources (biomass like wood, plants, and algae) and the conversion of these resources and their waste streams into value-added products, such as food, feed, bioplastics, pharmaceuticals, and bioenergy (Brunori, 2013; Diakosavvas & Frezal, 2019). However, the bioeconomy is still in its infancy. The combined value added of the European bioeconomy in 2015 was estimated to be 460.6 Billion Euro, or 11% of Gross Domestic Product in a recent report (Kuosmanen et al., 2020). This means that the expected benefits of a transition to the bioeconomy are largely based on expectations and promises. The promise of the bioeconomy rests on two pillars. Firstly, the bioeconomy is expected to aid in combatting climate change by helping with the substitution of fossil fuels by biomass (Daiglou et al., 2019; Stegmann et al., 2020). Secondly, the bioeconomy will spur innovative entrepreneurship and contribute to the so-called knowledge economy through the promotion of economic activities related to biotechnology, plant breeding, and innovative processing technologies (Bugge et al., 2016; McCormick & Kautto, 2013).

In this paper, we investigate these promises as they are employed within and around clusters that were formed in the evolving bioeconomy: bioclusters for short. Industrial clusters have their own promises: they are generally associated with high competitiveness, opportunities for employment and can serve as incubators for innovative start-ups (Birch, 2017; Sölvell, 2008). Based on the work of Porter (1998), the creation of clusters has become popular with regional policy-makers all over the world (Ketels et al., 2006, 2012; Perez-Aleman,

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2005). Within policy circles, there are high expectations of the contribution of bioclusters to the transition away from the use of fossil fuels while fostering innovation and rural development (Dietz et al., 2018).

Despite their popularity, neither of the two underlying concepts, cluster and bioeconomy, is very well defined. The terms ‘bioeconomy’, ‘biobased economy’, ‘knowledge-based bioeconomy’ and ‘circular bioeconomy’ are often used interchangeably but can have different meanings and implications (Lewandowski, 2018). Similarly, the cluster concept is ‘fuzzy’ and critics argue that cluster definitions and boundaries are often arbitrarily and subjectively chosen (Martin & Sunley, 2003). A shared understanding is, nevertheless, important to stimulate change and engage different groups in development efforts. When different actors attach different meanings to these concepts, a profound conceptual confusion ensues that will eventually impede realisation of innovation potentials (Beers et al., 2010). Since relevant stakeholders’ future expectations also steer investments and the selection of activities, they deserve strengthened research attention (e.g. Njøs et al., 2020).

Against this background, our paper aims to provide a clarification of the biocluster concept by investigating how different stakeholders interpret and value the different elements, meanings and promises. To that effect, we will analyse both components of the concept through the prism provided by sociotechnical imaginaries. Sociotechnical imaginaries describe attainable, desirable futures – ‘what constitutes the public good’ (Jasanoff & Kim, 2009). We will argue that both industrial clusters and the bioeconomy, have separate, but partly overlapping, sociotechnical imaginaries that are important in shaping stakeholders’ attitudes. Accordingly, the research question of this paper is: *How are sociotechnical imaginaries of a bioeconomy and industrial clusters combined and translated by regional stakeholders?*

With this question, we connect distinct fields. Although there are a number of studies of bioeconomy discourses (Bugge et al., 2016; Vivien et al., 2019) and regional cluster theory interpretations (Ebbekink & Lagendijk, 2013; Moulaert & Sekia, 2003; Njøs et al., 2017), these different perspectives remained separate. Our effort aims to contribute to a due consideration of the material, social and ideational aspects of bioclusters.

In the next section, we will first clarify the different concepts used in this paper: sociotechnical imaginaries, discourses and narratives. Furthermore, we present a categorisation of bioeconomy discourses that links them to existing environmental and sustainability discourses. Cluster conceptualisations are reviewed as well. This overview forms the basis on which different elements are included in the study and investigated for resonance in different groups’ visions of a good future.

We use Q-methodology to trace the uptake of imaginaries. Respondents from two different clusters, one in the Netherlands and one in Germany, have been asked to sort statements representing elements of deconstructed imaginaries. Statistical analysis of these sorts serves to identify different shared narratives of different groups of actors. These narratives will be presented in the result section. The paper ends with a discussion on the implications of findings for (bio)cluster theory and practice.

## 2. Sociotechnical imaginaries of bioeconomy clusters

As the starting point, we use the definition of Jasanoff and Kim (2009) who portrayed sociotechnical imaginaries as ‘collectively imagined forms of social life and social order reflected in the design and fulfilment of nation-specific scientific and/or technological projects’. This definition locates imaginaries at the level of the nation state and emphasises the role of government organisations in enacting sociotechnical imaginaries. In her later work, Jasanoff broadened the definition to also include the roles of other types of organised groups, such as social movements, corporations and professional societies in the co-production of imaginaries (Carrozza, 2015; Jasanoff, 2015). In this later definition, sociotechnical imaginaries describe desirable futures of what constitutes the public good and that are attainable through or supportive of advances in science and technology. Sociotechnical imaginaries result from discourses that deal with the future, especially related to (new forms and achievements) of science and technology. However, the concept of a ‘discourse’ has a number of different theoretical routes in the social sciences. For a comprehensive overview of that topic, we refer to the work of Arts and Buizer (2009) who identified four conceptualisations of discourse and approaches of discourse analysis: (1) discourse as communication, (2) discourse as text, (3) discourse as expression of mental frames and (4) discourse as social practice. These four categories are not mutually exclusive and partly

overlapping and most authors use a combination of different conceptualisations to analyse sociotechnical imaginaries.

In this paper, we refer to sociotechnical imaginaries in terms of ‘discourse as an expression of mental frames’ and ‘discourse as social practice’. The first approach emphasises how certain groups of actors share a certain ‘frame of reference or meaning’ that mediates their use of certain language. These frames live in the minds of people, known or unknown, and shape their mental models of the world. Based on shared conceptual frames, different groups identify certain problems and solutions (and not others) that can be revealed using the texts they use to communicate (Van Assche et al., 2014). Narratives result when individuals or groups combine some elements of discourses (concepts, subjects, objects and events) into coherent storylines that describe a problem, lay out its consequences and suggest (simple) solutions (Bauer, 2018; Roe, 1994). Using a frame-analytic approach, Eaton et al. (2014), for example, analyse sociotechnical imaginaries around bioenergy. Accounting for multiple understandings of the material world, popular narratives of past and future in specific places, allows them to identify competing sets of frames.

The use of discourse as practice is related to the work of Foucault (1994) and Hajer (1995) who highlighted the relation between discourses and social practices, including the shaping of institutional arrangements and power processes: different actors are empowered by particular social relations and can draw on discourses as an institutional resource to advance their agendas. In order to gain traction in society, imaginaries have to be enacted. This enactment leads to publicly visible experiments and prototypes, demonstration plants or projects that are accompanied by discursive practices that try to make sense of the enactment, supporting or rejecting what eventually represents social progress. Studies that highlight the ‘politics of sociotechnical imaginaries’ like Burnham et al. (2017) or focus on the on-going political struggles between actors promoting different visions in order to gain policy commitments and R&D funds (Levidow & Papaioannou, 2013) follow this conceptualisation of discourse.

We interpret sociotechnical imaginaries as results of a specific future-oriented form of discourse with an emphasis on the role of science and technology. Sociotechnical imaginaries can serve as a cultural resource that different actors can draw from, knowingly or unknowingly, to argue for certain solutions based on their identification of important regional problems or development potentials. This way, elements of diverse sociotechnical imaginaries are adopted and translated in specific regional contexts by specific regional actor groups. In the next two sections, we will present a review of the literature on discourses and imaginaries that refers to the bioeconomy and industrial clusters.

### 2.1. Discourses and imaginaries of the bioeconomy

Discourse analysis has been applied extensively to analyse the concept of the bioeconomy, for instance on the basis of scientific papers (Bugge et al., 2016; Pfau et al., 2014; Vivien et al., 2019) and policy documents (De Besi & McCormick, 2015; McCormick & Kautto, 2013; Ramcilovic-Suominen & Pülzl, 2018). Depending on their research interest, these authors identify two, three, four or five different discourses. To structure these different contributions, we use Dryzek’s classification of environmental discourses (Dryzek, 1997/2005). His categorisation allows us to bring different contribution into a single framework and at the same time links them to existing sustainability discourses.

Dryzek’s classification of environmental discourses centres around two axes (Table 1). The first axis is the general attitude (positive or negative) towards technology and industrialisation. Industrialisation and

**Table 1.** Classification of environmental sustainability discourses.

		Attitude towards industrialisation	
		Radical	Reformist
Place of the environment	Imaginative (integrated) Prosaic (separated)	‘Green radicalism’ ‘Survivalism’	‘Ecological modernisation’ ‘Problem solving’

Note: adapted from Dryzek (1997, p. 14).

**Table 2.** Overview of bioeconomy imaginaries.

	Biotech economy	Bioresource economy	Biosphere economy	Bio-ecology economy
Dryzek's sustainability discourse	Problem solving	Ecological modernisation	Survivalism	Green radicalism
Typical references	Organisation for Economic Co-operation and Development (OECD, 2009)	European Commission (2012)	Georgescu-Roegen (1978)	Levidow et al. (2013), Schmid et al. (2012)
Definition	A science-based economy driven by industrial biotechnology	A biomass-based economy	An ecological economy that is compatible with the biosphere	An ecological economy within local conditions
Aims and objectives	Economic growth and employment	Economic growth and sustainability	Human survival	Biodiversity of ecosystems, soil conservation
Research and technology	Industrial biotech as a goal: the main driver of progress	Biotech as a means to boost primary production and feedstock	Technology necessary to fit human activity within global biochemical cycles	Promotes co-production of knowledge and alternatives based on agro-ecological principles
Value creation	Application of biotech, commercialisation of R&D	Conversion and upgrading of bioresources	Focus on 'degrowth'	Localisation of production systems with territorial identity
Role of the primary sector	Mostly irrelevant	Narrow: Provision of raw materials	Part of global circular value chains	Focus on agro-ecological farming practices including landscape values

Based on Bugge et al. (2016), Dryzek (1997), Schmid et al. (2012), and Vivien et al. (2019).

technology are either a potential solution, or the main culprits of some of the most important environmental problems society experiences. The second axis is concerned with perceptions of the political-economic situation and its relationship with environmental problems. Prosaic discourses see environmental problems as things that require action; however, they do not require a new kind of society. In contrast, imaginative discourses seek to completely redefine the current situation. Environmental problems are rooted in the way economic and social systems are structured and solving these problems requires a complete re-organisation of society. Environmental questions are thus brought into the heart of political deliberations and this discourse envisages to identify 'win-win-win' solutions across the three pillars of sustainable development.

Building on Bugge et al. (2016), Levidow et al. (2013) and Vivien et al. (2019) it is possible to identify four bioeconomy imaginaries that are rooted in these typical environmental discourses: (1) a biotech imaginary, (2) a bioresources imaginary, (3) a biosphere imaginary and (4) a bio-ecology imaginary. These imaginaries provide a vision of the future that identifies different problems and proposes different solutions. Some of the decisive elements of the imaginaries are summarised in Table 2.

The biotech imaginary represents a typical 'problem solving' discourse in Dryzek's typology. It is closely associated with the Organisation for Economic Co-operation and Development's version of a bioeconomy (OECD, 2009). Central is the focus on the implementation and further development of biotechnology. The conviction is that it offers great potential to transform the way many products are being made. Economic growth based on a 'knowledge economy' that employs biotechnology is the goal. The primary sector doesn't really play a role in this sociotechnical imaginary – except as beneficiary of new breeding technologies that will increase production output.

The bioresource economy imaginary rests on an ecological modernisation discourse: it's fairly positive about the possibilities of technology and innovation and at the same time environmental concerns are assessed within the triple Ps of sustainability: People, Planet, Profit. The bioresource economy imaginary is closely linked to the bioeconomy vision of the European Union. Farmers and foresters play an important role as providers of biomass.

The bio-ecology imaginary is described by Schmid et al. (2012) as a public goods-oriented bioeconomy that emphasises agro-ecological methods, organic and low (external) input farming systems, ecosystem services, social innovation in multi-stakeholder collective practices and joint production of knowledge. The bio-ecology imaginary looks at the local and regional scale and favours the localisation of production. By contrast, the

biosphere imaginary, as originally elaborated by Goergescu-Roegen, has a global outlook on a bioeconomy and defines sustainability squarely on the global scale: a quest for human survival. This imaginary is far more pessimistic on the possibility of technological development and innovation to provide solutions for environmental problems: this might not happen, or only too late. Circularity is important here and defined on the scale of global biochemical flows (Goergescu-Roegen, 1978). The biosphere and bio-ecology imaginaries have a critical view on the role of technology. This does not mean that they are completely opposed to the use of technology. However, they often prefer different kinds of knowledge and technology rooted in specific knowledge frameworks around the issue of agro-ecology.

## **2.2. Discourses and imaginaries around industrial clusters**

Sociotechnical imaginaries around the cluster concept have their roots in the promotion of industrial clusters as a policy instrument for regional development in the work of Michael Porter. In the ‘The Competitive Advantage of Nations’, Porter (1990) made the observation that a country’s most competitive companies are often geographically concentrated in just a number of places: clusters. From that observation, it was a small step to actively promote the creation of new clusters in order to encourage regional competitiveness, innovation and growth. Policy-makers around the world have tried to create the ‘next Silicon Valley’ (Ebbekink & Lagendijk, 2013). However, Porter’s definition left ample room for interpretation and Martin and Sunley (2003) have criticised the subjective and arbitrary nature of the cluster concept in many scientific studies. The same is true for the uptake by other stakeholders:

actors will have different conceptions of what clusters are and in cluster projects, different cluster stakeholders, such as cluster facilitators, regional policy-makers, research and development (R&D) institutions, industry associations and firms, add new, and often divergent, interpretations of the traditional academic understanding. (Njøs et al., 2017, p. 2)

Although there is increasing awareness of the relevance of specific social and cultural practices, discourses and expectations that form cluster identities and development paths (Amdam et al., 2020; Hassink & Gong, 2019; Steen, 2016), social constructivist perspectives on clusters and cluster formation processes are still rare. The paper by Fløysand et al. (2012), where clusters are studied as a mix of discursive and material elements, is one of the rare exemptions. As examples of the material characteristics of a cluster they name the geographical co-location of firms, the flows of good and services between these firms and the local infrastructure with roads, buildings and laboratories. The discursive elements of a cluster are the result of communicative processes among policy-makers, academics, firm representatives and other stakeholders. Especially for ‘policy-driven clusters’ (Ebbekink & Lagendijk, 2013; Richardson et al., 2012), which are the result of strong commitment of governmental actors, discursive processes can precede the actual material agglomeration processes ‘on the ground’. Bioclusters are prominent examples of such policy-driven clusters. Reflections on the role of clusters in promoting green and sustainable innovations and for the re-orientation of existing clusters towards sustainable regional development have also been increasing in recent literature (Hermans, 2018; McCauley & Stephens, 2012; Sjøtun & Njøs, 2019).

Growing attention for the sustainability of industrial clusters has also broadened the associated sociotechnical imaginaries. The once dominant imaginary associated with the work of Porter had a focus on competitiveness, local factor conditions and innovation. This has broadened towards other expectation in terms of contributions to regional development and the transition towards sustainability. Thus, the focus of attention also shifts towards those processes that are of crucial importance in transition theories: vision development, networking and learning (Susur et al., 2019), the importance of leadership (Grillitsch & Sotarauta, 2019), environmental impacts of clusters at different scales and levels (Ayrapetyan & Hermans, 2020; Siebert et al., 2018), the emergence of radical innovations that are ‘new to the region and new to the world’ (Boschma et al., 2017) and other organisational forms, like Living Labs as sites to design, test and learn from innovations in real time (von Wirth et al., 2019). There is no overarching typology, yet, for a categorisation of evolving discourses and resulting imaginaries of green-tech and bioclusters. This paper could be seen as a first step towards creating such a typology: we investigate the actual narratives of stakeholders in a discursive

realm instead of the theoretical classifications that predominantly refer to the material properties of (bio)clusters.

### **2.3. Deduction of the research question**

With respect to a bioeconomy, we identified four imaginaries and linked them to existing environmental discourses. For industrial clusters, the dominant sociotechnical imaginary is related to the work of Porter. From our overview, we conclude that some combinations of bioeconomy imaginaries and expectations related to Porter-type clusters are a natural fit. For example, the biotech imaginary shares a positive attitude towards industrialisation and technology with the classical cluster concept and both promise increased competitiveness of industry. However, with an increasing attention for the role of clusters in sustainability and regional transition processes, the cluster imaginary is being broadened, challenged and stretched (Njøs et al., 2017). We are interested in the question how imaginaries of clusters and of a bioeconomy resonate in practice: how their enactment and adoption at the regional level brings certain elements to the forefront and diminishes the importance of others. Thus, we investigate real-world discursive interaction on bioclusters.

## **3. Case selection and Q-methodology implementation**

### **3.1. Case selection and characterisation**

To answer our research question, we have administered a Q-methodology study in and around two bioclusters. We selected clusters that emerged with early bioeconomy promotional strategies launched in the European Union, one in Germany ('Spitzencluster Bioökonomie', or SCB) and one in The Netherlands (Biobased Delta – BBD). From a material and discursive perspective, both clusters are similar in many aspects: both originated in the vicinity of old petro-chemical clusters, both clusters cross multiple governance scales (three provinces in the Netherlands and three Federal States in Germany) and both try to make use of local inputs from forestry or agriculture. From interviews conducted in both regions, we learned that some actors in both regions identify them as peripheral places that either lack intellectual luminance or innovation dynamic.

An important difference can be found in the innovation policy rationales driving bioeconomy promotion in the two countries. The Dutch innovation policy can be characterised as company-driven innovation for near-term growth with demand-driven promotional impulses and attention to eventual necessities of regulatory changes (RVO, 2015). German innovation policy has a stronger focus on science-driven opportunity exploration in a medium to long-term perspective (BMEL, 2016).

### **3.2. Construction of the concourse and statement sampling**

Q-methodology is a form of discourse analysis that combines quantitative and qualitative techniques to access personal experiences, preferences and beliefs (Brown, 1980; McKeown & Thomas, 1988). It is designed for small numbers of participants and does not require a random sample.

The first step in Q-methodology is the construction of a concourse that should capture the complete range of perspectives that different groups of stakeholders might have. We used different sources towards that end. Our most important source were the transcripts of 56 in-depth interviews that were done in the two cluster regions in 2018. These interviews were directed at the perceived hurdles and drivers of bioeconomy development. Interviewees were chief executive officers and chief technology officers of companies (19 German, 11 Dutch), researchers from universities, private and public R&D service providers (12 German; 4 Dutch) and representatives of the cluster and a few promotional units (4 German, 6 Dutch). Some respondents were residing in the cluster area but did not join cluster activities and therefore contribute the perspectives of 'outsiders'. Relevant interview statements were categorised and labelled by theme. This collection of statements was enriched with other sources such as press releases, strategy papers, speeches and other materials published

by stakeholder types which were not covered by the interviews. Out of all sources, we gathered about 250 relevant statements from the German and Dutch context each.

The second step was to compose a sample from these statements. We used a structured sampling matrix, based on the different elements of the bioeconomy cluster imaginaries, identified earlier. This way, we included a total of nine categories, more precisely: categories related to elements of bioeconomy imaginaries, categories that are related to old and new imaginaries of clusters and elements that are shared by both.

- (1) Regional economic characteristics and bioeconomy rationale.
- (2) Concept of nature, agriculture and forestry.
- (3) Role and characteristics of markets.
- (4) Role of consumers.
- (5) Role of knowledge and research.
- (6) Role of the government.
- (7) (Transition) Management strategy and process steering.
- (8) Relevance of (bio)cluster policy.
- (9) Role of and impact on the rest of the world.

It is important to note here that we found no statements, neither in the interviews nor in the additional material gathered that matched elements of the biosphere discourse of Goergescu-Roegen. It seems to be an academic or radical non-governmental organisations' (NGO) imaginary without relevance for current policy discussions. Likewise, Vivien et al. (2019) concluded that this original bioeconomy discourse was 'hijacked' by a green growth imaginary. Therefore, we decided to drop this category out of the sampling matrix.

Statements in these nine categories were prioritised in view of their clarity and thought-provoking formulation. Through several discussion and selection rounds, a total of 36 statements were finally chosen to best represent divergent bioeconomy and cluster imaginaries. Original statements were translated with attention to issues of cross-cultural understanding. An effort was made to keep the tone and substance of the original statements reflected (see Annex, Table 4). Six pre-tests were implemented and led to the final Q-sort.

### 3.3. Mobilisation of respondents and Q-sorting

Potential respondents were selected from known contacts in and around the two clusters and complemented by internet research on missing or underrepresented stakeholder types. The process resulted in invitations to 75 Dutch and 83 German organisations. The respondents, who participated in the study, are specified by actor type in Table 3. In both clusters, seven respondents also participated in the 2018 interviews.

Data collection took place via the platform QSortWare, developed by Pruneddu (2017). Respondents were guided through the software-supported rank-ordering of the statements in Dutch and German in March and April 2020. The 36 statements were sorted on the grid displayed in Figure 1. Researchers contacted the respondents for clarifications in cases of perceived inconsistencies.

**Table 3.** Number of respondents, by actor type and nationality.

	DE*	NL**
Regional Government/Policy	4	3
Regional Development Promotional Agency	1	1
NGO (Environment & Consumer Protection)	4	0
University (of Applied Sciences)	2	4
Research Institute/R&D Service Provider/Cluster management units	3	2
Company (Industrial Economy)	3	5
Agriculture & Forestry Business Association	1	0
Industrial Business Association	3	0
Total	21	15

\*Stakeholders from Saxony-Anhalt, Saxony and Thuringia.

\*\*Stakeholders from Brabant, Zeeland and Zuid Holland.





production without making any difficult choices or radical life style changes: green growth will preserve employment, while industry absorbs less (fossil) resources, recycles them and produces less waste. Agricultural land use and environment protection go hand-in-hand with a diversified farm structure and the import of raw materials from abroad is not problematic. There is a large trust in the market: when prices include external effects, government can stay in the background. Biobased solutions will flourish and the rest of the world will benefit in terms of reduced inequality. This narrative take the existing industrial sectors as the starting point for further development with a biocluster. Biotechnology is not a major concern in this narrative because it's not perceived as a strong point of the regions. The task of clusters in this narrative is to build new actor networks and cross-industry value chains.

### ***Factor 2: industry policy for a bioeconomy with biorefineries***

This narrative believes strongly in the future of regional biorefineries. They shall build on the existing competencies in industrial processing of agricultural and wood resources, and in chemistry. Biorefineries allow the substitution of fossil fuels, but leave the rest of the value chain intact. Life style changes are, therefore, unnecessary. The role of agriculture is to supply these biorefineries with large feedstock volumes. Biotechnology has no role to play in agriculture but is relevant for industrial processes in organic chemistry. Here, sustainability is not prioritised as much as in the Factor 1 and 3 narratives: the Factor 2 perspective does not aspire full inclusion of social and environmental costs. Conditions in the rest of the world are not perceived as a regional responsibility.

University spin-offs and entrepreneurial graduates are important in this perspective, while clusters are evaluated positive but are not expected to play a prominent role. Stronger than all other narratives, the Factor 2 storyline argues for government support with global competitive pressure and jobs in the region. It appears to belong to industrial incumbent. However, primarily (non-biotech) researchers in our sample supported the call for subsidised first-of-their-kind biorefineries.

### ***Factor 3: green transition with industry-led bioclusters***

Change towards increased sustainability is rated as urgent in this narrative. The vision for the region is to turn it into a European hotspot of high-tech companies. Biorefineries are part of such a high-tech strategy, but regional agriculture and forestry are not. This is the narrative of ambitious technology-based entrepreneurs who see themselves leading the transition. These actors may rely on global sourcing of feedstocks and will come up with scalable technical solutions and provide good quality goods at reasonable prices with reduced environmental impact and waste. Clusters serve the (industry's) purpose to create new contacts or industrial alliances, but that is about it. This perspective has no role for inspirational leaders or a management team with politicians and researchers. Strong disagreement to this narrative was raised by an environmentally concerned SME as well as by a business association from agriculture and forestry. More pronounced than in the Factor 2 (and unlike in the Factor 1) narrative, the future is not 'for all' to benefit.

### ***Factor 4: bioeconomy with science leadership***

The fourth narrative is positive about the prospect to harmonise economic growth and sustainability. Support for bioeconomy development is not particularly grounded in regional characteristics. Instead, the general contributions of biotechnology to sustainable and efficient agriculture and biobased industrial production are highlighted. Accordingly, actors express worries about a brain drain from the region and Europe at large due to strict regulations on Genetically Modified Organism (GMO). The future will be technology driven, like in the Factor 2 and 3 narratives, and the rest of the world is associated with competitive threats. The government should support the bioeconomy and cluster promotion is regarded as a suitable and effective strategy as clusters are seen as a good way to disseminate the results of fundamental research. Universities and researchers play a leading role.

This narrative is supported by German respondents only, namely researchers who work close to natural resource production and processing at institutes of applied research and universities. In this perspective government-assisted and managed change is welcomed – in contrary to the Factor 3 and Factor 5 narratives.

### **Factor 5: growth and free markets**

This is the narrative where the rest of the world is neither a threat nor something to care about. It is not concerned with (environmental) sustainability or any change in the regions' agricultural sector. Instead, there is alignment with the Factor 3 framing of the region as seedbed and hotspot of high-tech companies. As growth is considered important for continued prosperity, the diverse qualities of the region can and should be leveraged in competition on global markets. This narrative detests government subsidies, rejects government steering efforts in regional development and clusters. The latter are perceived as ruled by 'the establishment' and built for subsidy acquisition.

This narrative is supported only by Dutch respondents in our sample. These are a regional representative of a right-wing populist party, a senior official in regional development promotion and an innovative company fighting with market access hurdles in spite of superior environmental performance of the product. Perspectives expressed are positioned closest to the Factor 2 and 3 narratives and underline that it is best to leave economic dealings to businesses which will also employ and feed ordinary people in the region.

## **5. Discussion and conclusions**

We started with the question how local stakeholders combine and translate (inter)national imaginaries of a bioeconomy and clusters. Which elements of the two imaginaries found resonance and gained traction in regional actors' narratives about a good future? We will first review the uptake of the bio-ecology imaginaries and then discuss the uptake of the different cluster imaginaries to come to our conclusion.

### **5.1. Resonance of the bioeconomy imaginaries in distinct shared narratives**

We analysed the average *z*-scores for each of the five narratives on the statements associated with the three guiding bioeconomy imaginaries we used in our sampling matrix ('bio-ecology', 'bioresources' and 'biotech', see Figure 2). High appreciation of the bio-ecology and bioresource imaginaries is present in the Factor 1 narrative supported by a broad range of respondents. Even higher resonance can be found between the bioresource imaginary and the Factor 2 biorefinery-focussed narrative supported by researchers. Bio-ecology is rejected, because it is associated with small scale agriculture that doesn't fit with the assigned role of the primary sector as feedstock producer. The Factor 3 narrative also leans towards the bioresources imaginary. Biorefineries have a role to play while high-tech entrepreneurs are the driving force. The biotech imaginary got substantial traction only in the Factor 4 narrative. By contrast, the Dutch Factor 5 narrative simply does not subscribe to any of the bioeconomy imaginaries: these are perceived as yet another lever of established elites to justify their lobbying for government support.

An important conclusion is that certain bioeconomy imaginaries are rejected by each narrative leading to controversial relations of the distinct storylines and supporting actor groups. The bio-ecology and the biotech imaginaries actively exclude each other in our results. The bioresource imaginary takes up a middle ground. It can be positively associated with bio-ecology (as in Factor 1), or it can be positively associated with biotech as it is in Factor 3 and Factor 4. Based on these conflicting narratives we diagnose a lack of a societal consensus over the significance and definition of problems or attainable objectives in both cluster regions. A majority of stakeholders subscribing to Factor 1 rather ignores that a combination of the bioresource and bioecology imaginaries (Fritsche & Rösch, 2020) is problematic with growing demands around the globe (Fritsche & Rösch, 2020; Piotrowski et al., 2016).

Widespread criticism of the biotechnology imaginary, for instance about an insufficiently precautionous treatment of biotechnology applications in agriculture (Brunori, 2013; Schmid et al., 2012), might explain why the

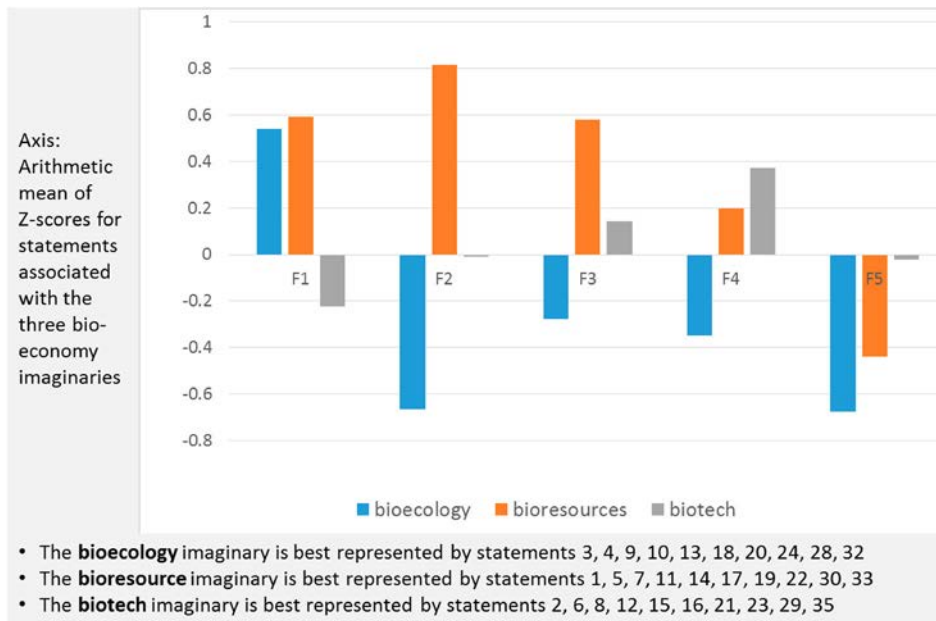


Figure 2. Representation of bioeconomy imaginaries in stakeholder narratives.

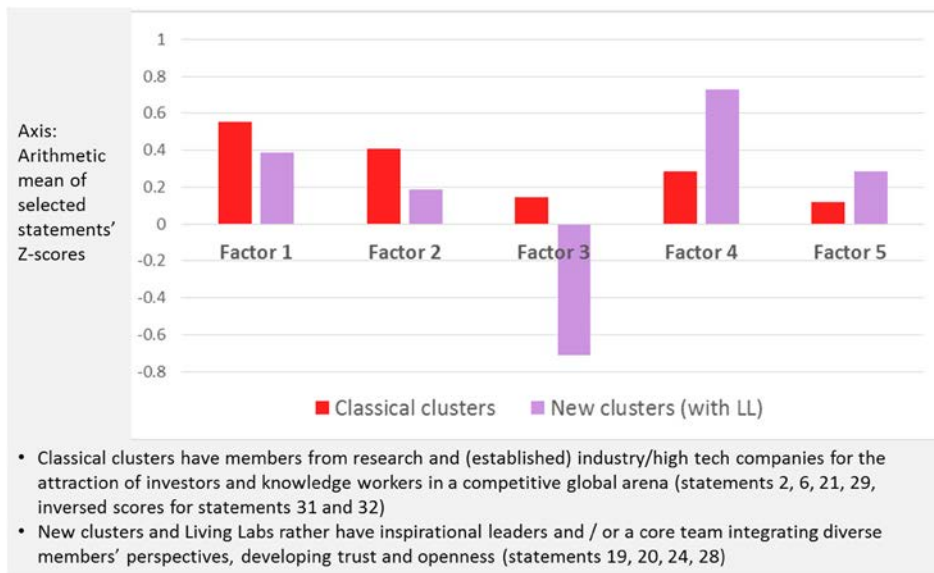
biotech imaginary doesn't play an important role (neither negatively nor positively) in most narratives. Most respondents don't see the problem of biotechnology research leaving Europe that was highlighted by Factor 4 supporters.

### 5.2. Resonance of cluster imaginaries in the narratives

We have argued that with the inclusion of the issue of sustainability leads to a recognition of other shapes and functions of clusters beyond Porter's focus on competitiveness and innovation. New cross-sectoral interaction with an inclusion of actor groups like, e.g. NGOs and consumers is increasingly advocated. As a consequence, 'new' clusters require orchestration of more actors, inspirational leadership and active steering of collaboration arrangements. In Figure 3, we have visualised how each of the five narrative scores on statements that refer to Porter type of cluster imaginaries and 'new' cluster imaginaries.

In contrast to the high level of controversy on bioeconomy imaginaries, imaginaries connected to both 'old' and 'new' types of clusters are viewed positively in almost all the narratives. The Factor 3 (industry-led bioclusters) represents the only exemption. Successful high-tech entrepreneurs view their peers not in the region, but on the global playing field. This narrative doesn't really care about any type of cluster, (old or new), and rejects any major involvement of politicians or researchers in their dealings. The Factors 1 and 2 storylines have a preferences for old clusters, although both also have some positive recognition of aspects associated with new clusters. Different rationales are likely: The Factor 1 relies less on the government but places stronger hopes on the broader civil society to drive the transition. Factor 2 supporters prefer collaboration with the group of established (large-scale) companies and research centres but also recognise the need for some government support, regional development finance and the involvement of university spin-offs.

Supporters of the Factor 5 narrative show up with quite some appreciation of more inclusive Living Labs that might at least be expected to not (only) serve the established elites. The high score for the new cluster associated with the Factor 4 (the science-led biocluster narrative) demands some explanation. We hypothesised that the biotech imaginary would be positively associated with the traditional view of



**Figure 3.** Shared narratives in relation to different sociotechnical imaginaries of a (bio)cluster.

clusters. The Factor 4 narrative scores high on 'old' cluster imaginaries, but still likes the alternative new cluster imaginary best. Thus, we assume the need to achieve more societal acceptance of biotech applications and products to drive supporters towards deepened contacts to consumers and NGOs.

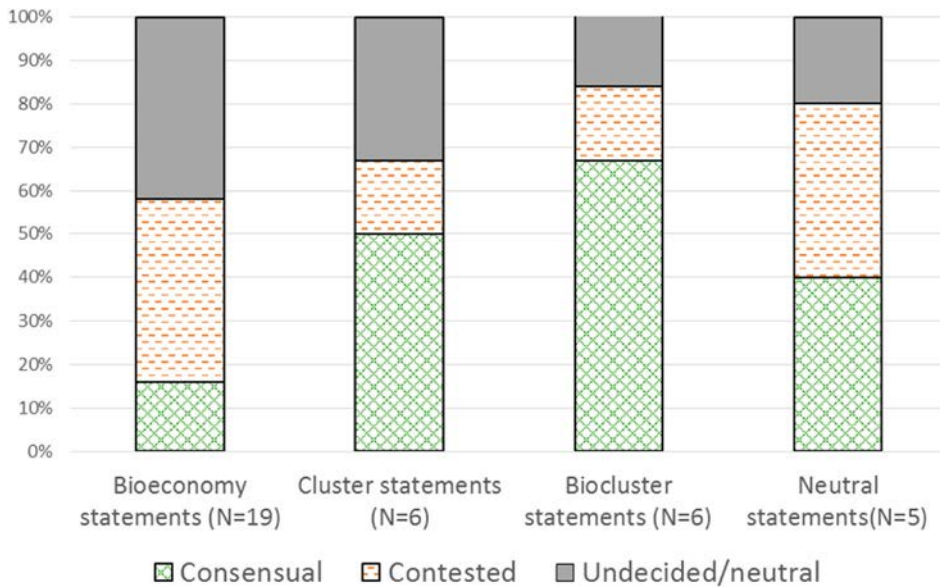
### 5.3. New imaginaries around bioclusters

From our overview of the resonance of cluster and bioeconomy imaginaries in the different narratives, we can conclude that the bioeconomy imaginaries received more contestation than the cluster imaginaries. After years of government-supported cluster promotion almost every narrative can benefit from a 'next Silicon Valley'-imaginary to draw upon (Ebbekink & Lagendijk, 2013). It can be flexibly stretched from no-government-involvement in the Marshallian dynamics of industrial districts to high-government-involvement in clusters formed in the framework of mission-driven innovation policy.

In our two cases the cluster requirement of geographical co-location of companies is weakened. In the later stages of the German SCM cluster development, membership was expanded to firms located far away. Similarly, Flemish-Dutch transboundary contacts were mobilised early on in order to frame the BBD cluster as a bioeconomy 'mega-cluster' at the European level (RDI2CluB, 2018). The fact that this 'cluster' has no registered membership makes it even clearer that BBD is rather developed by inspirational leadership in the discursive realm than by the infrastructure and regional characteristics in the material realm.

In order to substantiate this reading of results, we ranked Q-sort statements in the order of their standard deviation across the five z-scores. A high standard deviation indicates a controversial evaluation, while a low standard deviation indicates a degree of consensus. We then segmented the statements into three equally strong (12 statements each) categories with high consensus, a mid-range between consensus and contestation, and contested statements.

As shown in Figure 4, only 16% of bioeconomy statements (three out of 19) were among the consensual statements, while the same applied to three out of six cluster statements. The statements that combined a reference to bioeconomy and cluster imaginaries recorded a high degree of consensus for most of the statements. This confirms again that the bioeconomy imaginaries are rather contested, while the cluster imaginaries



**Figure 4.** Consensual and contested imaginaries in Q-methodology results.

mobilise overwhelmingly positive associations with resonance across diverse stakeholder groups. From this perspective, the popularity of the cluster concept in policy and across other relevant actor groups helps the bioeconomy concept to gain traction. With the main cluster argument of augmented competitiveness and the main bioeconomy argument of strengthened sustainability, a biocluster imaginary becomes a winning proposition in the discursive realm.

#### 5.4. Limitations and further research

Q-methodology is not built on random sampling and this means that we cannot extrapolate our results beyond the chosen cluster regions. Moreover, our two clusters are examples of (potential) green chemistry clusters while the biocluster concept includes also other types: clusters entirely focused on the life sciences, fashion districts or food clusters (Hermans, *in press*). As such, findings resulting from the two cases only represent a small subsection of possible biocluster narratives. An even wider variety connecting specific bioeconomy and cluster imaginaries may surface in other contexts. Future studies could also aim to differentiate the analysis further and thereby account for different types of regional innovation systems, specific industries and the perception of incumbents vis-à-vis ‘born green’ start-up companies and their scientific counterparts.

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