Bioeconomy Transformation Strategies Worldwide Require Stronger Focus on Entrepreneurship

Andreas Kuckertz

Entrepreneurship Research Group (570c), Faculty of Business, Economics and Social Sciences, University of Hohenheim, D-70599 Stuttgart, Germany; andreas.kuckertz@uni-hohenheim.de

Received: 6 March 2020; Accepted: 2 April 2020; Published: 6 April 2020

Abstract: The number of governments worldwide embracing the vision of a sustainable bioeconomy is constantly rising. One factor facilitating the transformation of economies to such sustainable bioeconomies will be entrepreneurial activity. Hence, I analyze how available bioeconomy strategies account for the role of entrepreneurship in driving the bioeconomy transformation. That analysis indicates that the majority of existing bioeconomy strategies account for the transformative potential of entrepreneurship but remain ineffective with respect to achieving their goals. I consequently suggest devising entrepreneurship substrategies of bioeconomy strategies that are holistic, dedicated, and based on a clear causal rationale.

Keywords: bioeconomy; biobased economy; entrepreneurship; sustainability; transformation

1. Introduction

Entrepreneurship is widely understood as the pursuit of primarily business opportunities [1–3]. Exploiting such opportunities often involves innovation, such as technological or business model innovation, which introduces the potential to change how business is done, how value is created, and how markets behave [4,5]. In other words, entrepreneurship is a driving force that contributes to the transformation of economies and societies. One important area requiring transformation is the so-called bioeconomy, which focuses on changing the modus operandi from one based on fossil resources to one employing biological resources [6,7].

A transformation toward the bioeconomy seems desirable [8–11], because it would at least partially align with the goal of carbon neutrality and the attainment of the UN Sustainable Development Goals [12]. Ever more policymakers worldwide acknowledge this necessity and are developing dedicated bioeconomy strategies [13]. In Germany, the Federal Ministry of Education and Research has even declared 2020 to be the Bioeconomy Science Year, a nationwide initiative intended to educate the wider public about the potential of the bioeconomy and following such eminent topics as “The Working Life of the Future” in 2018 and “Artificial Intelligence” in 2019.

Given the great importance attached to the bioeconomy transformation by policymakers and researchers, the question arises of how the transformation envisioned could actually materialize and be actioned. Innovation will be part of the solution [14] and the entrepreneurship literature suggests that entrepreneurs can contribute to the transformation by commercializing innovative technologies through startups and new business models [11,15,16]. In particular, entrepreneurs that manage the triple bottom line and aim to achieve social and ecological goals extending beyond pure monetary ones can contribute: a phenomenon termed sustainable entrepreneurship [11,17]. The bioeconomy transformation literature acknowledges this fact [18–20]. Many entrepreneurial opportunities for entrepreneurs result from a transition to a bioeconomy, which allows entrepreneurs to introduce new products and establish new ventures [21]. These are realized through so-called “entrepreneurial experimentation” [22–24]. Support
from investors [25] as well as universities and research institutions [26,27] will be essential in this regard and policy can intervene to help maximize the potential resulting from entrepreneurial activity.

If entrepreneurs are the agents that put political vision into action [28], bioeconomy policies should acknowledge this fact and include measures and initiatives that help sustainable bioeconomy entrepreneurs to fulfill this vision. Hence, in the subsequent paragraphs, I will determine how national bioeconomy strategies worldwide take account of the transformative role of entrepreneurship. In doing so, I contribute to the emerging discourse on the bioeconomy transformation and provide explicit suggestions on how to develop existing strategies going forward.

2. The Status Quo: Entrepreneurship in Bioeconomy Strategies

Identifying the entrepreneurial elements of bioeconomy strategies makes it possible to pinpoint gaps and weaknesses in existing strategies, to outline a metastrategy for entrepreneurship in the bioeconomy combining those elements, and to suggest ways to develop those strategies. The current research relies on the overview of available bioeconomy strategies continuously maintained by the German Bioeconomy Council (GBC) [13,29,30]. All policy documents classified by the GBC as holistic strategies were collected in their most recent edition. The collection thus comprises 15 national strategies from all over the world plus the European Union’s bioeconomy strategy. Nearly all the documents are available in English; those only available in other languages were analyzed with the help of a native-speaking researcher.

To understand how bioeconomy strategies account for entrepreneurship, a data extraction sheet was developed. This data extraction sheet contained six dimensions utilized by the OECD in its Entrepreneurship Indicators Programme (EIP) to assess the determinants of entrepreneurial activity on the national level [31]. Careful reading of the bioeconomy strategies allowed to assign components of the bioeconomy strategies referring to entrepreneurship to the categories of the data extraction sheet. To minimize subjectivity in this process and to establish intrarater reliability [32], all strategies were reread after completing this process; conducting the exercise a second time did not result in any necessary changes, suggesting the reliability of this procedure.

Table 1 plots the contents of these holistic bioeconomy strategies regarding aspects of entrepreneurship. These are the regulatory framework of an economy, market conditions, access to finance, knowledge creation and diffusion, entrepreneurial capabilities, and culture, which together are considered to determine the entrepreneurial performance of a given economy. With the exception of Japan, all bioeconomy strategies at least acknowledge the importance of entrepreneurial activity in facilitating the bioeconomy transformation.

However, the degree of specificity of measures varies widely. Whereas some strategies (e.g., that of Argentina) reduce proposed measures simply to the availability of venture capital that would allow bioeconomy entrepreneurs to realize their projects, only the US and Latvian strategies could be considered (almost) complete in addressing the EIP dimensions. Most strategies, however, exhibit a clear tendency to focus only on access to finance, knowledge creation and diffusion, and the building of entrepreneurial capabilities. A further characteristic is that nearly all strategies avoid introducing measures to monitor their success, with only the South African strategy incorporating concrete key performance indicators (KPIs) with which to evaluate its success.
Table 1. Determinants of entrepreneurship in holistic bioeconomy strategies.

| Country       | Accounts for Entrepreneurship | Regulatory Framework | Market Conditions | Access to Finance | Knowledge Creation and Diffusion | Entrepreneurial Capabilities | Culture |
|---------------|-------------------------------|----------------------|-------------------|-------------------|----------------------------------|-----------------------------|---------|
| Argentina     | Yes                           | +/-                  | +/-               | +/-               | - Support provision of venture capital for startups | +/-                         | +/-     |
| Finland       | Yes                           | +/-                  | +/-               | +/-               |                                  | +/-                         | +/-     |
| France        | Yes                           | +/-                  | +/-               | +/-               | - Hubs and ecosystems connect entrepreneurs with important actors | +/-                         | +/-     |
| Germany       | Yes                           | +/-                  | +/-               | +/-               | - Support provision of venture capital for startups and SMEs | +/-                         | +/-     |
| Ireland       | Yes                           | +/-                  | +/-               | +/-               | - Concrete investment in bioeconomy innovation facility as the nucleus of an innovation hub/entrepreneurial ecosystem | - Entrepreneurship education to foster bioeconomy entrepreneurship in rural areas | +/-     |
| Italy         | Yes                           | +/-                  | +/-               | +/-               | - Direct investments in spin offs/startups | - Development of a platform connecting entrepreneurs and key stakeholders | +/-     |
| Japan         | No                            | +/-                  | +/-               | +/-               |                                  | +/-                         | +/-     |
| Latvia        | Yes                           | +/-                  | +/-               | +/-               | - Addressing the problem of unfair competition in the bioeconomy - Involvement of local authorities to foster regional bioeconomy entrepreneurship | - Utilize public procurement to speed up market adoption | - Generally creating an investment-friendly environment | - Supporting the exchange of entrepreneurs and research associations in the bioeconomy | - Entrepreneurship education at the higher education level | +/-     |
| Malaysia      | Yes                           | +/-                  | +/-               | +/-               | - Connecting venture capitalists, crowd funders, and financial institutions | +/-                         | +/-     |
| Norway        | Yes                           | +/-                  | +/-               | +/-               | - Strengthening innovation loans | +/-                         | +/-     |
| South Africa  | Yes                           | +/-                  | +/-               | +/-               | - Build an enabling environment with proper tax incentives - Support exchange of intellectual property | - Stimulate venture capital funding - Establishment of a co-investing Bio-Innovation Venture Capital Fund | - Foster interaction of academics and entrepreneurs | - Bioeconomy transformation requires entrepreneurial skills | +/-     |
| Country | Accounts for Entrepreneurship | Regulatory Framework | Market Conditions | Access to Finance | Knowledge Creation and Diffusion | Entrepreneurial Capabilities | Culture |
|---------|-------------------------------|----------------------|------------------|------------------|-------------------------------|----------------------------|---------|
| Spain [45] | Yes | -/ | -/ | -/ | -/ | -/ | - Successful role models should attract entrepreneurial initiative |
| Thailand [46] | Yes | -/ | -/ | -/ | -/ | -/ | - |
| USA [47] | Yes | - Creation of tax reliefs - Reduction of regulatory barriers - Assist entrepreneurs in obtaining and defending patents | - Utilize public procurement to speed up market adoption | - Support the provision of venture capital for startups | - Educate entrepreneurs about regulation - Connect mentors and entrepreneurs - Support the development of entrepreneurial ecosystems - Educate agencies about entrepreneurship with the help of an entrepreneur-in-residence program | - Enhance university entrepreneurship | - Creation of an overview of available prizes/awards - National entrepreneurship month |
| Western Nordic Countries (Greenland, Iceland, Faroe Islands) [48] | Yes | -/ | -/ | -/ | -/ | -/ | - General enhancement of entrepreneurial skills |
| European Union [49] | Yes | -/ | - Entrepreneurship in the bioeconomy helps to develop rural areas | -/ | -/ | - Entrepreneurship education at the vocational, higher education, and researcher level - Utilization of role models | - Fostering an entrepreneurial mindset and culture in the bioeconomy |
3. Moving Forward: Dedicated and Holistic Entrepreneurship Strategies for the Bioeconomy

The analysis of bioeconomy strategies suggests that these initiatives are only effective on first sight. The vague and incomplete treatment of an important transformative power—entrepreneurship—necessarily leads to the conclusion that nearly all strategies are ineffective in enabling transformation in a convincing way. Admittedly, for many bioeconomy strategies it would already be a huge step forward to consider the measures included in Table 1 and then to utilize that overview to inspire construction of a metastrategy with regard to supporting bioeconomy entrepreneurship by combining all the elements available in different bioeconomy strategies. However, such an eclectic approach could only be an initial step.

Based on the assumption that entrepreneurs are important actors helping to achieve the bioeconomy transformation and thus warrant a maximum of attention, I suggest the following three adjustments to any bioeconomy strategy.

First, it would be preferable to devise strategies that are holistic, dedicated, and based on a clear causal rationale. That is, while the bioeconomy strategies assessed here can be considered holistic as such, even the most complete strategies are incomplete with respect to entrepreneurship and omit many potentially interesting options. Just as the overall strategies are intended to be holistic, their entrepreneurial substrategies have to be holistically conceptualized too. For instance, research suggests the nucleus of entrepreneurial transformation to be universities and research institutions [50,51]: knowledge that could serve as a starting point. Any strategy needs to support the entrepreneurial transfer of basic research out of research institutions and the OECD’s EIP dimensions can then serve to roll out initiatives supporting the commercialization of bioeconomy knowledge with the help of entrepreneurship education, dedicated innovation systems and entrepreneurial ecosystems [9,50,52,53], and a legal framework and culture that is generally positive toward bioeconomy entrepreneurship.

Second, many bioeconomy strategies seem to be torn over whether they see entrepreneurial potential in small, rural entrepreneurs or with innovative, technology-based bioeconomy startups. Either type of entrepreneurial activity can contribute to the bioeconomy transformation; policymakers, however, have to tailor their initiatives to the specific needs of these very different types of entrepreneurial activity (e.g., funding for technology-oriented bioeconomy startups to scale up vs. tax incentives or education for rural entrepreneurs). Whatever the decision, specific measures aligned with concrete KPIs seem to be essential.

Third, while some strategies acknowledge that bioeconomy entrepreneurs will require public funding to realize their entrepreneurial projects (e.g., the German and the US bioeconomy strategy), such strategies always refer to available general programs to support innovation in their respective economies. To assume such innovation programs would be as receptive as necessary to bioeconomy innovations and startups as well is however unwise. Decision makers in such general programs will not necessarily account for the goals of the bioeconomy transformation (e.g., sustainability, circularity, or perhaps even degrowth), and instead employ traditional, growth- and profit-oriented decision-making criteria when evaluating initiatives. Bioeconomy entrepreneurs thus risk failing to meet these standard criteria. Consequently, dedicated innovation programs accounting for the specifics of bioeconomic innovation will be required in order to recognize the potential of many promising and possibly game-changing entrepreneurial initiatives.

Funding: This research received no external funding.

Acknowledgments: I am indebted to three anonymous reviewers for their comments and suggestions. Moreover, I thank Leif Brändle for challenging my thinking, Elisabeth S.C. Berger for her ideas during the conceptualization of this analysis, Carlos Arturo Morales Reyes for his help with Spanish language documents, and Sebastian Hinderer for his guidance through the bioeconomy transformation literature.

Conflicts of Interest: The author declares no conflict of interest.
References

1. Shane, S.; Venkataraman, S. The Promise of Entrepreneurship as a Field of Study. *Acad. Manag. Rev.* 2000, 25, 217–226.

2. Kuckertz, A.; Kollmann, T.; Krell, P.; Stöckmann, C. Understanding, differentiating, and measuring opportunity recognition and opportunity exploitation. *Int. J. Entrep. Behav. Res.* 2017, 23, 78–97. [CrossRef]

3. Kuckertz, A.; Hinderer, S.; Röhm, P. Entrepreneurship and entrepreneurial opportunities in the food value chain. *NPJ Sci. Food* 2019, 3, 6. [CrossRef] [PubMed]

4. Urban, K.; Schiesari, C.; Boysen, O.; Hahn, R.; Wagner, M.; Lewandowski, I.; Kuckertz, A.; Berger, E.S.C.; Morales Reyes, C.A. Markets, Sustainability Management and Entrepreneurship. In *Bioeconomy: Shaping the Transition to a Sustainable, Biobased Economy*; Lewandowski, I., Ed.; Springer: Cham, Switzerland, 2018; pp. 231–286.

5. Kuckertz, A.; Berger, E.S.C.; Gaudig, A. Responding to the greatest challenges? Value creation in ecological startups. *J. Clean. Prod.* 2019, 230, 1138–1147. [CrossRef]

6. Bugge, M.M.; Hansen, T.; Klitkou, A. What is the bioeconomy? A review of the literature. *Sustainability* 2016, 8, 691. [CrossRef]

7. Lewandowski, I. *Bioeconomy: Shaping the Transition to a Sustainable, Biobased Economy*; Springer: Cham, Switzerland, 2018.

8. Priefer, C.; Jörissen, J.; Frör, O. Pathways to Shape the Bioeconomy. *Resources* 2017, 6, 10. [CrossRef]

9. Schlaile, M.; Urmetzer, S.; Blok, V.; Dahl Andersen, A.; Timmermanns, J.; Mueller, M.; Fagerberg, J.; Pyka, A. Innovation systems for transformations towards sustainability? Taking the normative dimension seriously. *Sustainability* 2017, 9, 2253. [CrossRef]

10. Schanz, H.; Federer, J.; Wilczynski, M. Markets as leverage points for transformations of economic systems: The example of the German bioeconomy. *Environ. Innov. Soc. Transit.* 2019, 33, 140–161. [CrossRef]

11. Hall, J.K.; Daneke, G.A.; Lenox, M.J. Sustainable development and entrepreneurship: Past contributions and future directions. *J. Bus. Ventur.* 2010, 25, 439–448. [CrossRef]

12. El-Chichakli, B.; Von Braun, J.; Lang, C.; Barben, D.; Philp, J. Five cornerstones of a global bioeconomy. *Nature* 2016, 535, 221–223. [CrossRef]

13. German Bioeconomy Council. *Bioeconomy Policy (Part III) Update Report of National Strategies around the World*; Office of the Bioeconomy Council: Berlin, Germany, 2015.

14. Pyka, A.; Prettner, K. Economic growth, development, and innovation: The transformation towards a knowledge-based bioeconomy. In *Bioeconomy: Shaping the Transition to a Sustainable, Biobased Economy*; Lewandowski, I., Ed.; Springer: Cham, Switzerland, 2018; pp. 329–340.

15. Johnson, M.P.; Schaltegger, S. Entrepreneurship for Sustainable Development: A Review and Multilevel Causal Mechanism Framework. *Entrep. Theory Pract.* 2020, in press. [CrossRef]

16. Venkataraman, S. Regional transformation through technological entrepreneurship. *J. Bus. Ventur.* 2004, 19, 153–167. [CrossRef]

17. Kuckertz, A.; Wagner, M. The influence of sustainability orientation on entrepreneurial intentions—Investigating the role of business experience. *J. Bus. Ventur.* 2010, 25, 524–539. [CrossRef]

18. Huber, P.; Hujala, T.; Korttila, M.; Wolfslehner, B.; Vacik, H. Application of multi criteria analysis methods for a participatory assessment of non-wood forest products in two European case studies. *For. Policy Econ.* 2019, 103, 103–111. [CrossRef]

19. Viaggi, D. Research and innovation in agriculture: Beyond productivity? *Bio-Based Appl. Econ.* 2015, 4, 279–300.

20. Dunham, L.; Ahn, M.; York, A.S. Building a bioeconomy in the heartland: Bridging the gap between resources and perceptions. *J. Enterprising Communities* 2012, 6, 84–100. [CrossRef]

21. Kokkonen, K.; Oljans, V. From opportunities to action—An integrated model of small actors’ engagement in bioenergy business. *J. Clean. Prod.* 2018, 182, 496–508. [CrossRef]

22. Giurca, A.; Späth, P. A forest-based bioeconomy for Germany? Strengths, weaknesses and policy options for lignocellulosic biorefineries. *J. Clean. Prod.* 2017, 153, 51–62. [CrossRef]

23. Lazarevic, D.; Kautoo, P.; Antikainen, R. Finland’s wood-frame multi-storey construction innovation system: Analysing motors of creative destruction. *For. Policy Econ.* 2020, 110, 101861. [CrossRef]
24. Scordato, L.; Klitkou, A.; Tartiu, V.E.; Coenen, L. Policy mixes for the sustainability transition of the pulp and paper industry in Sweden. *J. Clean. Prod.* 2018, 183, 1216–1227. [CrossRef]

25. Festel, G.; Rammer, C. Importance of venture capital investors for the industrial biotechnology industry. *J. Commer. Biotechnol.* 2015, 21, 31–42.

26. Borge, L.; Bröring, S. What affects technology transfer in emerging knowledge areas? A multi-stakeholder concept mapping study in the bioeconomy. *J. Tech. Transfer* 2020, 45, 430–460. [CrossRef]

27. Ylimartimo, A. Case study on bioeconomy campus, Central Finland. *Biofuels Bioprod. Biorefining* 2018, 12, 177–186. [CrossRef]

28. Mazzucato, M. *The Entrepreneurial State: Debunking Public vs. Privat Sector Myths*; Penguin: London, UK, 2018.

29. German Bioeconomy Council. *Bioeconomy Policy. Synopsis and Analysis of Strategies in the G7*; Office of the Bioeconomy Council: Berlin, Germany, 2015.

30. German Bioeconomy Council. *Bioeconomy Policy (Part II): Synopsis of National Strategies around the World*; Office of the Bioeconomy Council: Berlin, Germany, 2015.

31. OECD. *Entrepreneurship at a Glance 2017*; OECD Publishing: Paris, France, 2017.

32. Gwet, K.L. Intrarater Reliability. *Wiley Encyclo. Clin. Trials* 2008, 1–14. [CrossRef]

33. Ministerio de Agroindustria. *Bionomía Argentina. Visión desde Agroindustria*; Ministerio de Agroindustria: Buenos Aires, Argentina, 2017.

34. Ministry of the Environment. *Sustainable Growth from Bioeconomy. The Finnish Bioeconomy Strategy*; Edita Publishing Ltd.: Helsinki, Finland, 2014.

35. Ministry of Agriculture and Food. *A Bioeconomy Strategy for France. 2018-2020 Action Plan*; Ministry of Agriculture and Food: Paris, France, 2018.

36. Federal Ministry of Food and Agriculture. *National Policy Strategy on Bioeconomy*; Ministry of Food and Agriculture: Bonn, Germany, 2014.

37. Federal Ministry of Education and Research; Federal Ministry of Food and Agriculture. *Nationale Bioökonomiestrategie. Kabinettssvorlage*; Federal Ministry of Food and Agriculture: Bonn, Germany, 2020.

38. Government of Ireland. *National Policy Statement on the Bioeconomy*; Government of Ireland: Dublin, Ireland, 2018.

39. Presidency of Council of Ministers. *Bioeconomy in Italy*; Presidency of Council of Ministers: Rome, Italy, 2017.

40. Federal Ministry of Agriculture, Forestry and Fisheries. Basic Plan for the Promotion of Biomass Utilization. Available online: https://www.maff.go.jp/e/policies/env/attach/pdf/index-4.pdf (accessed on 21 February 2020).

41. Latvian Ministry of Agriculture. *Latvian Bioeconomy Strategy 2030*; Latvian Ministry of Agriculture: Riga, Latvia, 2018.

42. Ministry of Science, Technology and Innovation. *Bioeconomy Transformation Programme. Enriching the Nation, Securing the Future*; Ministry of Science, Technology and Innovation: Putrajaya, Malaysia, 2015.

43. Ministry of Trade, Industry and Fisheries. *Familiar Resources—Undreamt of Possibilities: The Government’s Bioeconomy Strategy*; Ministry of Trade, Industry and Fisheries: Oslo, Norway, 2016.

44. Department of Science and Technology Republic of South Africa. *The Bio-Economy Strategy*; Department of Science and Technology Republic of South Africa: Pretoria, South Africa, 2013.

45. Spanish Ministry of Economy, Industry and Competitiveness. *The Spanish Bioeconomy Strategy—2030 Horizon*; Spanish Ministry of Economy, Industry and Competitiveness: Madrid, Spain, 2016.

46. Ministry of Science and Technology Thailand. *Thailand’s National Biotechnology Policy Frameworks (2012–2021)*; Ministry of Science and Technology Thailand, National Science Technology and Innovation Policy Office: Bangkok, Thailand, 2012.

47. White House. *National Bioeconomy Blueprint*; White House: Washington, DC, USA, 2012.

48. Nordic Council of Ministers. *Future Opportunities for Bioeconomy in the West Nordic Countries*; Nordic Council of Ministers: Copenhagen, Denmark, 2014.

49. European Commission. *A Sustainable Bioeconomy for Europe: Strengthening the Connection between Economy, Society and the Environment*; European Commission: Brussels, Belgium, 2018.

50. Guzman, J.; Stern, S. Where is Silicon Valley? Forecasting and mapping entrepreneurial quality. *Science* 2015, 347, 606–609. [CrossRef]
51. Urmetzer, S.; Lask, J.; Vargas-Carpintero, R.; Pyka, A. Learning to change: Transformative knowledge for building a sustainable bioeconomy. *Ecol. Econ.* **2020**, *167*, 106435.

52. Kuckertz, A. Let’s take the entrepreneurial ecosystem metaphor seriously! *J. Bus. Ventur. Insights* **2019**, *11*, e00124. [CrossRef]

53. Pyka, A. Dedicated innovation systems to support the transformation towards sustainability: Creating income opportunities and employment in the knowledge-based digital bioeconomy. *J. Open Innov. Technol. Mark. Complex.* **2017**, *3*, 27. [CrossRef]

© 2020 by the author. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (http://creativecommons.org/licenses/by/4.0/).