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THE BIOMASS USAGE AS AN ENERGY SOURCE IN CHOOSING THE ENTERPRISE'S LOCATION

The article reflects the possibilities of biomass usage as an energy source while choosing the enterprise location. The connection between comprehensive resources management and supply chain at an enterprise is revealed. The advantages and long-term perspective of biomass usage on the Ukrainian market is described. Taking the biomass supply logistics as an example, the author analyzes and recommends for practical implementation the following ecologistical models: the model of maximum distances of energetically reasonable transportation for different types of biomass, the economic model, the model of heuristic choice of enterprise location due to narrowing the radius of biomass collection.

Key words: enterprise ecologistics, SCOR *(*supply-chain operations reference model), Total Resource Management, biomass supply logistics, ecologistical models, biofuel, renewable energy sources, business location.

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ВИКОРИСТАННЯ БІОМАСИ ЯК ДЖЕРЕЛА ЕНЕРГІЇ У ПРОЦЕСІ ВИБОРУ МІСЦЯ РОЗТАШУВАННЯ ПІДПРИЄМСТВА

Відображено врахування можливостей використання біомаси як джерела енергії під час вибору місця розташування підприємства. Розкрито зв'язок між комплексним управлінням ресурсами та ланцюгом постачання на підприємстві. Описано переваги використання та тривалу перспективу біомаси на ринку України. На прикладі логістики постачання біомаси проаналізовано і рекомендовано для застосування на практиці три екологістичні моделі: модель максимальних відстаней енергетично обгрунтованого транспортування для різних видів біомаси, економічну модель, модель евристичного вибору місця розташування підприємства за допомогою зменшення радіуса збору біомаси.

Ключові слова: екологістика підприємства, SCOR (еталонна модель ланцюга постачання), комплексне управління ресурсами, логістика постачання біомаси, екологістичні моделі, біопаливо, відновлювані джерела енергії, розташування підприємства.

Statement of the problem

The global problem of determination of optimal enterprise's placement and logistical centers in the present economical conditions is solved considering financial conditions which are frequently influenced by state authorities. When choosing the enterprise's location owners rarely consider the effective energy and resources expenditure, ecological standards and what's more important do not take into account the logistical aims of an enterprise in future. The need of resources saving and effective usage of energy lead to the key business problems, e.g.: future disappearance of global supply chains due to oil prices rising or negative influence on ecology and steady enterprises development because of other countries' raw stuff supply for bio fuel production.

Analysis of recent research and publications

The theoretical fundamentals of effective resources and energy usage management and compatible logistical processes were developed in research works of such foreign scholars as P. Bolstorf, R. Rosenbaum, R. Poluha [1], S. Augustin, M. Schenk [2], S. Troyan [10], V. Launhardt [11], V. Brettske [12], S. Brinhetsu [14].

The biofuel production and market formation problems were developed by such native scholars as M. S. Habrel [3], Y. Voskobiynyk [6], B. Andryushchenko, G. M. Kaletnyk [9] and many others.

The modern enterprise's ecologistics development, in particular, logistics of biofuel supply as renewable energy source, is strategic. Hence, the essential need of scientific research in this direction is obvious.

The formulation of objectives

The search of long-lasting economical and ecologically rational logistical chains, the assistance in choosing the location and best functioning of an enterprise predetermine the following aims:

- ✓ To substantiate the advantages of using biomass in Ukraine;
- ✓ To introduce the ecologistical models which could assist to create the ecological and progressive logistical networks considering the correlation between transported energy carriers to the energy spend for their transportation;
- ✓ To highlight the research's results for best choosing an enterprise location on designing stage and for structures in operation on the grounds of ecologistics.

Presentation of main materials

The necessity of energy, resources and economical expenditures reduction is indisputable in the process of choosing the enterprise's location. However, there aren't any comprehensive and quiet universal models of manufacture's location choosing so far, as well as distributional places, accounting the effective resources and energy usage. Currently, the effectiveness of bio-plant functioning, geothermal stations, solar panels, wind power plants, solid-fired boilers and their link with enterprise's functioning is not researched enough. The energy carriers' price rising and authorities' demands for CO_2 emissions reduction speed up the search of the logistics management instruments which could facilitate the enterprise's best location choose.

The problem of resources can only be solved comprehensively, with all influencing factors taking into account. Thus, the ideas of energy usage efficiency increase must be implemented on the level of entire enterprise and grounded on consideration of each step of price formation in the global chain of supply and logistics. According to SCOR (Supply chain operations reference – standard model of supply chain) model [1], every of the main chain processes require resources, though these processes are to be regarded strategically and consider the resources usage on each of these five steps:

- Planning and organization;
- stocking;
- manufacturing;
- supply;
- utilization.

Formally the ideas of comprehensive resources management are based on quality management. The strategy provides not only all sections of the quality control but also the enterprise's partners. Hence, the term of "comprehensive resources management" belongs to each and every enterprise's partner and organizational aspects. Logistics managers should use new criteria of choice and evaluation relating to resources application and usage. The important issue is the integration of "comprehensive resources management" into the enterprise and its supply system. The efficiency of energy in production processes can be described by the example of biomass supply logistics. This is the very place where the efficient logistical scheme is needed in case not to lose the advantages of renewable energy sources usage by an enterprise [2].

Biomass which relates to the alternative energy producing sources occupies the fourth place among the world's fuels (about 2 billion tons per year) and plays the crucial role in energy supply of industrially developed countries. The data depicted on the fig. 1 testifies this [3]. The main objective of Ukraine as a country with huge amount of agricultural and energetic refuses is the rates decreasing of natural gas consumption by developing production and usage of bio fuel [4]. The economic potential of biomass in our state is 27 million of tons per year. Since the demand for alternative energy sources constantly increase, in the year of 2012 Ukrainian enterprises produced around 1.5 millions of tons of solid bio fuel which provided the export into the EU countries up to 10 % of the total demand for this goods [5, 6]. The modern techniques allow recycling different biomass ranges from plant and animal fats till straw, grain and oil crops processing refuses. As the result, the enterprises supplementing the bio fuel business founded on their own raw material base are successful. They rapidly shift their heating supplies due to the appearance of solid bio fuel boilers. The application of bio fuel boilers approved their high efficiency and quick payback, resulting in double decrease of thermal power price, gas import shortenings and decrease of public services prices [7]. Some experts are convinced that it is possible for Ukraine to substitute 15–20 % of natural gas with solid bio fuel which can reduce the tariffs for population by 10–15 % [8]. The most ecological energy resource for fuel production is renewal energy, bio ethanol, bio diesel and biogas for instance. To substitute 30 % of petrol and diesel fuel amounts in Ukraine 8–10 % of cultivated areas should be used to produce bio ethanol and bio diesel. This is the very acreage that is not involved today and getting weeded [9].

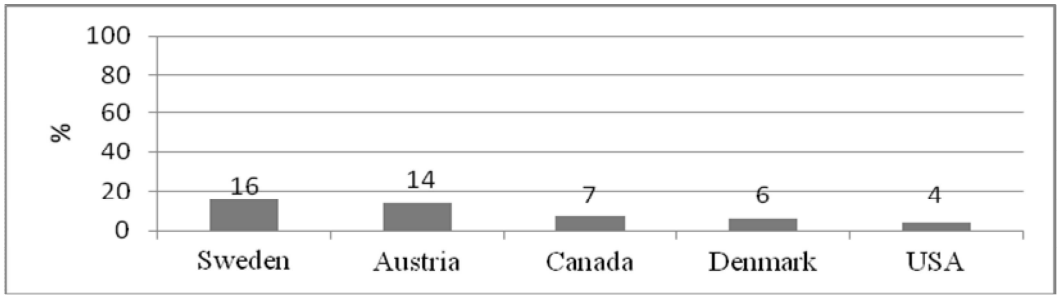

Fig. 1. Countries' solid fuel consumption rate comparatively to the total energy resources consumption
The author's stretch on the basis of source [3]

The search and evaluation of the appropriate places for exploitation varying in terms of customer's special requirements and enterprise's capacity could be based on the following ecologistical models:

1. The model of economically reasonable transportation for various kinds of biomass (fig. 2). The biomass usage as an energy carrier requires the development of ecological and stable logistical chain. Due to the low energetic density comparatively to fossil fuels the logistics of effective biomass supply to the energy production destination must be arranged. The restricting factor for hay, straw and biogenic gas transportation is the truck's capacity, while the transportation ability for other kinds of biomass is limited by their weight. These considerations are essential as far as different kinds of biomass density vary and are considerably lower than of coal and oil. The following factors are taken into consideration when calculating the transportation radius along with energy density:

- the road to provision place and reverse way;
- technology effectiveness – outcome of a ready for consumption biomass is about 50 %;
- the correlation of land ways' length (km);
- 1 liter of diesel is equal to 10 kilowatt;
- default diesel consumption per 100 km is 20 liters;
- default additional provision spending – 20 % of biomass energetic value.

The first step is figuring out the top energy value of biomass batch in one truck which is determined by material density and product's (biomass) energetic density. The next step is the calculation of energy spent for transportation (the mentioned above factors taking into account). Thereby, the critical value is calculated, when the logistics consumes more energy that it could be produced later from biomass [10].

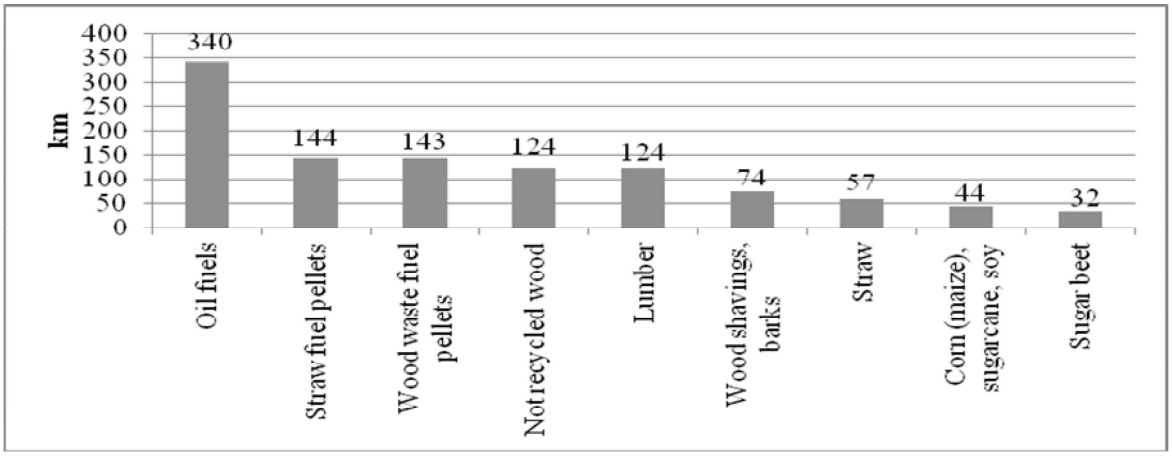

Fig. 2. The top distances of economically grounded transportation of different kinds of biomass [10]

The index of each kind of biomass top transportation distance ensures the ecological expediency of renewal energy carriers' usage and appears to be an important factor of their successful application. It would be a mistake to construct the biomass heat and power plant with the expectation of biomass producers come to region, in order to shorten the way. Hence, the more energy is spend on energy carriers storing and transportation the less it could be produced from biomass. Herewith, the amounts of energy to be generated from biomass are compared with the energy spent on transportation of renewal amount of biomass.

2. Economic model (fig. 3). Often biomass is used not in the place of its production. The main reason for this the economic factors which account the maximum price difference in raw materials transportation. It s determined by "location triangle" by German scholar Launhardt, different storing process structure and different staff salary expenses [11, 12].

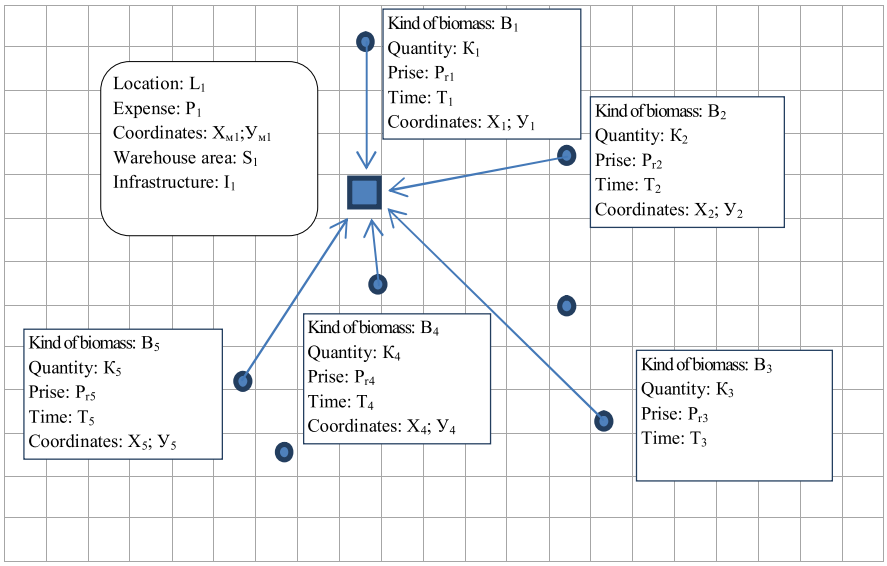

Fig. 3. The economic model [10, 11, 12, 13]

The region were an enterprise can be located must meet the needs of biomass and be characterized with minimum expenses. These expenses must be covered by financial incomes from biomass recycling [13]. Only if the incomes overpass the biomass purchase and stocking spending the region is profitable for an enterprise.

The above showed model is realized on a computer program which requires an internet connection for operation. The possible enterprise's locations are figured out using geographical coordinates, where each potential location can be accurately described. However, in practice the available data is not equal, namely the data about one region can be very accurate and vice versa of the others.

Due to the fact that model is based on geographical coordinates network, it is possible to broaden it to the world scale and apply to any other product. To work with the purchase places the following information must be indicated in the program:

- geographical coordinates (latitude and longitude);
- type of products;
- date or period of purchase/storing;
- amount of product;
- price of product.

Types of biomass, its tightness and density of energy are recorded in the program in advance. These parameters can be chosen in the program's menu. To get the required amounts of product the distinct date or supply periods can be determined. Interactive spending, possible incomes calculations for a certain region are figured out for each coordinate. It is possible to indicate the interval for coordinates and in this way to advantage speed or accuracy of supply.

The calculations will show the places suitable for low-cost enterprise location. The places where due to supply interruptions the stable operation of an enterprise is impossible are left unnoticed. This model also allows inputting the forecasted data in case to create the future course of events, taking into account the changes in prices [14].

3. The model of heuristic enterprise location choice due to the narrowing of the radius of biomass collection (non-directional search, method of expert assessments) (fig. 4). The only one optimal place of location on the given territory is chosen in heuristic method in order to get the required amount of biomass from as small area as possible. To shorten the distances the consolidation of biomass in single radius is recommended, as the centripetal distance in a circle shape is the shortest one.

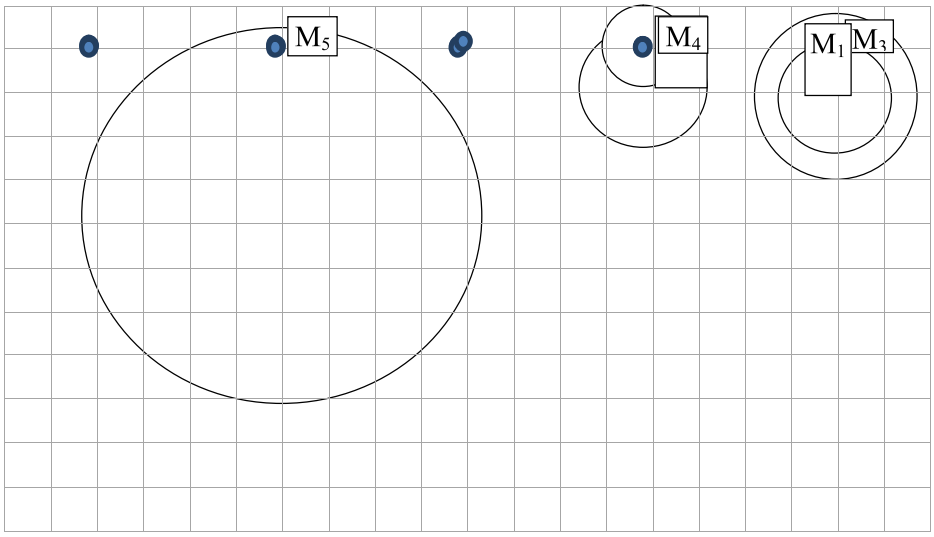

Fig. 4. The model of heuristic enterprise location choice due to the narrowing of the radius of biomass collection [10, 15]

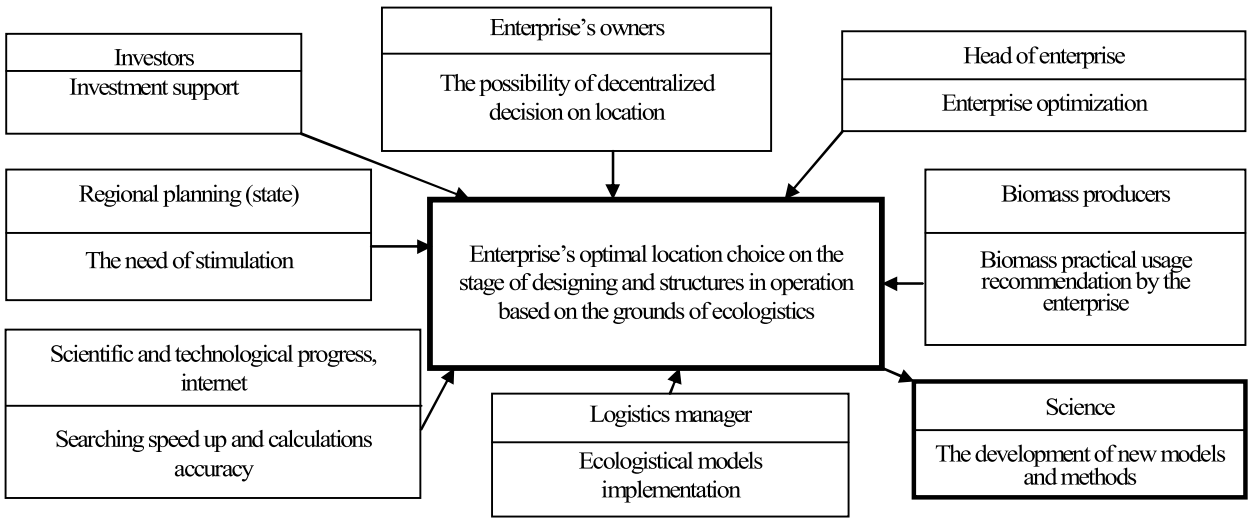

Fig. 5. The important factors for optimal enterprise's location choice based on the grounds of ecologistics in the process of designing and for structures in operation
Author's stretch

First, the collection of information about unequal regional biomass dissemination takes place, the region which would meet the needs of an enterprise in ecological energy carriers and include stations of research situated uniformly from each other (e.g. 3 km). Secondly, the amounts of storage and structure are figured out while heuristic method, depending on needed accuracy, determines the stations where the locality's profound research is needed. The research of the available amount of biomass is conducted in order to calculate the radius of energy carriers' transportation for an enterprise.

The fig. 4 depicts the radius of transportation in stations M_1, M_2, M_3, M_4, M_5. In practice, the radius of biomass collection is set for each station to satisfy an enterprise's demand. The decision is made in favor of the place with the smallest radius of transportation. The station M_2 requires the lowest amount of energy and the harmful impact on the environment is the easiest [10, 15].

In view of the above said, it is possible to present the factors of enterprise's optimal location choice based on the grounds of ecologistics in the process of designing and for structures in operation (fig. 5).

The qualitative implementation of the researches' results is possible with close cooperation of state authorities, local administrations and heads of enterprises aiming at achieving ecological and economic efficiency of conducting business.

Conclusions

1. Taking into consideration the possibilities of biomass usage three ecologistical models can be used for optimal enterprise's location choice and functioning in purchasing and distribution, as they present the additional ways for location choice with optimal logistics taken into account.

2. The maximum distances of the energetic proved transportation are presented for different kinds of biomass and the approaches to ecological and economic optimization are summarized.

3. The biomass usage for heat and power production in Ukraine started recently. Hence, the effective strategies of promotion and development of this technology needed. On the example of biomass it was proved that it is possible and necessary to develop ecologistical approaches on enterprises, conduct the cooperation with state authorities in order to use biomass as an energy carrier effectively and protractedly.

4. The advantages of biomass usage are so considerable that enterprises and the state would have the possibility not only to save the traditional energy resources, but also to create new workplaces in the rural areas, rich in biomass. While logistical researches are mainly focused on the new models and solutions, the producers of eco-kinds of energy from biomass expect the specific practical steps from behalf of the state and investors towards the new ideas, technology promotion and investment issues support.

Prospects for future research

The new methodology of enterprises placement are perspective direction for further implementation of ideas of comprehensive management in the entire logistics chain. The further researches are to be aimed on search of energy and resources usage reduction methods due to the coherent view on productive and logistical processes. It is possible to combine, improve and connect ecologistical models together aiming at construction of low-cost enterprise, accounting efficient resources and energy usage.

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