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AN ANALYSIS REGARDING THE BIOMASS PRODUCTION SECTOR IN ROMANIA - A BIOECONOMY POINT OF VIEW

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Abstract

Bioeconomy was defined as the economic sector which is based on sustainable use of bioresources (crops, wood, vegetal and microbial biomass), provided either by the soil or the aquatic environment, for producing food, materials and energy. The present paper is representing an overview of the opportunities and challenges surrounding green growth through the use of biomass as renewable raw material in the transition towards bioeconomy. Global and European data are provided, and Romanian situation is briefly described. In a broad sense, biomass is a general term, covering various biological materials that can be further used in the production of renewable energy or materials. The biomass signifies the biodegradable part of byproducts, wastes and residues of biological (vegetal and animal) origin from agriculture, silviculture, related industries and also urban activities. It came into the attention due to the increased potential as clean, affordable and renewable bioenergy source, with a particular interest on the production processes that imply agricultural and forest waste as those two possess a great potential throughout the whole world.

Key words**:** *biomass, bioeconomy, green growth, resources management, Romania*

INTRODUCTION

The EU Bioeconomy Strategy defines the Bioeconomy sector as "the sustainable production of primary biomass and the conversion of organic resources (primary or waste) into food, feed, bio-based products and bioenergy" [4]. Bioeconomy is seen through multi-sector approach, connecting multiple industrial sectors [5], such as: agriculture, food, fishery, forestry, energy, waste management, pulp and paper production, chemical industry) aiming to reach the goals of sustainable growth through recycling, recovery and circularity.
In this context, biomass residues from a broad range of industrial sectors are expected to play a major role in supplying the feedstock needed for sustainable bioeconomy pathways [14].
Biomass is a general term, covering various biological materials that can be used to produce food, materials or energy. The biomass signifies the biodegradable part of byproducts, wastes and residues of biological (vegetal and animal) origin from agriculture, silviculture, related industries and also urban activities [6].
Biomass – the fourth largest energy source after coal, oil and natural gas - is the largest and
most important renewable energy option at present and can be used to produce different forms of energy [11].
Biomass includes any biological material that can be used as fuel or for industrial production.
Biomass is considered as organic material of non-fossil origin, including organic waste that can be converted into bio-energy. According to Eurostat official statistics based on data from 2016, more than 60% of EU-28 total primary energy production of renewable energy is generated from biomass sources (EUROSTAT, 2016)
Therefore, biomass production is an economic sector under exponential development due to increased interest in renewable sources of energy in the global context of circular bioeconomy strategies.

MATERIALS AND METHODS

A comprehensive literature analysis was carried out to extract official data for the evaluation of the biomass potential.
Data sources and collection of information was performed through a detailed survey of providers on European (Eurostat, Faostat), global (World Energy Association) and National (National Institute of Statistics) level.
This paper presents an overview of biomass use for energy production starting from global level, going deeper to European area and surveying the national potential of the biomass production, with a especial emphasis on agricultural sources.

RESULTS AND DISCUSSIONS

According to literature, among the renewable energy sources, biomass represents the largest renewable energy source, with a share of 13% in the global energy mix [9]. It is followed at long distance by hydropower (3%) and other renewable sources – solar (thermal, photovoltaic and concentrated), wind, geothermal, tidal etc. (2%) [20].
The World Energy Council defines bioenergy as the transformation of organic matter into an energy source based on the use of the following raw materials: traditional biomass (originating from forestry and agricultural residues) and modern biomass (industrial and municipal waste and biofuels [20].

Biomass sources - overview

Biomass came into the attention due to the increased potential as clean, affordable and renewable bioenergy source, with a particular interest on the production processes that imply agricultural and forest waste.
Broadly, biomass is represented by plant organic matter, animal metabolic residues (manure) as well as microorganisms [9, 17].
Other studies consider that the supply of biomass can be classified into three sections – agriculture, forestry and waste.
In this sense, the *agricultural biomass* includes the secondary by-products obtained from vegetal production such as straw (sunflower, soybean, maize) leaves (beets), pods (soybeans, beans), shells (nuts, peanuts), seeds (plums, peaches, apricots) as well as manure from livestock.
The sources of *forest biomass* are represented by the main and secondary material from the exploitation of forests such as dead trees, branches and tree stumps.
At this moment, besides the high dependence on fossil fuel, another major challenge of the global economy is arising from the preponderant share of biomass in the renewable energy sector. Moreover, deforestation and land conflicts are an important threat that has to be taken into account. The “food vs. fuel” conflict is mainly argued that the agricultural production of biomass for bioeconomic products (mainly biofuels) may be in competition with food and feed production [13, 19].
Many authors pointed ways of avoiding and controlling this competition, and one of those is that biomass for fuel or material applications should be derived from non-food crops, therefore avoiding direct competition for the same resource [13].
According to Sillanpää et al (2017), three main attributes may be involved in the biomass characterization: renewability, availability, and versatility, which are among the main prerequisite to implement bioeconomy on a sustainable ground [17].
The concept of bioeconomy as a multi-sectoral discipline is not yet well developed in our country although there are defined smart specialization direction in the national research and innovation strategies. For the moment there are several preoccupations in this direction, and hopefully the massive amount of biomass available will not remain un-exploited or under-exploited [1].
In Romania, there is a great potential of biomass, which can be used to produce energy, or conversion into biofuels and raw industrial materials. Romania's “Energy Strategy 2016-2030, with the perspective of 2050”, provides a special chapter regarding the strengthening of the role of biomass and waste materials towards the energy transition. It is estimated that the problem of waste management (agricultural, industrial and municipal) will be solved by transforming the

residues into energy products, biogas and energy-producing oils. However, it is considered that the resulting volume is lower than the potential of lignocellulosic plants [18].

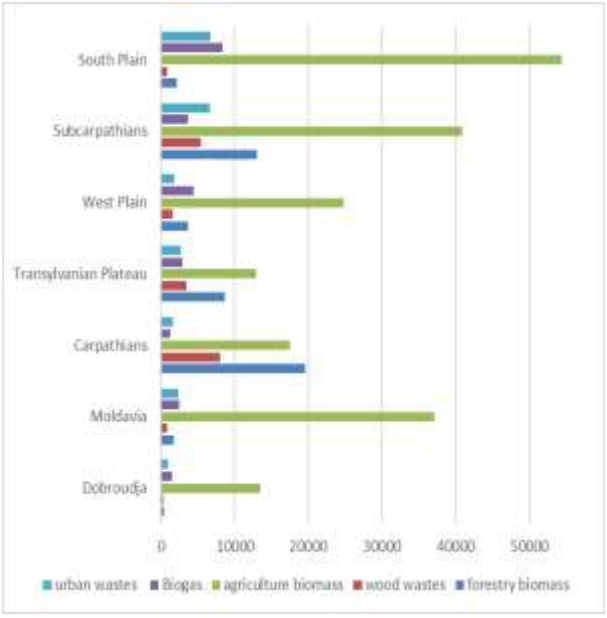

Figure 1. Biomass potential (TJ) in Romania,
Source: Faostat data [2]

To estimate the potential use of different types of biomass to produce green energy the territory Romania was divided into 7 regions. As can be observed from the figure 1, agricultural biomass possesses the largest share in most regions of the country. Obviously, in the mountainous area of the Carpathians, the highest potential is owned by forestry biomass due to extended areas covered by forests. However, exposed data refer to biomass potential use in general, without subtracting data on primary crop biomass and secondary biomass, an approach of interest to ensure the sustainability of agricultural land and mountainous areas.

A paper published in 2011, describes a study presented by Scarlat *et al.*, reporting a detailed analysis of the potential of residues originating from in different industrial sectors. Overall, bioenergy potential from annual crop residues has the highest share (60.1%), followed by firewood (16.2%), wood processing residues (11.8%), permanent crop residues (7.6%) and forestry residues (4.4%) Figure 2 [15].

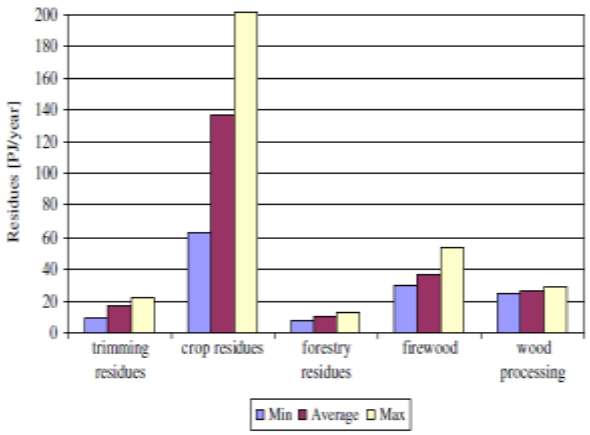

Figure 2. The biomass residues in Romania, by sector.
Source: Scarlat (2011) [15]

Comparison of data on waste biomass potential is challenging because it is necessary to survey the various sectors of bioeconomy with a rather low amount of initial data available in official statistics. The challenge is to compare the multiple sectors of bioeconomy while capturing their diversity.

The petrochemical and agro-food industries in Romania can play an important role in creating a new industry based on the use of biomass as a raw material and its transformation into value-added products, according to the latest country report by the Bio-Based Industries Consortium [1].

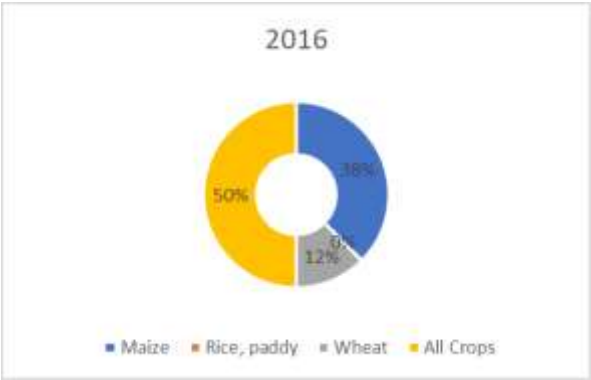

Figure 3. The biomass burned (dry matter) in Romania, 2016
Source: Faostat data [2]

The value of biomass burned in Romania, in 2016 came mostly from maize crops 2,578.5 thousand tonnes, and from wheat 854.1 thousand tonnes (Figure 3).

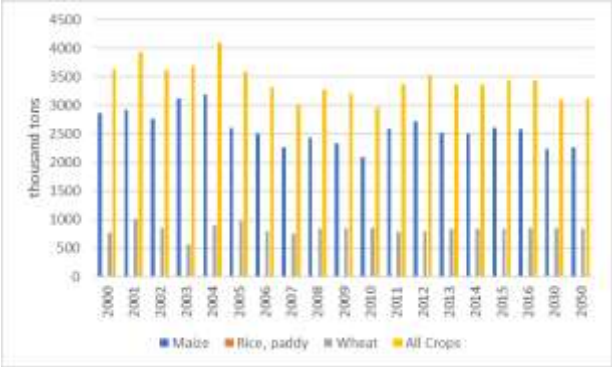

Figure 4. The biomass burned (dry matter) in Romania from 2000 to 2016, 2030, 2050
Source: Faostat [2]

The percentage of renewable energy from the total energy consumed for Romania reached a level of approximately 25% in 2016, higher than the target for 2020, established at 24% (Figure 5).
The highest share was reported in Iceland, namely 72.6%, and the lowest in Luxembourg 5.4%.
In 2017, according to European Environment Agency (EEA) data, 11 member states (Bulgaria, Croatia, Czechia, Denmark, Estonia, Finland, Hungary, Italy, Lithuania, Romania and Sweden) had already achieved their binding renewable energy share targets for 2020, as set under the Renewable Energy Directive [7].

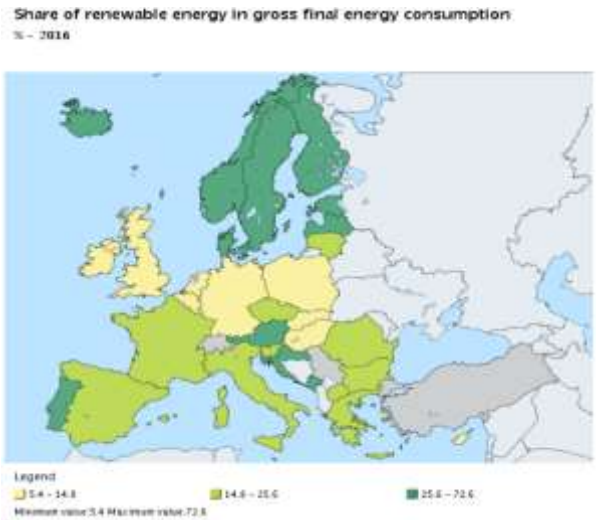

Figure 5. Share of renewable energy in gross final energy consumption
Source: European environmental agency; Eurostat t2020_31, [7]

It was reported in the literature that 1.4 billion people lack access to electricity, while 85% of them are living in rural areas. For the future, it is expected that the number of rural communities relying on the traditional use of biomass to rise from 2.7 billion in 2016 to 2.8 billion in 2030 [12].
The structure of the biomass sources across Europe has changed a lot during the last decade (Figure 6), nowadays making room for wind power, solar power and renewable wastes (Figure 7).

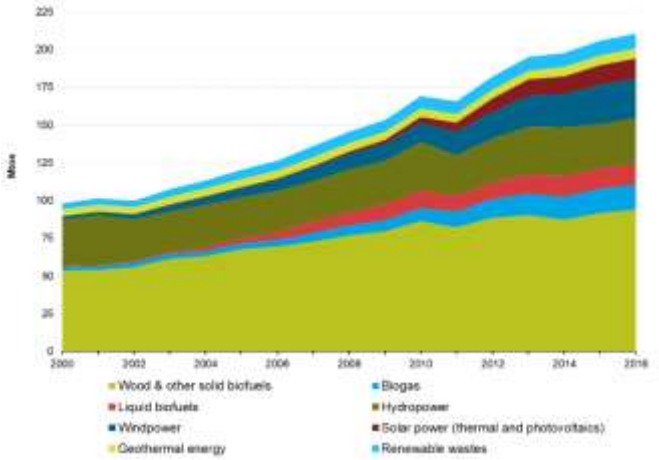

Figure 6. The structure of the raw material source for renewable energy in Europe.
Source: Eurostat [7]

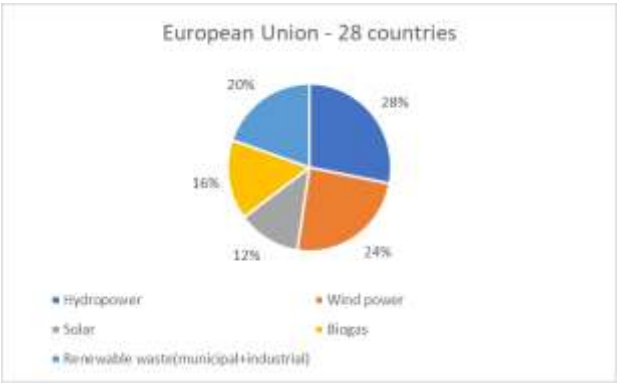

Figure 7. The share of renewable energy in Europe by source, 2016
Source: Eurostat [7].

It was reported that biomass (including the biodegradable fraction of waste) is by far the most important renewable energy source in the EU: it accounts for 63.3% of total renewable energy production. That is why the agricultural and forestry sectors are particularly important in this context. For example, in 2010, 48.5% of renewable energy produced in the EU came from forest biomass, while agricultural biomass

accounted for 10.6% of this total (Figure 6) [6].

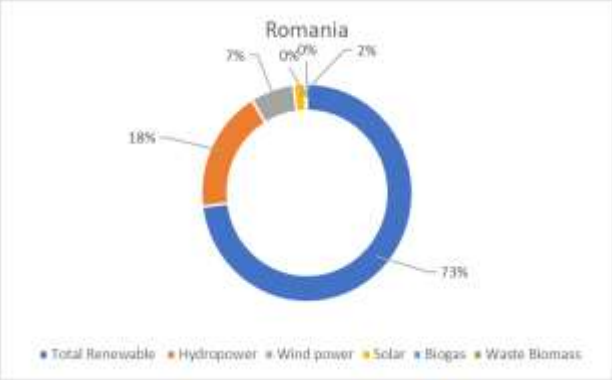

Figure 8. The percentage of renewable energy in Romania, sorted by source of provenience, 2016
Source: [8]

The percentage of biomass energy production of USA represented nearly a 50 % share in the total renewable energy in 2017, as shown in figure 9.

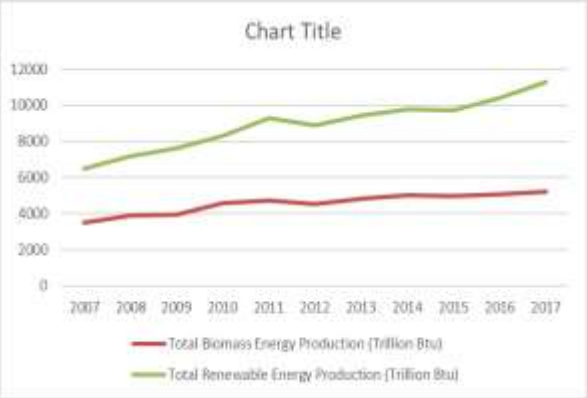

Figure 9. Production of Renewable Energy vs total Production of Energy - USA

Source: Data withdrawn from https://www.eia.gov/

Currently, biomass is used far-reaching as primary resource for the production of wood-based materials, pulp and paper production, biomass-derived fibres, and as biofuel feedstock (from oil crops, starch and sugar crops) [16]. However, the targeted transition to a bio-based economy will bring up questions and answers regarding the sustainability [3] of biomass as raw material for several industries, and the economic efficiency of its use [3, 10, 16]
Having as a target the sustainable development, the concept of biomass being reinsert into the market system represent the fundamentals of a bio-economy.

CONCLUSIONS

The transition of national economies towards the bioeconomy is seen as a pathway to reaching increased sustainability. However, the controversies within science, public and policy makers and public discussion panels on the conflict food vs fuel suggest are complex and need to be observed.
Biomass is the fourth largest energy source after coal, oil and natural gas, making it the largest and most important renewable energy option at present and can be used to produce different forms of energy. Therefore, biomass is the most important renewable energy source, which will play an important role in global and European energy markets. The role of using biomass energy resources is important as European development and energy independence strategies aim for 20% renewable sources by 2020.
Agriculture sector is a significant contributor to the biomass supply globally, and a great share of all biomass supply comes from agriculture sector in the form of energy crops, by products and waste materials.

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