

Bioeconomy pathways at national and regional levels



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Today, the bioeconomy is associated with multiple expectations regarding a number of sustainability-related policy aims, such as climate change mitigation, ensuring energy security, technological progress and environmental protection, employment protection and rural value creation. These expectations have developed over the past 30 years largely in response to the increased concern about enhancing competitiveness in the world market, but also achieving climate- and energy-related objectives to make the transition from a fossil fuels-based economy to a renewables- and bio-based economy. This transition has experienced and will continue to face substantial challenges and turning points, which are addressed below. This brief focuses especially on the EU as one of the global/regional leaders on bioeconomy but we include evidence from other world regions as well.

Europe leading the path

The emergence of the concept of a bioeconomy cannot be linked to any single source or publication, but can instead be described as a convergence and divergence of paths and an evolution. According to Birner (2018), the concept has its roots in the 1980s and 1990s, when the life sciences first came on to the radar of economists. Advances in gene manipulation and biotechnology more generally were also driving transformations in industry. Although the term bioeconomy was first introduced by scientists concerned about the industrial consequences of advances in biology, the bioeconomy became an important policy concept in Europe as a result of a deliberate decision by officials at the European Commission to promote the concept. Birner even identifies Christian Paternmann, the former Programme Director of “Biotechnology, Agriculture and Nutrition” in the Directorate General for Research, Science and Education at the Commission, as coining the term at a policy conference in 2000. In developing the concept within the EU, the label “knowledge-based” was added so that it had become the “knowledge-based bioeconomy” by 2005. This label was in line with EU innovation policy, which was prevalent at the time. Birner also acknowledges the role of the 2007 Cologne Paper in the evolution of the bioeconomy concept (German Presidency of the EU 2007). According to Birner, the Cologne Paper introduced two perspectives on the concept of the bioeconomy: the biotechnology innovation perspective and the resource substitution perspective. One of the key drivers of European innovation was the reconceptualization of the innovation chain and the EU research agenda. Paternmann and Aguilar (2018) regard the departure of the EU research agenda from the classical concept of a linear innovation chain – meaning from basic to applied research, followed by technological and industrial development that finally ends in industrial exploitation and commercialization – towards targeted research to meet

IMAGE (ABOVE): Cornfield with ethanol biorefinery © BanksPhotos / Getty

socio-economic needs and EU policy objectives as the primary impetus for the bioeconomy, albeit primarily in relation to biotechnology at that time. They argue that it was the fifth Framework Programme (1998–2002) that prompted European research to make a decisive contribution through innovative products, processes and services (Paternmann and Aguilar 2018). The European Commission published its first bioeconomy strategy, Innovating for Sustainable Growth: A Bioeconomy for Europe, in 2012 (European Commission 2012). This strategy not only became the guiding document on perspectives on the bioeconomy in Europe, but also provided a lead at the global level. The primary focus of the strategy was economic growth and its adoption boosted the development of bioeconomy strategies at the national level. National strategies were launched, for example, in Germany (2010; 2013), Sweden (2012), the United Kingdom (2012), the Netherlands (2013), Finland (2014) and Italy (2017). Outside the EU, Malaysia (2011), the USA (2012), Canada (2013; 2019) and South Africa (RSA, 2013) were forerunners. The European Commission upgraded its bioeconomy strategy in 2018 (European Commission 2018), putting greater emphasis on sustainability, climate objectives, the modernization of industry and the circular economy, but also on supporting healthy ecosystems. Thus, the upgraded strategy has much broader goals than the economic goals of the previous one. Meyer (2017) argues that it is now not the limits of growth, but new growth opportunities that are the focus of EU bioeconomy policy.

The EU strategy is much influenced by the UN 2030 Agenda (2015) and the Paris Agreement (2015), and commitments made on building a carbon neutral future and maintaining healthy life-supporting ecosystems. The release of the strategy triggered another peak of national bioeconomy strategies in the EU, initially led by the Scandinavian countries, the Benelux countries, in particular the Netherlands, together with Germany, and later joined by Ireland, France, Italy, Spain and Austria, each with regionally differing priorities, approaches and objectives (Paternmann and Aguilar 2018).

Regional strategies as the focus guiding development

While governments have been developing national policies on the bioeconomy, there have also been regional initiatives by industry on its own or in partnership. Partnerships between research and education organizations and local governments have emerged across Europe in the past two decades. Once again, these were perhaps largely promoted by the financial support systems provided to create such networks or the sectoral clusters provided by government or by EU funds, in particular the research and innovation programmes. These private-public partnerships were encouraged and supported to invest in new knowledge, technologies, products and processes. One of the EU Horizon 2020 projects, “Building Regional Bioeconomies” (BERST.eu), has provided tools for benchmarking and developing regional bioeconomy strategies. The Berst Tool (<https://berst.databank.nl/>) identifies four pillars of bioeconomy readiness in a region: biomass availability and land use; demographics and the quality of the workforce; employment and the structure of firms; and innovation. For example, there are more than 55 regional reports on bioeconomy readiness at the NUTS 1 statistical level and more than 240 regional reports at the NUTS 3 level across Europe, and these numbers are increasing. This demonstrates the interest in regions in using a common mapping framework to better understand their resource base – not only in terms of biomass, but also in terms of human resources and entrepreneurship – and their potential. At the same time, it also shows the growing interest in regions in identifying business advantages and mobilizing regional actors to utilize this advantage for the common good. An emergence of bioeconomy clusters, such as a wood cluster, a food and feed cluster and a biotechnology cluster and so on, at the regional level has been observed across Europe. However, Overbeek et al. (2016) point out that the concept of clusters has changed since the days of large enterprises dominating innovation processes, to become a network of agents interacting in the economic/industrial arena in a particular institutional structure.

Participatory co-creation of strategies more visible at the national level

A review of select national bioeconomy strategies finds that such strategies can be developed under the leadership of different ministries or agencies, or under the auspices of the entire government. Depending on the ownership of these strategies (see Table 1), the primary focus of a bioeconomy strategy may be on new knowledge (a research focus) (see e.g. Germany 2010; USA 2012), food production and rural development (Canada 2019; Germany 2013), biofuels (a renewable energy focus) (Sweden 2012; the Netherlands 2013), employment and jobs (Finland 2014; UK 2018) or the economy as a whole (France 2017; Italy 2017). The Malaysia bioeconomy strategy focuses on three sectors – agriculture, health care and industry – that will need to be transformed in order to meet future needs.

With regard to the development processes of these strategies, Overbeek et al. (2016) demonstrates that the involvement of civil society in bioeconomy planning is only just beginning. The research group observed that while national bioeconomy strategies encourage public participation and the involvement of the main actors can easily be traced, similar involvement and participation in regional bioeconomy strategies are less easy to identify because explicit strategies and guidelines are either lacking or not publicly available. Activities to encourage participative governance at the regional level are limited both in number and objectives. The main objective seems to be to increase public awareness by providing information on the policymaking process. Nonetheless, Overbeek et al. (2016) concludes that some attempts and intentions to move towards participatory governance can be identified.

Table 1 Lead departments or agencies in bioeconomy strategies

Country	Year of publication	Author of the strategy
Germany	2010	Federal Ministry for Education and Research
	2013	Federal Ministry for Education and Research, Federal Ministry of Food and Agriculture
Malaysia	2011	Ministry of Science, Technology and Innovation
Sweden	2012	FORMAS, VINNOVA and Swedish Energy Agency
UK	2012	Department of Transport, DEFRA and Department of Energy and Climate Change
	2018	Ministry for Business and Industry
USA	2012	Office of Science and Technology Policy
Canada	2013	Department of Agriculture and Agri-Food
	2019	Department of Agriculture and Agri-Food
The Netherlands	2013	Energy & Climate Change Secretary
Finland	2014	Ministry of Employment and Economy
France	2017	The French Government
Italy	2017	Council of Ministers

A bio-based approach, a bioscience approach or both?

Staffas et al. (2013) and Meyer (2017) distinguish between the biotechnology and life science aspects of and approaches to the bioeconomy and a transformation-centred approach. The latter requires the transformation of the entire economy across all sectors, rather than just improvement in particular sectors. A review of select bioeconomy strategies in Europe and globally finds both approaches present: strategies that provide visions of knowledge-driven technology innovation; and visions that require transformational changes in governance systems to meet the sustainability objectives of the bioeconomy.

Meyer, however, calls for a third approach – a public goods-oriented approach. The author provides the example of an agri-ecological bioeconomy, where farmers are seen not just as commodity producers, but also as providers of quality food and managers of ecosystems. This is also known as multifunctional land use/agriculture (Shortall et al. 2015), which aims to minimize the need for external inputs and to rely instead on ecological interactions (Priefer et al. 2017).

Table 2 Approach taken to bioeconomy strategy in selected countries

Country bioeconomy strategy	Biotechnology and life sciences centered approach	Transformation centered approach
Canada (2013, 2019)	X	
Germany (2010; 2013)		X
Finland	X	
France	X	X
Italy		X
Malaysia	X	X
RSA	X	X
Sweden		X
The Netherlands	X	X
UK (2012; 2018)	X	X
USA	X	

A sustainability perspective on the bioeconomy

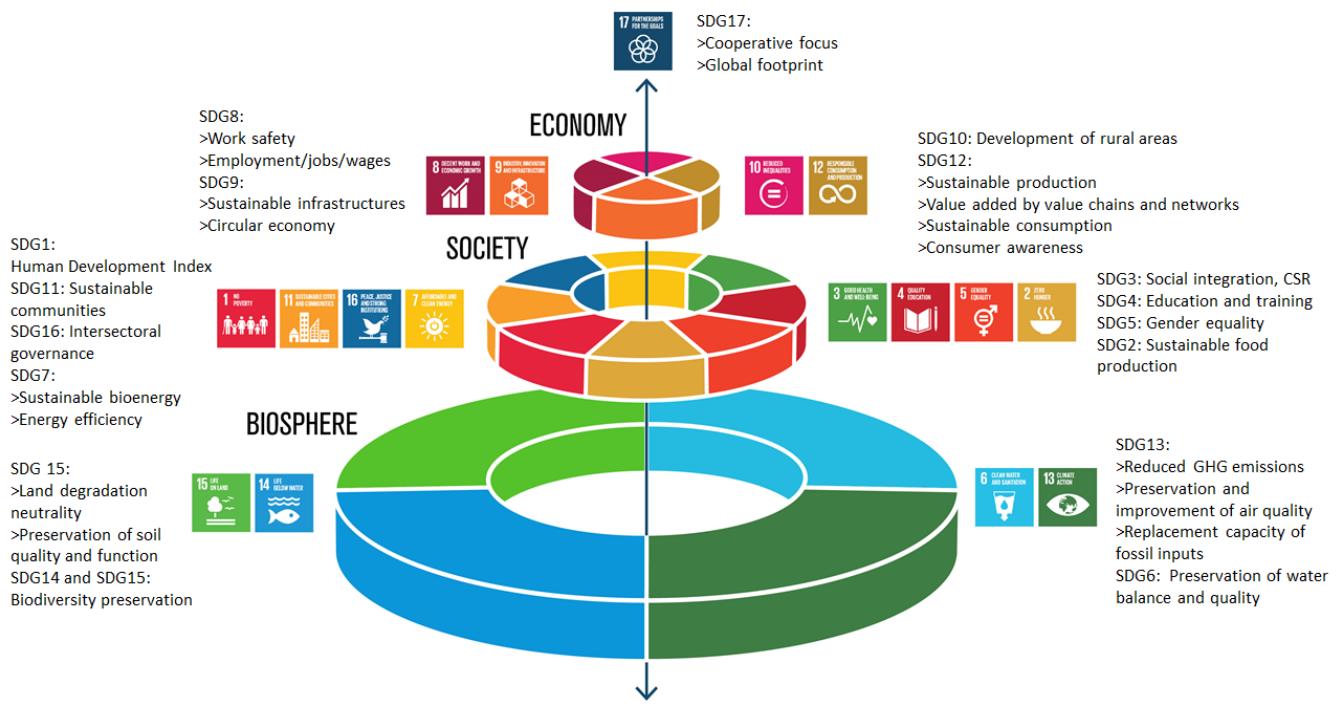
According to Scarlat et al. (2015), biomass availability and the competition between alternative uses of biomass for food, feed, fibre, bio-based materials and bioenergy are major concerns for the development of a bioeconomy. Biomass is a renewable, but limited resource, as biomass production requires land and additional resources such as water and nutrients. The demand for biomass will increase significantly in order to reach the EU's 2020 targets for bioenergy (Scarlat et al. 2015). It is therefore important to analyse the demand for biomass in relation to existing potential. Primarily, the production of biomass depends on the availability of land. If more land is needed for increased biomass production, this land could be made available through the conversion of forest land and grasslands to arable land, thereby releasing significant amounts of CO₂ into the atmosphere. Direct and indirect land use change and the carbon debt for the use of forest biomass, for example, are important issues. Scarlat et al. (2013) warns that the amount of land that will be required for biomass production is strongly dependent on the type of crop and the allocation of land use for co-products (e.g. for materials, feed, etc.). In addition, Staffas et al. (2013) argues that the economic aspects of the bioeconomy, such as providing new employment and business opportunities, are usually given more attention, while sustainability-related issues and resource availability are only addressed to a more limited extent.

Patermann and Aguilera (2018) provides a reminder that just because a process or product is bio-based or part of the bioeconomy does not automatically make it sustainable. Whether a process or process is sustainable is determined over its life-cycle, not just by placing a label on it. The same argument is made in Gawel et al. (2019), the analysis in which shows that the bioeconomy is not sustainable per se, as mere input substitution can entail welfare losses. The authors stress that sustainability has to be the key concept behind the bioeconomy. They define sustainability as sustainability of the resource base, and as sustainability of processes and products, especially through circular processes of material fluxes, not least to gain consumer acceptance of bio-based products. Gawel et al. (2019) regards the mere substitution of fossil fuel resources for bio-based resources as a weak contribution to the generation of additional societal and ecological benefits and meeting climate change-related objectives.

The sustainability perspective is especially valid in an era of global trade where production and consumption often take place far apart, which makes tracking the impacts (footprint) of national activities on foreign countries vital (Egenolf and Bringezu 2019). The authors provide two options for footprint calculations: footprint of production (domestic extraction plus imports) or the footprint of final consumption (domestic production plus imports, minus exports), which includes upstream resource requirements and greenhouse gas emissions.

Diaz-Chavez et al. (2019) explores the sustainability indicators of the bioeconomy and suggests looking at the indicators through a Sustainable Development Goals (SDGs) lens. Figure 1 provides an integrated view of how the bioeconomy indicators in several studies, as interpreted by the authors of this paper, interact with the SDGs (Egenolf and Bringezu 2019; Diaz-Chavez et al. 2019; Karvonen et al. 2017).

Figure 1. Sustainability indicators of bioeconomy and SDGs



Conclusions

Europe has been leading the development of the bioeconomy as a concept for the past 30 years. During that period, the concept has taken two main pathways: the biotechnology and life sciences pathway or a transformative pathway aimed at restructuring the governance system for bio-based sectors in pursuit of integration and effectiveness. Some countries seek to promote both pathways at the same time. Whichever pathway is taken, sustainability-related issues frame the policies and strategies of the bioeconomy to a great extent. The bioeconomy has an important role to play in achieving the 2030 Agenda and the SDGs, and the related targets have become central to the discussions of governments, businesses, research and education organizations, and the general public. As Patermann and Aguilar (2018) note, these discussions about the role of the bioeconomy indicate that initiatives such as these require not just goodwill but, above all, the development of matching managing instruments, mature sectoral policies and a broad socio-economic consensus.

References

- 2030 Agenda. Available at <https://sustainabledevelopment.un.org/post2015/transformingourworld>
- Birner, R. (2018). Bioeconomy Concepts. In *Bioeconomy: Shaping the Transition to a Sustainable, Biobased Economy*. Lewandowski, I. (ed.). Springer. <https://link.springer.com/book/10.1007/978-3-319-68152-8>
- Canada, Government of (2013). Growing Forward 2. <http://www.agr.gc.ca/eng/about-us/key-departmental-initiatives/growing-forward-2/?id=1294780620963>
- Canada, Government of (2019). Canada's Bioeconomy Strategy: Leveraging our Strengths for a Sustainable Future. https://docs.wixstatic.com/ugd/b22338_1906a509c5c44870a6391f4bde54a7b1.pdf
- Diaz-Chavez R., Mortensen, S. and Wikman, A. (2019). *Bioeconomy: Untapping Natural and Human Resources to Achieve Sustainability*. Working Paper 2019-nn. Stockholm Environment Institute, Africa Centre, Nairobi
- Egenolf, V. and Bringezu, S. (2019). Conceptualization of an indicator system for assessing the sustainability of the bioeconomy. *Sustainability*, 11(2), 443
- European Commission. (2012). *Innovating for Sustainable Growth: A Bioeconomy for Europe*. Brussels, 13.2.2012 COM(2012) 60 final. https://ec.europa.eu/research/bioeconomy/pdf/official-strategy_en.pdf
- European Commission. (2018). *A Sustainable Bioeconomy for Europe: Strengthening the Connection Between Economy, Society and the Environment*. Brussels, 11.10.2018 COM(2018) 673 final. <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52018DC0673&from=EN>
- Finland Ministry of the Environment (2014). *The Finnish Bioeconomy Strategy*. https://biotalous.fi/wp-content/uploads/2014/08/The_Finnish_Bioeconomy_Strategy_110620141.pdf
- France, the Government of (2017). *A Bioeconomy Strategy of France*. <http://agriculture.gouv.fr/telecharger/84625?token=e13f5ba7a8d26a552c8509c3c551418f>
- Gawel, E., Pannicke, N. and Hagemann, N. (2019). A path transition towards a bioeconomy: the crucial role of sustainability. *Sustainability*, 11(11), 3005
- German Presidency of the EU. (2007). Cologne Paper. Presented at the conference “En Route to the Knowledge-Based Bio-Economy”, 30 May 2007 https://dechema.de/dechema_media/Downloads/Positionspapiere/Cologne_Paper-p-20000945.pdf
- Germany, Federal Government of (2010). *National Research Strategy BioEconomy 2030. Our Route Towards Biobased Economy*. Available at https://www.pflanzenforschung.de/files/4514/7886/1937/German_bioeconomy_Strategy_2030.pdf
- Germany, Federal Ministry of Education and Research (2013). *Bioeconomy in Germany: Opportunities for a Bio-based and Sustainable Future*. https://www.bmbf.de/upload_filestore/pub/Bioökonomie_in_Deutschland_Eng.pdf
- Italy, Government of (2017). *Bioeconomy in Italy: A New Bioeconomy Strategy for a Sustainable Italy*. http://cnbbsv.palazzochigi.it/media/1719/bit_en_2019_web.pdf
- Karvonen, J., Halder, P., Kangas, J. and Leskinen, P. (2017). Indicators and tools for assessing sustainability impacts of the forest bioeconomy. *Forest Ecosystems*, 4(2)
- Malaysia (2011). *Bioeconomy of Malaysia: Enriching the Nation, Securing the Future*. Malaysian Biotechnology Corporation, Kuala Lumpur. http://www.bioeconomycorporation.my/wp-content/uploads/2011/11/publications/Bioeconomy_Transformation_Programme_Booklet_Brochure.pdf
- Meyer, R. (2017). Bioeconomy strategies: Contexts, visions, guiding implementation principles and resulting debates. *Sustainability*, 9(6), 1031
- Netherlands (2013). *Framework Memorandum on the Biobased Economy Gaan voor Groene Groei*. <https://www.rijksoverheid.nl/binaries/rijksoverheid/documenten/rapporten/2013/11/12/gaan-voor-groene-groei/gaan-voor-groene-groei.pdf>
- Overbeek, G., de Bakker, E., Beekman, V., Davies, S., Kiresiewa, Z., Delbrück, S., Ribeiro, B., Stoyanov, M. and Vale, M. (2016). Review of bioeconomy strategies at regional and national levels. BioSTEP, *Promoting Stakeholder Engagement and Public Awareness for a Participative Governance of the European bioeconomy*. January 2016. http://www.bio-step.eu/fileadmin/BioSTEP/Bio_documents/BioSTEP_D2.3_Review_of_strategies.pdf
- Paris Agreement (2015). <https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement>
- Patermann, C. and Aguilar, A. (2018). The origins of the bioeconomy in the European Union. *New Biotechnology*, 40, Part A, 25 January 2018, 20–24
- Priefer, C., Jörissen, J. and Frör, O. (2017). Pathways to shape the bioeconomy. *Resources*, 6, 10

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- RSA (2013). *The Bio-Economy Strategy*. Department of Science and Technology. Republic of South Africa. https://www.gov.za/sites/default/files/gcis_document/201409/bioeconomy-strategya.pdf
- Scarlat, N., Dallemand, J.F. and Banja, M. (2013). Possible impact of 2020 bioenergy targets on European Union land use: A scenario-based assessment from national renewable energy action plans proposals. *Renewable Sustainable Energy Review*, 18(1), 595–606
- Scarlat, N., Dallemand, J-F., Monforti-Ferrario, F. and Nita, V. (2015). The role of biomass and bioenergy in a future bioeconomy: Policies and facts. *Environmental Development*, 15, 3–34
- Shortall, O. K., Raman, S. and Millar, K. (2015). Are plants the new oil? Responsible innovation, biorefining and multipurpose agriculture. *Energy Policy*, 86, 360–368
- Staffas, L., Gustavsson, M. and McCormick, K. (2013). Strategies and policies for bioeconomy and bio-based economy: an analysis of official national approaches. *Sustainability*, 5, 2751–2769
- Sweden (2012). *Swedish Research and Innovation Strategy for a Bio-based Economy*. https://www.formas.se/download/18.462d60ec167c69393b91e60f/1549956092919/Strategy_Biobased_Economy_hela.pdf
- United Kingdom, Government of (2018). *Growing the Bioeconomy: A National Bioeconomy Strategy to 2030*. <https://www.gov.uk/government/publications/bioeconomy-strategy-2018-to-2030>
- United Kingdom, Government of (2012). *UK Bioenergy Strategy*. Department of Transport, Department of Energy and Climate Change, DEFRA. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/48337/5142-bioenergy-strategy-.pdf
- United Nations (2015). Sustainable Development Goals. <https://www.un.org/sustainabledevelopment/sustainable-development-goals/>
- USA (2012). *National Bioeconomy Blueprint*. The White House. https://obamawhitehouse.archives.gov/sites/default/files/microsites/ostp/national_bioeconomy_blueprint_april_2012.pdf