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Working Paper

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Institute of Economic Research Working Papers, No. 137/2017

Provided in Cooperation with:

Institute of Economic Research (IER), Toruń (Poland)

Suggested Citation: Vukovic, Natalia; Mehrentsev, Andrey; Starikov, Evgeny (2017) : Socio-economic and enviromental effects of bioenergy based on wood ine the development of remote areas, Institute of Economic Research Working Papers, No. 137/2017, Institute of Economic Research (IER), Toruń

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Institute of Economic Research Working Papers

No. 137/2017

**Socio-economic and environmental effects of bioenergy
based on wood in the development of remote areas**

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Article prepared and submitted for:

9th International Conference on Applied Economics Contemporary Issues in Economy, Institute of Economic Research, Polish Economic Society Branch in Toruń, Faculty of Economic Sciences and Management, Nicolaus Copernicus University, Toruń, Poland, 22-23 June 2017

Toruń, Poland 2017

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Socio-economic and environmental effects of bioenergy based on wood in the development of remote areas

JEL Classification: *O44;P28; Q01;Q42.*

Keywords: *bioenergy, woodchip, cleaning cuttings, forest thinning, remote areas development.*

Abstract

Research background: Traditional energy sources based on oil, coal, and natural gas have proven to be highly effective, but at the same time they have many negative environmental effects. Also by technical and economical points traditional energy sources are not available in many remote areas. In this paper, the authors have been discussed the alternative approach in energy supply, which also has positive social-economic and environmental effects.

Purpose of the article: This paper provides a new solution for energy supply in remote areas by implementing bioenergy based on woodchips, which has multi-sector effects.

Methodology/methods: Bioenergy generation based on woodchips has multi-sector effect that is why authors offer to combine forest cleaning cutting and forest thinning with bioenergy based on woodchips in one project which will have social, economic and ecological effects. The situation with forest fires makes the authors idea more attractive because after forest fires the problem of cleaning cutting in forest became very important and urgent by ecological and economical points: after cleaning cutting there are a lot of low quality wood which by author's idea can be recycled into chips for bioenergy. This methodology has been applied to bioenergy and regional development decisions in remote areas which mainly have a problem with energy provision; it is suitable for applications to infrastructure development projects in any remote forested region of the world.

Findings: Mobile bioenergy generation based on woodchips in remote areas settle the complex of environmental, social, economic problems and can become the driver of development of the region.

Introduction

Nowadays alternative energy which is a highly progressive topic for scientific research in the world is the use of renewable energy sources (RES) – biomass, water, wind, sun, tides, geothermal energy (Mingaleva, Z., Shpak, N. 2016). In recent years, the share of renewable sources of energy in the total consumption energy in the world is 13%.

Annually, in Russia, while oil accounts for about 34%, natural gas – 21%, coal – 25%, atomic energy - 6.5%, renewable sources of energy produce more than 1 million tons of conditional fuel electro-energy and just over 2 million tons of energy from biomass. At the same time, the economic potential of renewable energy is 270 million tons of oil equivalent per year slightly more than a quarter of the annual internal energy consumption in the country. Due to the fact in 2020 the growth in these indices from 2.0 to 8.0 million tones is projected to increase. In the overall balance used in the world of renewable energy more than 70% is biomass energy, which is produced mainly for biofuel and with internal combustion engines, boilers and other energy installations.

Russia has a big territory but not all areas of it have modern developed infrastructure, especially in the eastern part of the country, which has a lot of remote areas. The energy provision for remote areas which mainly do not have developed infrastructure and locate far from economic centers is one of the most important tasks in regional development. Modern infrastructure for industry and business needs the accessible and affordable energy continuously. Without sustainable energy, territory cannot develop its own local economy.

Nowadays projects on generation of small energy are quickly developing in forested regions. It happens because for startup this project needs only in generation capacity and it doesn't depend on supply infrastructure system of raw materials for the work of such expensive ones as pipeline or electrical network. These projects represent a bioenergy capacity based on biofuel. Statistics shows that the cheapest and most available raw material for bioenergy is wood chips (Table 1).

Table 1. Cost comparison of market energy prices 2016

A price comparison	Up to date prices can be checked from local suppliers
Forest chips	0,015 €/kWh
Wood pellets	0,034 €/kWh
Light fuel oil	0,060 €/kWh
Electricity, consumer price	0,080 €/kWh

Source: HT Enerco Oy (<http://www.htenerco.fi/en/bioenergy-heating/fuel-comparison>) (2017)

In science and practice the model of bioenergy based on processing of wood chips which is the waste of the process of logging dominates. The authors propose to change the existing approach and consider wood chips from cleaning and thinning cuttings for bioenergy in forested distant territories. In such cases it can be the main raw material for generation of bioenergy. In addition, one of the sources for wood chips can be low-quality wood, which is mainly a by-product in logging and not used by business, for example, in Russia.

Realization of the solution offered by the authors makes possible to implement a complex approach into the development of the remote territories with the following effects:

- utilization of low-quality wood, obtained in the process of logging, cleaning and thinning cuttings in forestry, especially after forest fires;

- solving of financing problem in cleaning and thinning in forestry, because these points are included in the complex budget of bioenergy generation and will be free for forest management;

- ensuring maintenance of the forest by promotion of the cultivation of highly resistant plantings of target species composition, which effectively perform a protective forest function;

- creation of new jobs at bioenergy facilities for carrying out of work on the provision of raw materials and functioning of energy generation facilities;

- generation of cheap energy for the needs of local population of non-urban distant areas which is mainly the great problem for local authorities.

Most studies of economic aspects of undeveloped regions were effectively solved in close regional frame within sector approach (Armstrong H., Taylor, J. 2000), determining factor of achievement of optimal sector and global development at the level of country and region (Kubović, 1974). Area development is considered as dynamic process of improvement of regional structures in order to create new potentials (Bogunović, 1991). In remote forested areas the main resource for development is forest (wood). Efficient consumption of wood in timber industry, economic accessibility of forest resources and the methods of evaluation of economic availability of forest resources are deeply considered in many modern scientific researches (Tretyakov, A. 2014), (Niskanen A., Petrov A., Filoushkina G. 2002), (Gerasimov, Y. 2011), (Karjalainen, T. 2011), (Shegelman, I. 2011), (Shegelman, I., Shchukin, P., Morozov, M. 2011), (Fedorenchik, A., Lednický, A. 2011).

Technology of processing of wood chips in bioenergy is considered mainly in a separate work by combining technological operations (Levin, V. 1984), (Surovtseva, L., Ivanov, D., Tsarev, M. 2004), etc.

From the authors' point of view the most effective for processing is the combination of the chipper operations felling and debarking after preliminary hydrothermal treatment. According to the research of Rubtsov Yu., Konnova V., Rud'ko S. (2011) the technology of processing of wood into chips in Russia is carried out the most efficiently by using disk chippers because it minimizes requirements to the quality of wood.

But in all these works the question of chips recycling in bioenergy is concentrated around logging waste. The issues of utilization of low-quality wood after sanitary and cleaning cuttings in forestry are not considered.

Therefore, implementation of the proposed approach in regional development of remote forest territories allows obtaining the synergetic effect in the environment, economy and social spheres.

Research Methodology

The research focuses on new pragmatic methodological approach in modelling of regional development based on implement of wood chips bioenergy, modifications of existing theoretical methods, and discussions of analysis and synthesis of data evaluations.

In recent years, interest to the models of regional development is still high as it was before, because in spite of strong global urbanization process in any country, by economic point there are problematic areas with low developed infrastructure due to different reasons.

By the authors point of view, using bioenergy based on wood chips from cleaning and thinning in forest is the most appropriate for the model of regional development "growth and development of poles" (Perroux, F. 1970). Perroux's (1950). "Space as force" a view on spatial interaction, which defines space as a type of network that is held together by centripetal forces, has formed the basis of most growth pole theories. In Perroux's (1950) original theory the growth pole referred to linkages between firms and industries. "Propulsive firms" are those that are large relative to other firms and generate induced growth through interindustry linkages as the industry expands its output. It means that due to cheap energy generation from wood chips it is possible to attract and stimulate new business projects, which will develop and diversify local economy.

The next dramatically increases the risk of reproduction of secondary pests and increasing of forest fires. Recycling of this trash, due to the low marketability of wood, is ignored by forest users as well. The use of this wood as a biofuel will allow solving the major environmental problems to prevent the spread of hotbeds of forest pests and minimize wildfires.

The usage of coal, oil, gas and refined products as fuel for remote territories is always connected with the problem of transporting fuel over long distances, which is not only costly, but also risky. It cannot be guaranty to be untimely or not fully performed for the purchase and delivery of fuel, and consequently, it is a great risk for the life of local population. The problem is not solved by bringing to these settlements of electricity, because there is always danger of outages because of natural factor (freezing rain, hurricanes) and anthropogenic (theft of wires, etc.) factors. The usage of local fuel solves the problem of providing electricity and heating of remote settlements regardless of their remoteness and availability of transportation routes. Besides, the implementation of a small boiler operating on wood chips will help to create employment of local population, which is a very important social result. Creating of boiler systems based on bioenergy generated with woodchip in the municipal units will reduce the cost transportation of electricity and heating. It will necessitate the development of small enterprises for harvesting of fuel wood and its preparation for burning, improve the ecological situation and the system of fire extinguishing in surrounded settlements and eliminates the risk of an extreme situation with heat and electricity supplying in winter. Nowadays, for the implementation of the project of distributed low power generation on renewable biofuels in remote forested areas all necessary conditions exist. Modern production of bioenergy generation equipment for wood chips is developed enough well today. Modern bioenergy equipment based on wood chips has enough high efficiency.

In this case we are not talking about large-scale harvesting of timber in the process of cutting of mature and over-mature stands and, as a consequence, the deterioration of the ecological situation in the region, but, on the contrary, about enhance of the productivity and sustainability of forests, improvement of their species composition. Wood chips are the raw material for bioenergy that will contribute to the implementation of key tasks of sustainable forest management.

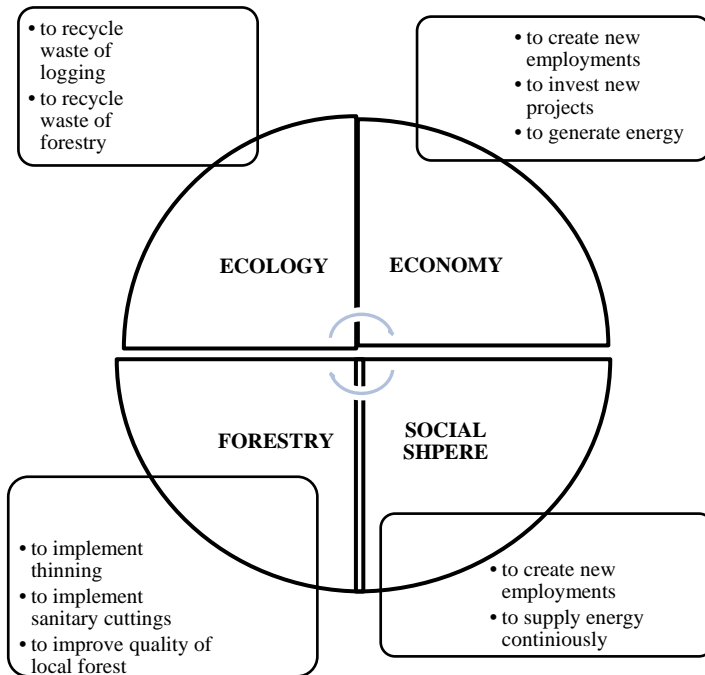
Investments into projects of bioenergy based on wood are effective and they will be attractive for banks not only in Russia, but also in

world practice showing their attractiveness from financial point (Jovanović, A., Vuković, D., & Zakić, N., 2012).

The real practice in Russia shows us effectiveness of bioenergy based on wood chip as a tool of neo-industrialization of regional industrial systems with multiplier effects (Lavrikova Yu.G., Suvorova A.V.E., Kotlyarova S.N., 2015).

Nowadays, the drop in oil prices in liberal currency regime stimulates high inflation and collapse of credit activity (Domashchenko D. 2016), that is why the bioenergy sector based on wood chips with its complex positive effects for economy can be the prospective direction for the development of state-private partnership

Figure 1. The effects of the implementation of a model of socio-economic development of remote areas on the basis of bioenergy with the application of wood chips



Source: Author (2017)

Conclusions

Thus, creating of small bioenergy distributed enterprises based on wood chips derived from low-quality wood in remote areas solves a complex of the following of tasks:

- to improve quality of local forest by realization of all necessary forest care events;

- to improve the ecological situation in the region by implementing the quality of health care work of the forest and ecological recycling of wood waste produced during harvesting and silvicultural operations;

- to generate cheap energy for remote settlements for electricity and heating systems;

- to supply constantly with bioenergy produced from wood chip for electricity and heating systems;

- to implement a cost-effective investment project in economically underdeveloped region that, as a consequence, leads to the growth of the gross regional product;

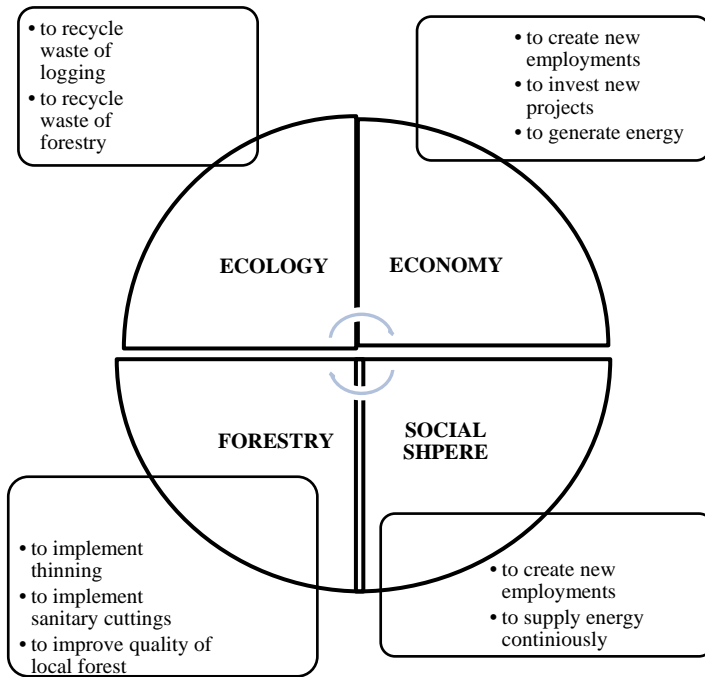
- to provide with new employment places

Finally the implementation of bioenergy generation based on wood chips in remote areas has complex multi-sector effects in economy, ecology, forestry and social sphere (Figure 1).

Acknowledgement

The research was supported by the Ministry of Education of Russian Federation (Grant № 26.8660.2017/DCH « The Research Methodology Forms of Economic and Technological Reality in the Aspect of Sustainable Forest Management»).

Figure 1. The effects of the implementation of a model of socio-economic development of remote areas on the basis of bioenergy with the application of wood chips



Source: Author (2017)

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