Bio-based and Applied Economics 7(2): 179-190, 2018
DOI: 10.13128/bae-7674

Short Communication

Bioeconomy and the Common Agricultural Policy: will a strategy in search of policies meet a policy in search of strategies?

Davide Viaggi

Dipartimento di Scienze e Tecnologie Agro-Alimentari, Università di Bologna

Date of submission: 2019 25th, June; accepted 2019 15th, July

Abstract. Both the revised EU Bioeconomy strategy and the proposals for the Common Agricultural Policy (CAP) 2021-2027 were released in 2018. This paper explores the connection between these two policy areas, the needs for economic and policy research and the way economic literature in the field of the Bioeconomy is meeting these needs. The paper concludes that the two policies are highly complementary in principle, but the current exploitation of potential synergies is largely delegated to the implementation stage of the CAP, hence to country and local programming authorities. To make both policies effective, and to bring about constructive synergies, the availability of bridging concepts allowing for territorial-level integration of chain and ecosystem services views is key. However, on the practical side, monitoring indicators for policy and economic/management support to developing sectors is even more important. Support to innovation design, uptake and exploitation will remain key to the sector and will need a proactive and participatory collaboration among multiple actors. The increased relevance of the role of ecosystem services and environmental attention in both policies will make the results more dependent on the ability to understand the value of public goods and to incorporate them into policy design and marketing strategies.

Keywords. Bioeconomy, Common Agricultural Policy, Rural development, EU.

JEL. Q00, Q01, Q02, Q57.

1. Introduction and objectives

Interest in the Bioeconomy has been growing steadily in recent years, both in policy and literature. A growing number of countries have Bioeconomy strategies and are implementing policies that promote the development of the Bioeconomy (El-Chichakli *et al.*, 2016; German Bioeconomy Council, 2018). Markets for bio-based solutions are growing and are attracting the attention of consumers and investors alike. Applications are at times

Corresponding author: davide.viaggi@unibo.it

ISSN 2280-6180 (print)
ISSN 2280-6172 (online)

visible but in some cases appear to be simple (drop-in) substitutes to existing products.Yet technological change is fully under way, with continuous new solutions being proposed (Wesseler and Von Braun, 2017; Ronzon *et al.*, 2017). Cross-cutting connections among different value chains are now countless and growing exponentially.

The concept of the Bioeconomy as the aggregate of the sectors using biological resources is now undergoing consolidation, at least in Europe. Agriculture, forestry and food are at the core of the Bioeconomy while the most important progress in terms of markets concerns new sectors, such as bio-based materials and bioenergy. Sectors of the Bioeconomy such as forestry, aquaculture and marine production are seen as major areas for future development. The idea that the Bioeconomy needs to be sustainable and circular is getting stronger as well as the awareness that these features are not implicit in the Bioeconomy, but rather need to be purposefully promoted.

The context driving these trends is different than it was at the beginning of the history of the Bioeconomy. Climate change concerns, long-term sustainability objectives and circular economy objectives (European Commission, 2015) have reinforced the focus on bio-based solutions. While energy concerns are less often in the news, they are taking on greater importance due to their linkages with climate change causes and adaptation strategies. The guiding focus on the UN Sustainable Development Goals has made evident how comprehensive concepts such as the Bioeconomy are key to managing the interplay between social concerns and sustainable economic growth in an interwoven economy.

In spite of the above-mentioned trends, several (or perhaps the majority of) Bioeconomy activities linked to bio-based solutions, bioenergy and co-product management are far from being cost-competitive with fossil resources. In addition, technologies are often insufficiently stable and reliable with respect to market expectations. For these reasons, uptake is slower than sought by promoters and increased efficiency is needed. One of the keys to this increased efficiency is the connection between bio-based and bioenergy chains through biorefinery optimisation, but the issues at stake are much wider and involve the efficiency of the whole system of biomass production and use, as well as the consistent accounting of public good components linking society and market values. Moreover, general knowledge of the Bioeconomy as a concept and a vision remains poor.

On the EU policy side, a new boost to the Bioeconomy has been given by the EU Commission through the revision of the 2012 Bioeconomy strategy and several studies aimed at quantifying the economic role of the Bioeconomy. This was followed by the launch of the revised Bioeconomy strategy in October 2018 (European Commission, 2018). Meanwhile, the whole programming period 2021-2027 is under discussion, notably with new proposals for the CAP related to this period.

Economic research has been developing in parallel (Lewandowski, 2018; Viaggi, 2018; Wesseler, Banse and Zilberman, 2015; Viaggi, 2016). In 2018, Scopus reported 123 papers related to the Bioeconomy in the fields of economics, business and social sciences, with a growth of about +66% compared to the previous year and a constant increase over time.

This paper aims to provide a review of the policy challenges brought about by the revised Bioeconomy strategy and the CAP legislative proposals, with a focus on the connection between these two policy areas. Based on this, the paper discusses needs for support and research in the field of economics and policy, matches these with the related

trends in literature, and provides insights into future research developments targeting the most relevant current challenges.

The next section (section 2) provides an overview of the revised Bioeconomy strategy, the proposed CAP reform and the connections between the two policy initiatives. Section 3 discusses economic and policy research needs emerging in response to these policy developments. Section 4 provides a discussion and concluding remarks.

2. The EU Bioeconomy strategy and the CAP

2.1 The revised Bioeconomy strategy

The announced revision of the EU Bioeconomy strategy followed a 2-year process building on the previous 2012 strategy. The evaluation of the strategy painted a rather positive picture in terms of strategy and action plan implementation (European Commission, 2017). Funding has increased for Bioeconomy research and action has been taken in several directions. Bioeconomy concepts have affected different policy areas in the EU and a number of countries now have their own Bioeconomy strategy. Italy is among them, with a broadly supported strategy published in 2017.

In addition, a manifesto for the Bioeconomy in Europe was published in 2017. Several relevant topics for attention and further action were included; in particular, it is noteworthy that there is an emphasis on the role of regions in the development of the Bioeconomy and the need for focused training and education.

The revised Bioeconomy strategy (European Commission, 2018), basically maintains the same objectives of the 2012 strategy, namely:

- ensuring food and nutrition security;
- managing natural resources sustainably;
- reducing dependence on non-renewable, unsustainable resources whether sourced domestically or from abroad;
- mitigating and adapting to climate change; and
- strengthening European competitiveness and creating jobs.

Instead, from a definition point of view, the revised strategy includes some relevant novelties. The Bioeconomy is now defined as follows (European Commission, 2018):

"The bioeconomy covers all sectors and systems that rely on biological resources (animals, plants, micro-organisms and derived biomass, including organic waste), their functions and principles. It includes and interlinks: land and marine ecosystems and the services they provide; all primary production sectors that use and produce biological resources (agriculture, forestry, fisheries and aquaculture); and all economic and industrial sectors that use biological resources and processes to produce food, feed, bio-based products, energy and services. To be successful, the European bioeconomy needs to have sustainability and circularity at its heart. This will drive the renewal of our industries, the modernisation of our primary production systems, the protection of the environment and will enhance biodiversity."

The most interesting feature is the placement of sustainability and circularity at the heart of the notion of Bioeconomy. The definition also explicitly highlights the role of eco-

systems and their services. On the contrary, innovation and new technologies, in particular genetic engineering, have much less emphasis. Biomedicines and health biotechnology remain excluded.

To achieve the objectives above, the communication envisages three action areas:

1. Strengthen and scale-up the bio-based sectors, unlock investments and markets; this includes: mobilisation of public and private stakeholders, in research, demonstration and deployment of bio-based solutions (Action 1.1); a Circular Bioeconomy Thematic Investment Platform (Action 1.2); identification of bottlenecks, enablers, and gaps affecting bio-based innovations, and providing voluntary guidance on their deployment (Action 1.3); environmental performance information (Action 1.4); facilitation of the development of new sustainable biorefineries (Action 1.5); contribution to the global challenge of plastic-free oceans (Action 1.6).
2. Deploy local bioeconomies rapidly across Europe; this includes: develop a StrategicDeployment Agenda (Action 2.1); Pilot actions enhancing synergies between existing EU instruments to support local activities (Action 2.2); set up of EU Bioeconomy policy support facility for Member States (Action 2.3); piloting on education and skills (Action 2.4).
3. Understand the ecological boundaries of the Bioeconomy; this includes: enhancing the knowledge base and understanding of specific Bioeconomy areas (Action 3.1); implementation of an EU-wide, internationally coherent monitoring system (Action 3.2); voluntary guidance for operating the Bioeconomy within safe ecological limits (Action 3.3); integration of the benefits from biodiversity-rich ecosystems (Action 3.4).

2.2 The proposed CAP reform

After the release of preliminary documents in 2017, the Commission published the legislative proposals for the post 2020 CAP in June 2018.

The objectives of the future CAP are:

- to ensure a fair income to farmers;
- to increase competiveness;
- to rebalance the power in the food chain;
- climate change action;
- environmental care;
- to preserve landscapes and biodiversity;
- to support generational renewal;
- vibrant rural areas; and
- to protect food and health quality.

The basic structure of the CAP is not expected to change dramatically, in particular the organisation into two main pillars. However, in terms of measures, the CAP will bring some important novelties. These include the refocusing of the direct payments towards a basic payment for sustainability; the replacement of the current cross-compliance and greening measures with a new enhanced conditionality scheme; and the provision of voluntary ecological payments (eco-schemes) in the first pillar.

A critical aspect of the CAP reform is the new delivery model, leaving to strategic plans to devise precise actions for implementation. Strategic plans are expected to cover all CAP measures and to be designed at Member State (MS) level. This implies a larger level of flexibility for MS concerning the design of measures and implementation, while the European Commission will monitor the results on the basis of a list of indicators. This should, in principle, allow for higher efficiency through greater flexibility and better targeting, but will also rely more on decentralised coordination and management capacity.

The CAP reform is accompanied by an important effort toward innovation and research, with a proposed allocation of 10 billion euro to agriculture and food in Horizon Europe. This continues the coordination between the CAP and research policy already established during the 2014-2020 period.

2.3 The Bioeconomy strategy and the CAP: opportunities, drawbacks and emerging policy issues

In spite of the obvious interplays, the convergence between the Bioeconomy strategy and the CAP is still weak; however, the rural development objectives in the Bioeconomy strategy and the explicit mention of the Bioeconomy (as well as of the need for biomass production) in the CAP are important steps forward in the field of policy harmonisation. Notably, this does not only concern the areas in which the Bioeconomy is mentioned, but also other components of the CAP including the international dimension.

The CAP does not contain/impose any specific measure related to non-food Bioeconomy sectors; however several measures can be used in this direction by local strategy design. A number of CAP measures can indeed contribute to the Bioeconomy. These include: a) those strengthening the role of farmers in the supply chain; b) sectorial programmes if connected to bio-based products; c) enhanced conditionality, including crop rotation provisions; d) voluntary eco-schemes,which are mandatory for MS; e) coupled income support, directly or indirectly affecting specific value chains; f) rural development measures (including agri-environmental schemes, innovation and investment support, knowledge transfer measures). However, the decision to use these measures to support the Bioeconomy development will be in the hands of Member States or local authorities.

One stated CAP objective (also in the documentation about strategic plans and their evaluation) is directly connected to the Bioeconomy, namely: "Promote employment, growth, social inclusion and local development in rural areas, including bio-economy and sustainable forestry". In terms of CAP result indicators for the monitoring of evaluation plans, two main indicators are specific to the Bioeconomy: R.15 Green energy from agriculture and forestry: Investments in renewable energy production capacity, including bio-based and R.32 Developing the rural bioeconomy: Number of Bioeconomy businesses developed with support.

On the other hand, the Bioeconomy strategy envisages a number of supporting instruments that could be used by the CAP implementation strategy. These primarily concern initiatives for sustainability diagnostics and intra-regional coordination.

In addition, there seem to be a number of procedural meeting points in the two strands of policy in as much as both envisage some implementation plan at the country or regional level. This could provide an opportunity for greater coordination to the extent that it does not result in duplication. Indeed, the CAP strategic plans offer an improved

opportunity for coordination with the Bioeconomy strategies through needs analysis and the setting of objectives. One potential issue, however, remains the scale of coordination and inter-scale dialogues.

Potential conflicts are difficult to envisage. The most evident issue is that of biorefinery development and investment programmes, which have the potential to affect the farming sector and could lead to undesired effects if the two areas of intervention are not locally coordinated.

3. Challenges for economic & policy support

3.1 Bioeconomy definitions and boundaries

From the definition point of view, the Bioeconomy is shaping up and consolidating at least in terms of the sectors involved. The new strategy makes it more explicit that the Bioeconomy is the aggregate of all sectors using living organisms and this partially goes beyond a number of discrepancies found in the literature between different approaches to the Bioeconomy. These do tend to remain, however, when the Bioeconomy is viewed from different regional or stakeholder perspectives (de Besi and McCormick, 2015).

The current trends in the EU policy clarify once more that the Bioeconomy concept will not substitute our current notion of sectors, such as agriculture, food etc., at least in the short-term, but will rather provide a complementary view at system level. This separation will also remain as such in the policy realm. This is a reasonable strategy, which is legitimate with path-dependency motivations, as sector identity and related policy are already quite consolidated and have been developed over time. On the one hand, the difficulty in understanding and communicating what the Bioeconomy is will continue. Indeed, there is a consolidation of the view of the Bioeconomy as a bridging concept rather than a sector. On the other hand, the definition of the Bioeconomy has clearly expanded in the direction of accounting for ecosystems, clarifying the increasing trends towards the need for a consistent inter/trans-sectoral approach to the management of biological resources.

Biorefineries are clearly seen as a key connection point among the Bioeconomy sectors. Their development across Europe is somehow the most practical action envisaged in the strategy. This is very relevant as biorefineries are peculiar solutions connecting different value chains and at the same time are the strategic topic to connect the industrial and territorial visions of the Bioeconomy. However, chain coordination and consistency with the ecosystem services perspective needs to be carefully investigated.

3.2 Bioeconomy sectors and markets

The pragmatic identification of the Bioeconomy as an overarching concept encompassing or including different sectors, as well as the envisaging of only a (mainly) strategic approach from the point of view of Bioeconomy policy, somehow refocuses attention, including for the Bioeconomy, on the functioning of markets and their dynamics. The developing of new markets (except for bioenergy) seems to remain not supported by strong direct incentives from policy, but rather promoted by soft measures related to primary production, chain structure, certification and information.

Here, a focal point remains cost-competitiveness with similar fossil-based products and the distinction between drop-in and new products (Petrovič, 2015). On the one hand, this requires an improved understanding of consumer and citizen behaviour, on the other hand it needs to address supply side (cost) issues. These topics are emphasised for markets for new products, such as innovative (in terms of value proposition) bio-based products.

The increased relevance of the role of ecosystem services and environmental attention in both policies will shine light on the ability to understand the value of public goods and to incorporate them into policy design and marketing strategies.

3.3 System view

The territorial planning envisaged in the Bioeconomy strategy and the strategic planning envisaged in the revised strategy call for both a description and an understanding of Bioeconomy systems. In this direction, the Bioeconomy literature already seeks to deliver interpretations of complex Bioeconomy systems through the evolution of the concept of value chains into a vision of value webs (Scheiterle *et al.*, 2016; Virchow *et al.*, 2016); at the same time, examples, especially of biomass provisions for biorefineryand logistics, need to explicitly address the connection between process design and territorial scale. This, in turn, extends to international biomass and value flows. The direct consideration of the engagement of consumers and citizens is also a key factor in these processes.

The inclusion of ecosystems into this view, and the Socio-Ecological System approach as a potential interpretation of society's action are also under way. An attempt to merge these approaches into a unified view goes under the proposed term Socio-Ecological Technological Value-Enhancing Web System (SETVEWS)(Viaggi, 2018), which is still, however, undefined in operational terms.

The system view not only provides a vision of the Bioeconomy, but also highlights the need to understand the role of logistic organisation (Lamers *et al.*, 2015), chain structure (Espinoza Pérez *et al.*, 2017) and flexibility (Swartz, Wang and Mastragostino, 2015) as the key to efficiency. In addition, the understanding of system organisation needs to take into account technological potential. In particular, the increasing ability to break down and recompose biomass has lead the emergence of the concept of platform products as key "connectors" in the biomass flows, with potential implications on system organisation and market power (Bomtempo, Chaves Alves and De Almeida Oroski, 2017).

3.4 Policy coordination and territorial governance

Both Bioeconomy and agricultural policy require territorial level programming. This is connected to the system view and the need to consistently manage resources and opportunities in a landscape (ecosystemic) framework. In addition, the topic of policy coordination is of paramount importance. The Bioeconomy is already most often promoted by a mix of policy instruments with different strategies and composition depending on the individual country and location (German Bioeconomy Council, 2015). The focus on strategy emphasises these needs.

In a more analytical way, the picture above requires the ability to understand the working of policy mixes. Research and innovation policy clearly plays a major role in this context. The CAP already includes a variety of different measures which consistency is sometimes not straightforward (or clearly lacking). Addressing the Bioeconomy consistently requires, greater effort with regard to connecting agriculture, food, fisheries, industrial and environmental sectors, energy policies, as well as activities related to research, innovation and education.

In addition, this strategic approach highlights the need for working approaches to participation and governance. This has been an area of particular focus in the literature on participatory decision-making, and, among other issues, highlights the positive role of the Bioeconomy as an 'umbrella concept' to provide a dialogue platform for different views of the future. On the other hand, for the same reasons, it runs the risk of remaining just a buzzword with unclear references to the use of biomass. Indeed, in a communication context, 'Bioeconomy' can be qualified as a 'boundary object' or a 'bridging concept', i.e. serving specific interests of different stakeholders under a generally accepted conceptual umbrella (Hodge, Brukas and Giurca, 2017).

The relevance of the topic has been highlighted in contexts in which the different players have rather different backgrounds and power, so it is of special importance for rural areas. This implies the consideration of two connected aspects. One is the role of local institutions in the governance of the Bioeconomy. The other is the involvement of the ecosystem service view as compared with the value chain view.

3.5 Innovation

The definition of the Bioeconomy used in the revision of the EC Communication seems to downplay innovation and research. In particular, genetic engineering, which was at the core of some of the founding documents by other bodies (e.g. OECD) is has no particular relevance here. In fact, looking at the actions proposed, research and innovation is still high in the agenda and even more important in economic terms. Most likely, in the current setting, innovation stands behind the scenes and is less to be interpreted as a specific set of technologies and rather as whatever is needed to promote the objectives of developing Bioeconomy sectors in industrial terms while guaranteeing circularity and sustainability. This approach certainly brings Bioeconomy innovation closer to current practices in agriculture and rural innovation such as the Innovation systems perspective adopted by the Agricultural Knowledge and Innovation Systems (AKISs) or the collaborative perspective used by the EIP AGRI measures.

However, it is also connected to information, education and human capital, and is linked to industrial innovation. On the other hand, innovation is connected to appropriate incentives related to the features of final products, and hence cannot be thought of as being disconnected from markets and value chain development.

The link among research disciplines is even more important, as also implied by transdisciplinary research linked to multi-actor driven processes. The balance between multi-actor emphasis and consistent new research has, however, proven to be difficult to manage and this will be a key issue to tackle in order to provide genuine and result-focused innovation systems.

One important perspective here relates to the trend towards technology design as an explicit process aimed at specific achievements and within circular innovation processes, which implies an even greater degree of coordination.

3.6 Defining and measuring

The problem with measuring the Bioeconomy remains at the core, due also to the dearth of suitable data (Wesseler and Von Braun, 2017; Ronzon *et al.*, 2017; Lokko *et al.*, 2017). Besides agriculture and food, bio-based sectors such as energy, biomaterials, and biorefineries are largely included in other sectors' statistics and require difficult disaggregation procedures and, at times, questionable assumptions.

On the other hand, the new definition and policy approach require a move towards a more functional use of measurements, most notably in three directions:

- First, in the direction of measuring the actual progress of Bioeconomy sectors and in particular, understanding the dynamics of emerging sectors such as those of bio-based products.
- Second, in the direction of understanding the sustainability of current Bioeconomy systems, with a focus on the new field of measurement represented by circularity and consolidating areas such as the connection with ecosystem services and public goods; while the Bioeconomy strategy focuses to a significant extent on the concept of ecological boundaries, the CAP more and more explicitly focuses attention on the positive potential of the primary sector to produce valuable public goods.
- Third, in the direction of having measures suitable for policy evaluation or even for performance/impact measurement linked to the provision of CAP payments.

3.7 Communication, awareness and education

Communication, awareness and education are clearly important for an emerging sector of the economy. The first straightforward aspect is linked to awareness and acceptability by the general public, which is well known to be critical for new products such as those obtained through genetic modification. Furthermore, information is linked to market expressions of willingness to pay. This is clearly key in a policy approach only weakly based on direct incentives and more focused on the promotion of innovation.

The role of education and human capital in the Bioeconomy is of primary interest to the academia. Noteworthy initiatives are being developed that range from primary to post-university and Lifelong Learning, but the role of Bioeconomy studies in curricula remains, to a large extent, questionable and under developed.

4. Discussion and conclusions

Research and interpretation of the Bioeconomy is taking shape (Viaggi, 2018). The sought after interaction between the CAP and Bioeconomy is now at a crossroad, with the revised Bioeconomy strategy and the upcoming CAP reform, ushering in significant opportunities for coherent and synergetic support, while at the same time leaving the

details of these synergies rather open to local action. Both strategic approaches also bring with them a number of implications for economic research related to policy.

While the Bioeconomy is consolidating as one of the biggest phenomena of our age, it continues to be in search of an identity. There are different dimensions to this identity-building process. One is policy, as can be expected from an emerging area of the economy. However, the EU's Bioeconomy action and most country strategies rely more on strategies than Bioeconomy policies, leaving to specific sector policies the role to implement actions. This is also the case of the EU. This approach is in itself understandable, due to the fact that some parts of the Bioeconomy have long-term policy structures, the implementation of which is rather consolidated with reforms depending on path-dependency.

As for the CAP reform there is a reliance on decentralised strategic planning, which is fuelling debate about implementation procedures (new delivery model) and priority setting.

Accordingly, this is an ideal time to discuss the coordination between the Bioeconomy and agricultural priorities and policies. The explicit call for convergence (or the beginning of dialogue) between Bioeconomy and the CAP is a relevant step forward. Certainly, strong support for economic information is imperative. Economics is moving forward in building this identity through an increasing number of works and new concepts. The next step is to improve the application of these concepts to the next generation of policy problems. The main contributions likely rest in providing a coherent system view, helping to identify priorities and designing improved mixes of policy instruments. Each of these areas of action is facing a number of new challenges, as discussed above. The enlargement of the Bioeconomy concept to ecosystem services and the more neutral view of innovation also represent important topics to be dealt with in economic research.

Finally, both from an academic and sector perspective, greater attention is needed to bring the Bioeconomy into the education system. Perhaps there will never be a Bioeconomist profession, but the comprehensive vision of the Bioeconomy and an economic focus on its evolving components will undoubtedly be of great importance for any professional working with biological resources in the future.

5. References

de Besi, M. and McCormick, K. (2015). Towards a Bioeconomy in Europe: National, Regional and Industrial Strategies. *Sustainability* 7(8): 10461-10478. doi: 10.3390/su70810461.

Bomtempo, J.-V., Chaves Alves, F. and De Almeida Oroski, F. (2017). Developing new platform chemicals: What is required for a new bio-based molecule to become a platform chemical in the bioeconomy?. *Faraday Discussions* 202. doi: 10.1039/c7fd00052a.

Bonaccorso, M. (2016). The Bioeconomy Revolution. Kindle ver. Edizioni Ambiente, Milano.

El-Chichakli, B., von Braun, J., Lang, C., Barben, D. and Philp, J. (2016). Five Cornerstones of a Global Bioeconomy. *Nature* 535: 221-223.

Espinoza Pérez, A. T., Camargo, M., Narváez Rincón, P. C. and Alfaro Marchant, M. (2017). Key Challenges and Requirements for Sustainable and Industrialized Biore-

finery Supply Chain Design and Management: A Bibliographic Analysis. *Renewable and Sustainable Energy Reviews* 69: 350-359. doi: 10.1016/j.rser.2016.11.084.

European Commission (2015). Closing the loop - An EU Action Plan For the Circular Economy. COM(2015) 614 final. Bruxelles.

European Commission (2017). Review of the 2012 European Bioeconomy Strategy. Bruxelles.

European Commission (2018). A Sustainable Bioeconomy for Europe: Strengthening the Connection Between Economy, Society and the Environment. Updated Bioeconomy Strategy. *Bruxelles*. Available at: https://ec.europa.eu/research/bioeconomy/pdf/ec_bioeconomy_strategy_2018.pdf#view=fit&pagemode=none.

German Bioeconomy Council (2015). Bioeconomy Policy (Part II) Synopsis of National Strategies Around the World. Berlin. Available at: https://biooekonomierat.de/fileadmin/Publikationen/berichte/Bioeconomy-Policy_Part-II.pdf

German Bioeconomy Council (2018). Bioeconomy Policy (Part III): Update Report of National Strategies Around the World. Berlin. Available at: http://gbs2018.com/fileadmin/gbs2018/Downloads/GBS_2018_Bioeconomy-Strategies-around-the_World_Part-III.pdf.

Hodge, D., Brukas, V. and Giurca, A. (2017). Forests in a Bioeconomy: Bridge, Boundary or Divide?. *Scandinavian Journal of Forest Research* 32(7): 582-587. doi: 10.1080/02827581.2017.1315833.

Lamers, P., Tan, E. C. D., Searcy, E. M., Scarlata, C. J., Cafferty, K. G. and Jacobson, J. J. (2015). Strategic Supply System Design - A Holistic Evaluation of Operational and Production Cost for a Biorefinery Supply Chain. *Biofuels, Bioproducts and Biorefining* 9(6): 648-660. doi: 10.1002/bbb.1575.

Lewandowski, I. (ed.) (2018). Bioeconomy. Shaping the Transition to a Sustainable, Biobased Economy. Springer.

Lokko, Y., Heijde, M., Schebesta, K., Scholtès, P., Van Montagu, M. and Giacca, M. (2017). Biotechnology and the Bioeconomy - Towards Inclusive and Sustainable Industrial Development. *New Biotechnology* 40(A): 5-10. doi: 10.1016/j.nbt.2017.06.005.

Petrovič, U. (2015). Next-Generation Biofuels: A New Challenge for Yeast. *Yeast* 32: 583-593. doi: 10.1002/yea.3082.

Ronzon, T., Piotrowski, S., M'Barek, R. and Carus, M. (2017). A Systematic Approach to Understanding and Quantifying the EU's Bioeconomy. *Bio-based and Applied Economics* 6(1): 1-17. doi: 10.13128/BAE-20567.

Scheiterle, L., Ulmer, A., Birner, R. and Pyka, A. (2016). From Commodity-Based Value Chains to Biomass-Based Value Webs: The Case of Sugarcane in Brazil's Bioeconomy. *Journal of Cleaner Production* 172: 3851-3863. doi: 10.1016/j.jclepro.2017.05.150.

Swartz, C. L. E., Wang, H. and Mastragostino, R. (2015). Operability Analysis of Process Supply Chains-Toward the Development of a Sustainable Bioeconomy. *Computer Aided Chemical Engineering* 36:355-384. doi: 10.1016/B978-0-444-63472-6.00014-8.

Viaggi, D. (2016). Towards an Economics of the Bioeconomy: Four Years Later. *Bio-based and Applied Economics* 5(2): 101-112. doi: 10.13128/BAE-20086.

Viaggi, D. (2018). The Bioeconomy. Delivering Sustainable Green Growth. CABI Publishing.

Virchow, D., Beuchelt, T. D., Kuhn, A. and Denich, M. (2016) Biomass-Based Value Webs: A Novel Perspective for Emerging Bioeconomies in Sub-Saharan Africa. In Gatzweiler, F.W. and von Braun, J. (eds), Technological and Institutional Innovations for Marginalized Smallholders in Agricultural Development. Springer Open: 225-238. doi: 10.1007/978-3-319-25718-1_14.

Wesseler, J., Banse, M. and Zilberman, D. (2015). Introduction Special Issue "The Political Economy of the Bioeconomy". *German Journal of Agricultural Economics* 64: 209-211. Available at: http://www.scopus.com/inward/record.url?eid=2-s2.0-84949545519&partnerID=tZOtx3y1.

Wesseler, J. and von Braun, J. (2017). Measuring the Bioeconomy: Economics and Policies. *Annual Review of Resource Economics* 9: 275-298. doi: 10.1146/annurev-resource-100516-053701.