DEFINING SUCCESSFUL CRITERIA FOR REGIONAL BIOECONOMIES DEVELOPMENT

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Abstract

The paper is devoted to defining successful criteria for regional bioeconomies development. It is defined that the domestic production of biomass can result in a cheaper supply of biomass than would otherwise be available, however practical experience of the regional partners. A successful bioeconomy is one that maximises both the supply-side and demand-side of the market to ensure both that it is able to produce, and sell, bioeconomy products and services. Bioeconomy can be split into three distinct market segments; the sectors that supply biomass, those that convert biomass into intermediate products and those that bring biobased end-products to market. It is given such successful regional bioeconomies criteria: environmental, economic and social. Each criterion is matched with a bioeconomy model characteristic and a market model driver, agents that help the corresponding models function.

Key words: *regional bioeconomies, supply of biomass, bioeconomy model, intermediate products, production factors.*

JEL Classification: O13, Q12, Q20

Introduction

Bioeconomy development is constrained by the availability of sustainably sourced resources and the efficient exploitation of production factors such as land, water and human capital/labour (European Commission, 2013). Bioeconomy development plays an important role not only in reducing greenhouse gas emissions but also for the potential positive effects on soil, water and air quality all of which are essential to the sustainability of bioeconomy resources. The literature (European Commission, 2012, Teagasc, 2008 and Eduardo and Guy, 2012) indicate managing resources sustainably and mitigating and adapting to climate change are important challenges of bioeconomy.

The literature on the drivers of regional bioeconomy can be classified under the three key pillars of EU policy (Biomass Energy Europe, 2011) namely: economy – regional development; society – social inclusion; environment – sustainability & resource efficiency. Within these policy areas, the literature classifies and assesses the key drivers of regional bioeconomy. This involves a review of the characteristics of successful bioeconomy and an assessment of these characteristics through measureable

criteria as well as developing policy recommendations based on the findings. The literature is largely policy-orientated, although studies often provide empirical indicators for measuring drivers of bioeconomy. The literature also largely focuses on the environmental aspects of bioeconomy, although the economic aspects are also explored to an extent, while the societal characteristics are not explored in any great depth.

Most of the literature focuses on the link between the environment and the economy and to a lesser degree society although many studies define environmental challenges as social issues and vice versa (European Commission, 2012 and European Commission, DG JRC, 2013).

There are a lot of works both of the Ukrainian and foreign authors devoted to the bioeconomy formation and development. For example, Shubravska O., (2010) analyses the world experience of the bioeconomy development Ryabchenko O., (2013) emphasizes the social element and forms the definition of the bio-social economy as a form of economic activity based on interaction of three systems – economic, ecologic and social that is defined by processes of mutual exchange by renewal bio-resources with the aim of saving of ecological balance for the next generations. Potapenko V., (2012) makes organizational and economic mechanisms which allow instilling the principles of "green" economy. Researches of the European project «Systems Analysis Tools Framework for the EU Bio-Based Economy Strategy» (SAT-BBE) make the systematic analysis of the bioeconomy, define its role, place and impact on the other sectors, particularly economic, ecologic and social impacts with developing of conceptual instruments, identify and analyze main effects of feed-back between the bio-economy and other parts of the system.

Material and Methods

Current EU development strategies, such as the Europa 2020 strategy, the Bioeconomy Strategy for Europe and the Research and Innovation Strategies for Smart Specialization (RIS3) include many incentives for regions to develop a bioeconomy cluster. Based on a review of existing literature and the views of regional and research partners, it was identified a list of criteria important for the development of regional bioeconomy. For capturing the state of these criteria, it has been identified and collected quantitative indicators, specific to each subsector of the bioeconomy. By using these indicators it was constructed an 'at a glance' analysis of the state of the criteria in a given region and subsector. In the analysis of the development path of a bioeconomy cluster, it has been assumed that the actors of the region, in which the cluster is located, apply a strategy to develop the bioeconomy by transforming biomass into competitive bioeconomy products.

A network of Bio-Regions is developed by the method of Community of Practice. A Community of Practice (CoP) brings together practitioners, policymakers, companies, cluster managers and researchers to jointly explore and share experiences on the development of regional bioeconomies in Europe. The objective is to increase the mutual understanding of how actors interact with each other in bioeconomy regions and to jointly build a toolkit by finding alignments with EU regions, Member States, EU policies, institutions and networks.

The data for the paper is taken from The State Statistic Office of Ukraine (2010-2014), publications and reports of the European Commission (2008-2013), OECD (2004-2011), International Journals in Economics: Science, Technology & Human Values

(2013), Integrated Assessment (2006), Science as Culture (2012), Life Sciences Society and Policy (2006), Critical Policy Studies (2012).

In the paper the descriptive analysis, supported by the quantitative analysis is applied.

Results and Debate

Availability of resources

The domestic production of biomass can result in a cheaper supply of biomass than would otherwise be available, however practical experience of the regional partners (amongst whom a number have imported large amounts of biomass rather than producing it) suggest that this is not a fundamental requirement for the operation of a successful bioeconomy; as such while domestic production of biomass might be desirable within certain sub-sectors of the bioeconomy, and should certainly be assessed, it can only be classified as being desirable, rather than essential to the development of bioeconomy.

Land use is the final aspect of resource availability that is identified as a criterion against which the success of a bioeconomy can be assessed. This can refer to the use of land for the production of bioeconomy (as identified above, an important factor in the development of some but not all bioeconomies) or the use of land for other stages of the bioeconomy. However, what is clear is that all bioeconomies that wish to expand need suitable land use policies which allows for the development of new processes and the establishment of new firms, and it is therefore classed as a key criteria. Primary examples of this include soil management, climate change adaptation, water management and nutrient management.

The bioeconomy model

A small number of the reviewed papers included a model of the bioeconomy. Having a clearly defined understanding of the operation of the bioeconomy is key for understanding how drivers and criteria for bioeconomy development are prioritised, and how the criteria assessed in this Work Package link to the instruments and measures that are explored in Work Package 2.

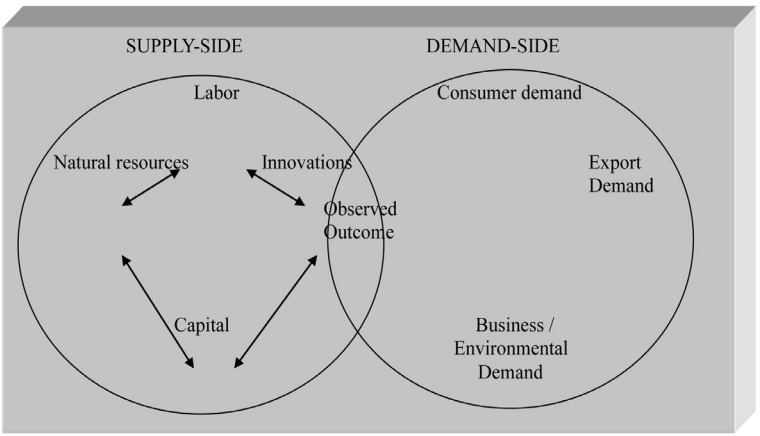
The most relevant model of bioeconomy reviewed in the literature was the SAT-BBE project (2013). This model concentrates on the demand and supply of biomass, and identifies the key drivers that feed into the bioeconomy; however, it does not break down the demand and supply-sides of the market in any great detail. An alternative model of the bioeconomy is presented in Regional Biotechnology (PwC, 2011), although this focuses solely on the supply side.

It is clear from the reviewed literature that an all-encompassing model of the bioeconomy must consider both the demand-side and supply-sides of the market for bioeconomy. A successful bioeconomy is one that maximises both the supply-side and demand-side of the market to ensure both that it is able to produce, and sell, bioeconomy products and services. Bioeconomy as a whole can be split into three distinct market segments; the sectors that supply biomass, those that convert biomass into intermediate products and those that bring biobased end-products to market. Clearly each of these has different priorities in terms of the supply and demand for

products. The model should take account of the factors of production (which affect the supply side) and the demand for bioeconomy both within and outside of the region (i.e. the demand side). Adopting a 'factors of production' approach to the supply side enables us to evaluate separately the criteria related to each element of the supply-side (Kean Birch, 2013). Here we consider separately the three classical factors of production: land (or, in a bioeconomy context, natural resources), labour (meaning human capital) and capital (describing the processes used within the bioeconomy); as well as a fourth factor, innovation, which while not traditionally a factor of production in itself, nonetheless plays a major role in how the three factors interact to determine the overall supply of bioeconomy products. On the demand-side we have consumer, export, and business demand combined. This gives us the following overall framework (Chart 1).

The observed outcome for bioeconomy is the area in which the supply-side and demand-side overlap; therefore the key to a successful bioeconomy is to maximise the overlap between these two. Each of the criteria that are identified in the literature (and which we expand upon below) are aimed at measuring the state of the regional market for bioeconomy: either through capturing the state of the supply side (i.e. one of the four identified factors of production), the demand side (i.e. the identified markets for bioeconomy) or the interaction between the two (e.g. the point at which demand and supply intersect).

Chart 1. The vision of the bioeconomy model



Source: Building Regional BioEconomies, (2014)

This model does not pre-suppose an outcome. It is possible for demand and supply to have no overlap without policy intervention, and indeed, in regions with little or no existing bioeconomy, a key question to be answered through this project is where specific strategies should be targeted within this model to maximise deployment of the regional bioeconomy.

Successful regional bioeconomies criteria

Environmental criteria

Resource availability is clearly classified under natural resources in the supply factors of our model of the bioeconomy. Whether from domestic production or through imports, the availability of sustainably sourced biomass is the single most important driver of bioeconomy development. Both from the literature and the practical experiences of regional partners it is apparent that without biomass a functioning bioeconomy is impossible. Therefore biomass availability is the first criterion identified, and is classified as an essential criterion of bioeconomy development.

Economic criteria

Clusters. The literature review highlights the role of clusters in successful bioeconomy and we group this, as a contributor to the innovation capacity in the region economy, as clusters pool knowledge and resources in extending the productive capabilities of firms via greater innovation. This is further reinforced by the experiences of the regional partners, whom all have their bioeconomy concentrated within small geographical areas. This highlights the importance of successful clusters to a successful bioeconomy.

Finance. The development of bioeconomy is further aided by availability of funding to companies and new technologies via instruments such as microfinancing and guarantees of large scale orders and it should be noted that finance models vary across the EU (e.g. German bank-based versus UK market-based models). These are desirable instruments in developing innovation and economic growth in bioeconomy and should direct towards innovation in particular. While bioeconomy may succeed on self-financing and existing market funding, schemes targeted at high-potential innovative companies will reduce the restraints that lack of access to funding places on the growth of firms (Joanna Goven, 2006).

Infrastructure. Infrastructure refers to the capacity of the transport, communications, complementary industries and utilities network in and around a bioeconomy. Therefore, this is classified as capital in the model above as the factor of production which increases both the efficiency and the productivity of other factors of production (Joanna Goven, 2012). There are three potential areas for exploitation of infrastructure; a strong transport infrastructure (road, rail, water, air) allows for the low-cost import and export of biomass and other bioeconomy products, as well as increasing the viable commuting distance for a potential workforce, while a strong communications, complementary industries and utilities infrastructure allows for the easy sharing of existing technology and uptake of innovations; finally a strong environmental infrastructure, able to mitigate environmental impacts, will aid sustainability of biomass supply and reduce long-term externalities.

Industrial culture. Industrial culture covers a large number of characteristics of the business base of a region and is classified under the innovation category of our model above. It includes the innovation culture; the rate of formation of SMEs (which the literature suggests is a key criteria for strong bioeconomy development as SMEs can fill 'gaps' in the value chain and are more prone to innovation); and the presence of multinationals (which can promote growth of the bioeconomy through the potential for large-scale investment). The economic history of the region is a

key characteristic which determines both the current level of development of the bioeconomy, but also current levels of capital and infrastructure which influence both the market for the products as well as the potential for investment.

Industry mix. The industry mix of a bioeconomy can play a desirable role in developing bioeconomy.

Collaboration across industries such as agrifoods and chemicals in research and development including collaborator and integer business models augment existing innovation successes and improve the performance of the bioeconomy. This is classified under the innovation category of our model.

Innovation. Innovation is a key criterion in the growth and establishment of bioeconomy and its importance is reflected in its classification as a factor of production in our model above. While bioeconomies may exist on current technologies, the growth of new technologies is a key to future growth and in sustaining the bioeconomy against competitors. In particular, the literature notes commercialization of innovative technologies as well as the diffusion of technology as key criteria in driving a bioeconomy to effectively capitalize on R&D activity (Kean Birch, 2006). The ability to absorb the diffusion of technologies is important in allowing growth convergence with the most innovation economies while the commercialization of innovative technologies is a key to generating the growth of the bioeconomy at the technological frontier.

Macroeconomic trends. The demand for bioeconomy products is an important criteria and falls into both the consumer and business demand classifications in our model. The literature highlights the role of consumer preferences in the development of bioeconomy (for example, the global emphasis on climate change driving consumers to more sustainable energy sources) and suggests consumption and production incentives to stimulate demand. Linked to this is public support and acceptance of bioeconomy products. Alleviating safety concerns about bioeconomy products and including the public in the discussion on the desirability of bioeconomy products will improve the ability of firms to both produce products appropriate to consumer preferences in the market and grow the market for new products based on consumer desires and/or changing perceptions about the products.

Another desirable criterion is changes in household income which not only increases general consumer consumption but also the preferences for new and innovative products.

Social criteria

Demographics. A range of demographic factors are desirable criteria of bioeconomies. Larger markets via greater population growth can stimulate greater demand and is classified as consumer demand. In addition, greater public acceptance for bioeconomy products and a more skilled labor force by increasing levels of education and human capital increases both the productivity of the bioeconomy sector and the demand for their products with can be classified under both consumer demand and capital in our model above.

Academic Institutions. Clustering and innovation within bioeconomy is augmented further by desirable criteria such as containing high quality universities or research institutes. Collaboration between institutions and industry further increases innovation output. Beyond this, the quality of those collaborations and research institutes are clearly paramount to successfully benefitting from these criteria; and this will be explored further in the work to quantify these criteria.

Regulation. Regulation of the safety of bioeconomy products with clear technical standards (to reassure producers and consumers) as well as stronger intellectual property rights securing the incentives to innovate are key criteria (Les Levidow, 2012). Standardization and methods of 'locking in' markets, along with the enforcement of intellectual property rights, provide a large degree of certainty to private companies operating (or wishing to operate) in the bioeconomy sector. Governance is an essential criteria for bioeconomy; activities range from offering subsidies to producers to including key stakeholders such as citizens, firms and influential government decision makers in the development of bioeconomy which links to the public acceptance of bioeconomy products. Feedback from regional partners is that without this government intervention (particularly the financial measures) there would, in the vast majority of cases, not be a functioning market for bioeconomy products. Finally, integrating cluster initiatives in the broader microeconomic policy particularly in trade policy is another desirable criteria as well as prioritizing biotech at the regional and/or national level.

Public attitude. Public acceptance of bioeconomy products is a desirable criteria and feeds into other drivers such as safety issues which involves effective governance/regulation as well as consumer preferences and can enhance the take-up of bioeconomy products. This falls under consumer demand in the model above (Table 1).

Table 1 Regional bioeconomies criteria

Criteria	Characteristics	Market model driver	Importance of criteria		
			Essential	Key	Desirable
Environmental criteria					
Biomass availability	Resource availability	Natural resources	+		
Domestic production of biomass	Resource availability	Natural resources			+
Land use	Resource availability	Natural resources		+	
Infrastructure	Infrastructure	Capital	+	+	
Economic criteria					
Cluster size	Clusters	Innovation			+
Cluster management	Clusters	Innovation		+	
Cluster governance	Clusters	Innovation		+	
Commercialization of innovative technologies	Innovation	Innovation		+	
Diffusion of technology	Innovation	Innovation		+	
KET R&D focus	Innovation	Innovation			+
Consumer preferences	Macroeconomic trends	Consumer demand			+
Public support and acceptance	Macroeconomic trends	Consumer demand		+	
Household income	Macroeconomic trends	Consumer demand			+
Availability of funding	Finance	Capital			+

Proximity to financial institutions	Finance	Capital			+
Rate of SME formation	Industrial culture	Innovation		+	
Presence of multinationals	Industrial culture	Capital/ innovation			+
Economic history	Industrial culture	Capital		+	
Collaboration	Industrial culture	Innovation		+	+
Enterpreneurial culture	Industrial culture	Innovation		+	
Quality of workforce	Demographics	Labor			+
Social criteria					
Prominent universities or research institute	Institutions	Innovation			+
Regulation	Regulation	All		+	
Intellectual property rights	Regulation	Innovation			+
Governance	Regulation	All	+		
Trade policy	Regulation	Consumer&business demand			+
Size of population	Demographics	Labor/ consumer demand			+

Source: Building Regional BioEconomies (2014)

The analysis above outlines the decisions made in prioritizing criteria of the bioeconomy, based upon the literature review and how regional economies (both bioeconomy and other sectors) develop. Each criterion is matched with a bioeconomy model characteristic and a market model driver, agents that help the corresponding models function. Linking the criteria to these characteristics and drivers may indicate what role each criterion plays in the models or in other words, what aspects of the bioeconomy or market it influences.

Conclusion

Given analysis allow to make such conclusions. Bioeconomy development is constrained by the availability of sustainably sourced resources and the efficient exploitation of production factors such as land, water and human capital/labour.

The domestic production of biomass can result in a cheaper supply of biomass than would otherwise be available, however practical experience of the regional partners (amongst whom a number have imported large amounts of biomass rather than producing it) suggest that this is not a fundamental requirement for the operation of a successful bioeconomy; as such while domestic production of biomass might be desirable within certain sub-sectors of the bioeconomy, and should certainly be assessed, it can only be classified as being desirable, rather than essential to the development of bioeconomy.

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