Chapter 19
Manufacturing of Marketable Energy Sources From Agricultural Crops: A Spanish Sector-Based Study on Bioeconomy

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ABSTRACT

The evolution of societies has been historically linked to the production, consumption and, ultimately, availability of energy. The development of more efficient technologies has led to several energy sources' evolution and change over the past centuries. However, those changes, together with a considerable rise of energy consumption, have also brought a threat to ecosystems in the form of several contaminants. In this chapter, a study on the potential use of crops for producing marketable energy is assessed, using the Spanish agriculture sector as study case given its substantial contribution to crop production in the European Union.

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INTRODUCTION

Throughout history, the evolution of societies has been linked to the joint development of a series of factors. For example, the Roman Empire achieved its expansion in part due to its ability to generate water infrastructures (e.g. aqueducts) or transportation infrastructures (roads and highways), seeing how the economic affluence achieved with some of these routes at the time still persists today (Dalgaard et al., 2018). Another example of this is the medieval period, in which Latin and Arab societies made numerous innovative contributions such as the construction of irrigation ditches or the water mill in the field of water engineering (Glick & Kirchner, 2000), or the creation of water and land routes, as well as bridges in the field of civil transport infrastructures (Langdon & Claridge, 2011). Despite the importance of these and other similar developments, it could be said that the greatest technological leaps forward have been related to the discovery and exploitation of energy sources.

The first major development in this line was the use of fire, since it was employed by prehistoric societies as an energy source applicable to various fields: heating, metal smelting or cooking, among others. However, fire as a primary source of energy offered several limitations. Its simplicity (an exothermic reaction based on the presence of a fuel, mainly organic matter, oxygen as oxidizer and a hot focus as activation element) allowed its widespread extension, but this technology had the disadvantage of not being easily controllable. This fact changed during the First Industrial Revolution, especially after the implementation of James Watt's steam engine (1880) in the production processes, which was an evolution of Newcomen's engine.

Indeed, the use of James Watt's steam engine allowed an effective control of the movement by means of an adequate design of its mechanism. In addition, the fact that it was an external combustion engine allowed the use of fuels of any nature, since the moving parts were isolated from the combustion chamber and, consequently, prevented the generation of problems related to deficient combustion. This machine was used in different fields, such as the creation of mechanical traction vehicles or the increase of productivity in the then new factories (as opposed to the old guilds).

In spite of this, energy needs have maintained a historical growth both due to the increase in population over the years and to the technologies themselves that require its supply for their operation. For this reason, the Second Industrial Revolution saw the exploitation of new energy sources such as gas or oil, as well as electricity, which ultimately led to the creation, improvement and democratization of access to various means of transport between the end of the 19th century and the first decades of the 20th century (railroads, various land vehicles and aircrafts), communications (telegraph, telephone, radio and television) and various infrastructures (electric lighting, the appearance of the first household appliances, etc.). The main advantage of this type of energy sources that promoted its wide development was the high power they can offer. However, the inability of the time to carry out an effective storage of electrical energy caused a need to be able to produce at all times the energy demanded.

On the other hand, the use of these energy sources, which currently remain broadly exploited, has led to the generation of various types of waste that have affected and continue to threaten the different ecosystems of the planet. According to the International Energy Agency (2021), in 2019 a total of 606.6 EJ (Exajoules) were produced among all the sources used, which is equivalent to the energy contained in approximately 99.15 billion barrels of oil. Within these sources, 30.9% of the energy came precisely from oil, 26.8% from burning coal and 23.2% from natural gas, implying that more than 80% of the energy generated came from non-renewable fossil fuels.

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