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Economic sustainability of pellet production in Latvia

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Abstract

The paper uses system dynamics modelling to analyse the development of bioenergy; economic system that uses biotechnology instead of conventional technology. The research is directed towards the use of biomass in the production of higher added value bioproducts in the forestry and agricultural sectors.
This paper emphasizes and evaluates the energy sector, which uses low quality wood. The main aim for this research study was to build a framework to analyse the development options for wood pellet production. A system dynamics model was created of energy wood supply, processing and consumption. Production capacity, energy consumption, technology efficiency, required labour, the price of wood, energy and labour are all taken into account. Validation and verification tests with available data and information have been carried out. These indicate that the model constitutes a viable dynamic hypothesis.

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Keywords: pellets production; bioresources; renewable energy; added value

1. Introduction

In the market of energy commodities, currently one of the fastest growing markets worldwide is pellet production and consumption [1]. Pellet production has grown from 1.7 million tonnes in year 2000 to 28 million tonnes in 2015 [2]. Europe is the major pellet consumer and producer followed by United States of America and then the rest of the world. Europe is also a global net importer of wood pellets, while the largest global net exporter is United States of America [3]. The European Union (EU) is responsible for 74 % of the world's wood pellet consumption. Two of the uses for main wood pellets are heating and power production [4]. In 2014, Latvia was the third biggest pellet producer

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in Europe only behind Germany and Sweden [4]. All markets are expected to expand their pellet production, with the highest projected increases being in the South-East Asian countries, especially China [5].

Market price is a key factor for the development of pellet manufacturing. The price of pellets has recently decreased considerably – the price drop of fossil fuels is an important factor in this decrease. While it is necessary for the price of pellets to decrease in order to make them competitive in the marketplace, the price of pellets is forecast to increase in the future [6].

Pellet and woodchip export from the Baltic countries shows that Latvia differs from other countries because it exports woodchips, which is a low value-added by-product of the forest industry. This means that resources that could strengthen Latvia's macroeconomic development leave the country [7]. In recent years, Latvia logs nearly 12 million m^3 per year of forest, of which 53 % are from private forests and 47 % are from state forests. Most of the wood-based fuel produced is in the form of firewood [7].

Also in recent years, woodchip production in Latvia has increased rapidly. Since 2008, wood chip production has almost doubled. The production of woodchips has increased because of the increased interest from local consumers. Firewood and the forestry sector's residues are used in woodchip production. Wood from overgrown agricultural land is also used. Most woodchips are used for industrial fuel. For the present time, only a small fraction of woodchips is produced from forestry residues. The woodchips from forestry residues are used as the primary fuel in the transformation sector to produce heat and electricity. The increase can be explained by the growing number of biomass-fuel boiler houses and cogeneration plants.

Pellet production strongly affects the wood fuel market, not only because the pellets that are used in the transformation sector are produced from wood but also because competition for the purchase of wood fuel resources increases. Measured by the currently installed capacities, Latvia is considered one of the leading pellet manufacturers in Europe. Although pellet production in Latvia is developing rapidly, the demand for pellets remains low in the local market which results in the export of about 90 % of the pellets produced [6, 7].

In any industry, the value of the product consists of elements that can be categorized as either for intermediate consumption or for value-added consumption later on.

There are research papers, which describe replacing fossil fuels with wood pellets in energy generation sector [8, 9], about environmental and economic benefits [10]. There is also research conducted on how pellet manufacturing and exporting affects the condition of the forests [11], as well as research that focuses on economic and environmental evaluation of pellet transporting [12]. All of the research concludes that pellet production has a future and it provides environmental benefits contrary to fossil fuels, but there are also barriers in the form of costs that delay the development of pellets. It is especially significant in countries with limited wood resources. All the research mostly focuses on comparing wood pellets against fossil fuels, but less research is done in comparing wood pellets against other types of fuelwood. No previous research is done by using system dynamic methodology.

The aim of this research was to determine the opportunities in pellet development compared to other wood products used for energy production such as woodchips and firewood. A system dynamics modelling method was used to carry out the research.

2. Methodology

The theory of system dynamics is based on studying the relationships between the behaviour of the system and its structure. It allows a better understanding of the causes of certain system behaviour, thus making it possible to identify a solution and eliminate the problematic behaviour in the system [13]. This modelling method allows one to understand the structure and dynamics of complex systems. Computer software is used, as it is the easiest means of illustrating and working with complex systems [14]. The model was developed in *Powersim Studio* 8 software.

There are three main elements that make up the system dynamics concept. If these elements are used correctly, it is possible to obtain acceptable results [15]:

- Stocks, flows, and feedback loops;
- Precisely set system boundaries;
- Causal relations not correlations.