

# A Sustainable Bioeconomy

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The Green Industrial Revolution



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# Preface

Nowadays, the sustainable production of food, energy, chemicals, and materials is the major challenge facing modern societies and future generations, after decades of reliance on fossil resources which, on the one hand, did generate economic growth and prosperity but, on the other hand, has left heavy environmental, geopolitical, and social legacies. In this alarming context, the concept of bioeconomy has been developed and promoted as a new sustainable and knowledge-based economic model centered on the use of renewable biomass and derived agro-industrial and municipal wastes using various supply chains and pretreatment, conversion, separation, and purification procedures and technologies. Thus, as a multidimensional concept, bioeconomy has the delicate task to replace the declining fossil-based economic model and manage its global and complicated legacy, while facing its own set of challenges, especially during the delicate transition phase toward the full-scale implementation of a biomass-based economy.

Throughout this book, the authors presented, analyzed, and discussed the concept of bioeconomy from various angles in order to provide basic and advanced knowledge about bioeconomy for students, researchers, industrialists, decision makers, and the general public by showing opportunities, discussing R&D findings, analyzing strategies, assessing the impacts and challenges, showcasing industrial achievements, criticizing policies, and proposing solutions. The task was indeed challenging for one book, and we sincerely hope that we were able to accomplish it.

Hence, this book, which is divided into nine chapters, started in Chap. 1 by analyzing the current situation resulting from the petroleum-based economy, showing its deficiencies and disastrous legacy, which is one of the major driving forces toward the shift to a new model: biomass-based economy. Chapter 2 analyzed the concept of bioeconomy and its sustainable dimension by discussing the proposed definitions and key issues related to the current transition phase such as raw material change and sustainable profitability. The expected role and impact of sustainable bioeconomy on the two main economic pillars, agriculture and industry, are also presented.

In Chap. 3, renewable biomass was discussed, as the core element in the bioeconomy concept, in order to provide the readers with information about its definition, classification (woody, herbaceous, and aquatic biomass, along with derived wastes), composition (cellulose, hemicellulose, lignin, proteins, lipids, etc.), as well as the various opportunities for their industrial valorization into strategic and added-value products.

Then, the opportunities to produce a multitude of bioproducts from biomass were showcased and thoroughly discussed in three consecutive chapters: Chap. 4 for biofuels and bioenergy, Chap. 5 for biochemicals, and Chap. 6 for the production of biomaterials. In each one of those chapters, a theoretical background was presented, followed by a detailed analysis of the various mechanical, thermochemical, and biological conversion procedures applied to transform raw biomass into value-added end products including bioethanol, biodiesel, biogas, organic acids, food and fuel additives, biocosmetics, biopesticides, as well as pulp and paper, bioplastics, biochars, and activated carbons.

One of the main challenges facing bioeconomy is to develop viable and efficient industrial-scale production schemes. Thus, Chap. 7 was devoted to analyze the industrial dimension of the bio-based economic model and its sustainable and integrated biorefining activities. In this chapter, the implementation of bioeconomy on the ground was examined by illustrating the various designs of biorefineries, the obstacles facing the implementation scenarios, as well as some study cases of green biorefining technologies. The knowledge and experiences of key countries in the field of bioeconomy were detailed and discussed in Chap. 8. The objective was to provide readers from different backgrounds with the strategic visions of the USA, many Eastern European countries, and China toward adopting bioeconomy and its various sustainable industrial-scale production processes and technologies. As well, the available bioresources, opportunities, and challenges in the studied countries were also investigated, along with some interesting industrial study cases. A special focus was made on the industrial achievements and prospects in Finland.

In Chap. 9, the various impacts of bioeconomy and the prospects of its world-wide implementation were thoroughly discussed from a multidimensional outlook including industrial, environmental, social, and geopolitical perspectives. This includes reflections on the need for a continuous monitoring of the sustainability of bioproducts and biorefineries via various indicators, as well as the assessment of key environmental and social factors such as greenhouse gas emissions, land-use change, biodiversity, employment, and food security.

Finally, we sincerely hope that our contribution to promote sustainable bioeconomy in this book will benefit researchers, industrialists, decision makers, professionals, and students around the world and thus create a momentum behind biomass-based economy and sustainable development. The authors thank Springer International Publishing for supporting our book from the preparation phase until its final publication.

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