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What is the role of energy in the circular economy? The case of wood industry in the Tomsk region

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Abstract

In this paper, the author proposes a certain view of the economic systems, which allow the creation of goods and services in the economy. At the same time, different pollutions are created and have impacts on the systems. In this context, the paper proposes to interrogate on the possible correlation between economic growth and consumption of energy, and on how to combine the need in economy efficiency and the protection of the environment. Through the spectrum of the circular economy model as an instrument of sustainable development and on the example of the wood industry of the Tomsk region (Russia), the author discusses the role and the development perspectives for forests in the future.

Keywords: Energy, circular economy, sustainable development, green economy, timber industry, forest;

1. Introduction

A production system allocates 3 types of resources: 1) natural resources as materials or substances that occur in nature and can be used for economic gain; 2) labor as a human activity that applied to the production, creation, or maintenance of goods or services in an economy; 3) capital as a stock of resources that may be employed in the production of new goods and services.

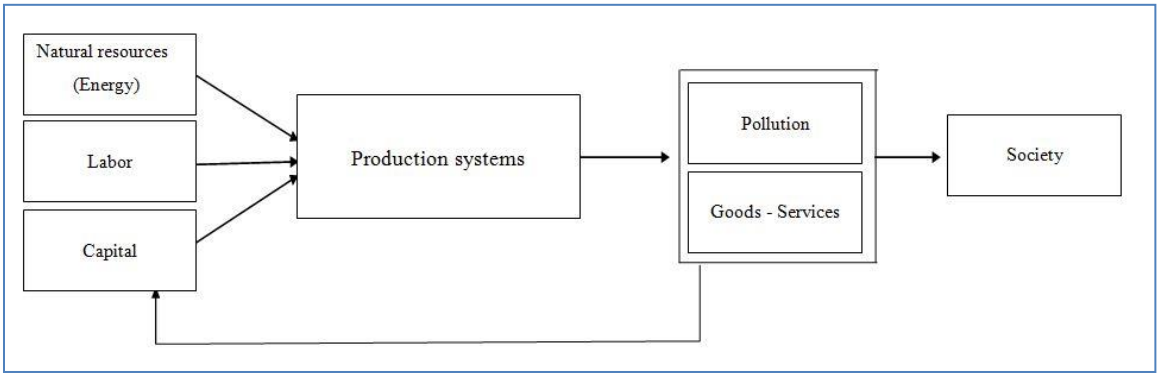

Fig.1. Schema of production systems

A production system is needed to satisfy needs of society (individuals, businesses, organizations, or governments). The consequence is that the production of goods and services has always a certain impact on the environment (fig. 1) such as waste, greenhouse gas emissions, deforestation etc.

The main aim of this paper is to discuss the potential of circular economy for energy savings in the production systems.

2. Materials and methods

This paper considers the circular economy model as an instrument to reach goals of sustainable development. Firstly, an examination of the role and consequences of energy in production systems was undertaken. Secondly, analytical work concerning potential solution was done in order to discuss performance of circular economy integration.

Behind every physical flow there is energy. Energy can be defined as the notion that characterizes a change of state in a system to transform a temperature, a state of matter, a speed, a chemical composition etc. In economy, it would mean that in order to create more goods and services for society, the production systems need more energy. Energy is used for machines to increase the production if the demand rises, or the productivity to reduce the costs. On average, the energy coming from machines is worth 200 times that coming from our muscles: this is the notion of "energy slave" [3].

Today almost 80% of energy comes from fossil fuels (fig. 2) because of their high intensity in energy and the ease of their extraction. In return, because of the law of Conservation of Energy, greenhouse gases are created and have a significant impact on climate change (fig. 3). This is why, in a context of sustainable development, new instruments and processes have to be found to use less energy and increase its efficiency.

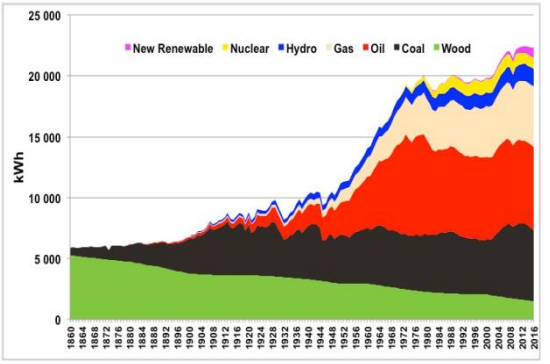

Fig.2. Evolution of the average energy consumption per capita in the world, since 1880, wood included (estimated) [3]

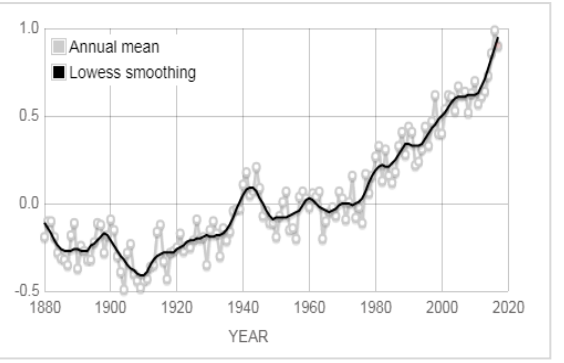

Fig.3. Global land-ocean temperature index [NASA/GISS, 7]

Carbon dioxide (CO2) is the first contributor of to the phenomenon of intensification of the greenhouse effect. It represents 70% of greenhouse gas emissions (GHG). But there is also a compensation effect because wood ecosystems need CO2 to synthesize the energy they need to develop themselves. That is why we call them "carbon sinks". Today forests capture about 10 GtCO2 per year, which represent almost 20% of anthropogenic GHG emissions. In addition to CO2 sequestration and storage, forests permit material and energy substitutions. Respectively it means that using wood materials for construction allow significant energy savings than using

steel or concrete for example, and that using wood for energy is profitable – in the case of carbon neutrality. Carbon neutrality means that wood is a low effective fuel but it is renewable. Wood emissions have more impacts than fossil fuels (tab. 1) but in the case of sustainable forest management, the compensation can be realised thanks to the CO2's recapture by the growing forest. Furthermore, it is more effective to use wood as energy than let it decompose because the captured CO2 will be released without making any profit from it [6].

Table 1. Emission factors of principal fuels (tonne of oil equivalent – toe) [6]

Fuel	Emission factor (tCO2 / toe)
Wood (anhydrous)	4,25 (0 if neutrality hypothesis)
Coal	4
Oil	3,05
Natural gas	2,35

In the Tomsk region (Russia), large investments were made and a strategy of wood cluster was created in 2017 in order to reach a new level of timber transformation efficiency [4]. In the development plans, wood waste plays a key role for energy production (fuel chips, pellets, briquettes). Indeed in 2013, the balance consumption of wood raw materials showed that 77% of wood waste is not used [2]. In addition to the reuse of wood waste in the production of fibreboards (MDF, LDF), the enterprises of the cluster would use the wood as energy to reduce costs and risks lied to energy access. Moreover, the market of pellets is in constant growth in Russia and in the world. At the end of 2016, the volume of wood pellets production in Russia production has been multiplied by almost 80 compared to 2008, and the exportation by 1,5 compared to 2012 [1]. Finally, concerning the problem of CO2 storage and release, the wood structure of the Tomsk region is dominated by mature and overmature plantations; their area represents 51.9% of the forest [2]. This accumulation degrades other plantations and the productivity of forests, and the processes of reforestation are slowing down.

3. Conclusion

Regarding these facts, the situation is encouraging concerning a possible integration of the circular economy (CE) in the production systems of the wood industry in the Tomsk region. CE is based on non-waste production and aims to create closed loops in the economy to open a prospective for important reduction of negative impact on the environment, to stimulate economy development and improve well-being of society [5]. However, before any integration some points have to be searched in order to maximise the benefits of circular economy integration [1,5]:

1) Concerning the possible evolution of pellets markets in the world, CE also discusses the need of short circuits for reducing environmental impacts and risks;

2) Information about forest ecosystems in the region is still not well known or updated, making the available data not always trustable. This condition is really important in order to define the carbon neutrality. If the carbon neutrality is not well defined, the impact on environment could be worse than initially.

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