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# Introductory Chapter: Renewable Resources and Biorefineries

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## 1. Introduction

In the face of global challenges, strategies to reduce and replace fossil resources towards a sustainable bio-based economy have been developed in several countries across the globe [1]. These challenges include rapid depletion of fossil resources, growing global population, climate change, energy security, food and water security and soil destruction. In this sense, the long-term objectives to achieve the global bioeconomy will be to ensure food and health security, make energy provision more sustainable, explore renewable resources, make the more efficient use of resources and produce new bio-based materials [2].

Although there are many viewpoints about bioeconomy, the notion itself is quite straightforward. Basically, the bioeconomy is the strategy that utilizes 'green' materials instead of fossil-based materials to generate bioenergy, chemicals, food, feed and other bio-based products, with a low or no generation of waste. Within such an economy, sustainability and the efficient use of resources are the key components of its implementation at the social and industrial level [3, 4]. Apart from its ecological impact, bioeconomy is also intended to have socioeconomic benefits such as fostering economic competitiveness, meeting rising demand and counteracting resource depletion [5]. The concept of bioeconomy is quite broad and can encompass a range of sustainability strategies, such as biorefineries, that were defined by the International Energy Agency [6] as a sustainable processing of biomass into a spectrum of marketable products.

All resources containing non-fossil organic carbon, recently (<100 years) derived from agriculture (dedicated crops and residues), forestry, industries (process residues and leftovers), households (municipal solid waste and wastewaters) and aquaculture (algae and seaweeds), are considered bio-based resources or also called biomass. Biomass can also be classified into

nonedible and edible. The latter case, generally represented by the use of vegetable oils for biofuel production, has been criticized by competing with the food supply [7, 8]. The most relevant classification of biomass for its integration into specific bio-based product chains is according to its major component, such as lignocellulose (lignin + cellulose + hemicellulose), carbohydrates, proteins and triglycerides [8].

This biomass can be untreated or may have undergone biochemical (fermentation or enzymatic conversion), thermochemical (combustion, gasification or pyrolysis), chemical (acid hydrolysis, synthesis or esterification) and mechanical processes (fractionation, pressing or size reduction), with the aim of depolymerizing and deoxygenating the biomass components [3, 7].

The products of major commercial importance produced in biorefineries are biofuels (biogas, syngas, hydrogen, biomethane, bioethanol, biodiesel and bio-oil), chemicals (fine chemicals, building blocks, bulk chemicals and bioactive compounds), organic acids (succinic, lactic and itaconic), polymers and resins (starch-based plastics, phenol resins and furan resins), biomaterials (wood panels, pulp, paper and cellulose), food and animal feed and fertilizers [9].

Despite the many advantages of biorefinery systems, it is essential that they simultaneously combine the three pillars of sustainability and aim to balance the environmental, economic and social aspects. For this task, tools are required to provide quantitative information about the sustainability of the process. To this end, the life cycle assessment (LCA) assumes the character of quantifying the potential environmental impacts of products, processes or services. This valuable tool should be used to expand the knowledge base of productive systems and their relationship with the environment, once it can increase the efficiency of its processes, reduce costs and, additionally, promote marketing of their products due to its appeal for sustainability [10].

This all suggests that bioeconomy is a necessity in order to pave the way to a more innovative, resource-efficient and competitive society that reconciles food security with the responsible use of renewable resources. The chapters presented in this book are intended to provide a deeper insight into the use of renewable resources through biorefinery systems to move towards a sustainable bioeconomy.

## **Conflict of interest**

The authors declare that they have no conflict of interest.

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