

## WOOD PELLETS PRODUCTION IN UKRAINE AS A BRANCH OF RENEWABLE ENERGY INDUSTRY



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**Abstract.** The article discusses the concept of a circular economy, as a system of closed circulation of goods and resources, functioning to minimize waste and convert them into additional cost. A classification scheme for waste and its management in the context of the product life cycle is presented. The author explores the wood pellet industry as an alternative fuel, the raw material for which is wood biomass collected in forestry and woodworking enterprises. The trends in the development of the pellet industry in Ukraine are analyzed, the main characteristics of wood and straw pellets are presented, and a chain of additional value creation in the industry from the point of view of management has been compiled.

**Keywords:** *Pellets, pellet production, biomass, solid biofuel, wood waste, wood pellets, "green" economy, circular economy, management.*

### Introduction

Renewable energy sources have existed for a long time, but due to the development of processes for the extraction of fossil fuels, as well as the moment of exacerbation of environmental problems in the world, their application was not considered as an alternative. Thus, the society at different times used the warmth of the sun, the power of water and wind, as well as the first natural biofuels - wood, as primary energy sources.

Ecologization of the world economy as a new global phenomenon dates back to the late 1960's. At about this time, the concept of "green" economy had been appeared. This is due to the actualization of processes of global warming, an increase of anthropogenic pressure on the environment. Recently this "greening" factor has been more updated and becomes the priority in branch development and on the international level. In our time, an important condition for the sustainable development of an individual country, a separate branch, an individual enterprise is the ecologization of production processes, the transition of the whole system of economic reproduction of mankind to principles that are consistent with the task of environmental protection and recircle of resources in the system.

Such a view of the problem means radical optimization of the use of resources during economic activity and consumption, the production of such development priorities that organically combine the financial performance of economic activity with its environmental benefits. This is especially relevant for the economy of Ukraine, which is characterized by extremely inefficient consumption of resources, extremely unfavourable environmental conditions, complicated functioning of economic systems through their energy and raw material costs.

Thus, in the article, we will focus on the pellet industry development, which can be considered as one of the "bricks" for building the circular economy, because it involves the recycling of waste from other industries and the production of environmental products for energy needs. An important nuance of the research is the application of a managerial approach, which reveals the problem of the functioning of enterprises and the industry in terms of management.

### **Analysis of the available investigations and publications**

There are numbers of scientists which devote their work to the problems of bioenergy development in Ukraine. Thus, O. Adamenko, I. Andriychuk, S. Devyatkin were involved in the study of the efficiency of using alternative fuel and energy resources. A. Grigansky, M. Kobets, G. Kaletnik, B. Overchenko, A. Samoilenko researched the problems of production development and market of biofuels. Issues of state regulation and management in this area are disclosed in the works of O. Ignatenko, Y. Malashenko, O. Serdyuchenko, O. Stoyan. A deep analysis of the current state of bioenergy in Ukraine and world trends in this area is carried out by G. Geletukha, T. Zhelezna and others. Additionally there are some branch reviews and analytical studies prepared by specified organizations in Ukraine, such as Group German-Ukrainian Agrarian Dialogue, PPV Knowledge Networks, Scientific and Technical Center "Biomass", Bioenergy Association of Ukraine, Ukrainian Pellet Union and others.

### **Results and discussion**

A conceptually new paradigm of development for Ukraine can be the model of the circular economy, based on the principles of sustainable development. Its main instruments are environmental innovations and green technologies, that is, those that are

environmentally friendly. Circular economy is not a traditional recycle from one point of view (Prob 2016, P.101). Ideally, the model of a closed cycle of resource flows begins to operate long before the goods come to a standstill, need to be recycled or repaired. The concept of the circular economy implies a direct involvement in the stages of product planning and development to ensure a long life cycle and high potential for further reuse, modernization, rehabilitation and recycling. Many successful presentations of the manifestation and implementation of the basic ideas of the circular economy are a lot of existing startups (Chu 2016; 7 Incre 2016).

In the model of the circular economy, a significant place is given to such a category as waste and waste process. The latter becomes an integral part of the strategy for the development of socially responsible business.

What is waste?

Waste is officially defined in the EU Waste Framework Directive. It refers to any substance or object, which the holder discards or intends or is required to discard. In other words, waste does not have an intrinsic value any more. In Europe, waste is classified under the so-called EURAL codes (Leek 2015, P.7).

The procedure of criteria categorization for waste and end-of-waste criteria for post-consumer waste is reflected in figure 1.

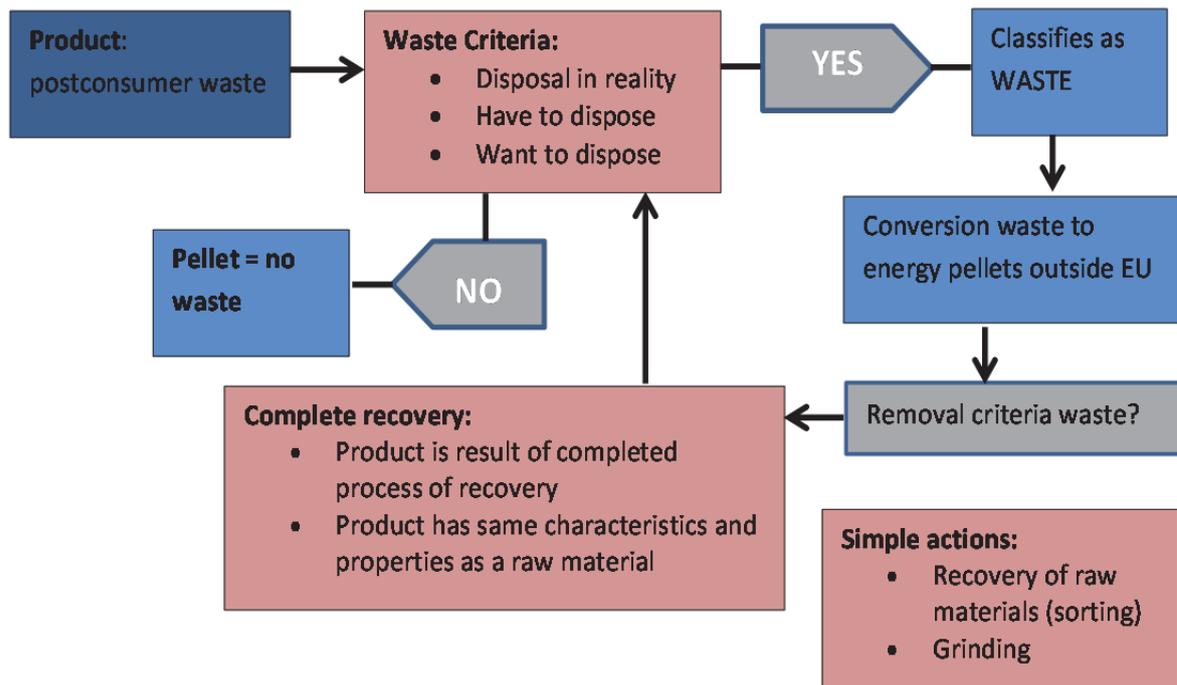


Figure 1. Criteria categorization and end-of-waste criteria applied for post-consumer waste (Compet 2013)

Scientific research emphasizes that innovative waste management practices are an inevitable element of management strategy. It forms the foundation for their sustainable development and requires the development of fundamentally new approaches to process management. At the same time, the achievement by enterprises of social and environmental goals in most cases gives a synergistic effect in their development. And proper waste management is becoming one of the links in creating circular value added chains, which brings the desired economic result and is the basis of long-term competitiveness.

Wood had been the main source of energy for the world until the mid-1800s. And now it continues to be an important fuel in many countries, especially for cooking and heating in developing countries.

The amount of wood waste generated in the EU27 was estimated at 70,5Mt in 2004. Taken together, the EU-27 Member States plus Croatia, Norway and Turkey generated some 2.6 billion tons of waste in 2008, or roughly 5.4 tons per person, of which around 3.7 % is hazardous. Overall, and taking into account the limited data, the trend shows growing or stabilizing amounts of hazardous and non-hazardous waste in the EU (Rukov).

In comparison to the EU, in 2016, about 2% of total U.S. annual energy consumption

was from wood and wood waste (bark, sawdust, wood chips, wood scrap, and paper mill residues). Wood is used in homes throughout the United States for heating as cord wood in fireplaces and wood-burning appliances and as pellets in pellet stoves. In 2015, about 11.5 million U.S. households used wood as an energy source, mainly for space heating, and 2.3 million of those households used wood as the main heating fuel (Biomass 2017).

Wood waste can arise from a number of sources (municipal, commercial and industrial, construction and demolition) and in many different forms. However, the main end-uses for recovered wood are: wood-based panel manufacture; biomass energy generation; animal bedding and others. When we talk about pellet's production we concern that it uses in the fact wood waste from some industrial processes such as sawmills, furniture fabrics, other woodworking enterprises. Taking into account that legislatively it means the further transformation of wood waste, we need to talk about wood waste definition and management system hierarchy.

The definition of "wood waste" used all around the EU countries varies, reflecting different waste management operations. In order to figure the main subject of this paper, we define "wood waste" as follows: non-

standard wood formed during the sanitary felling of trees during logging, as well as residues formed during the processing of wood into finished products. In this context, solid waste is understood as waste collected by or on behalf of processing (woodworking) industries.

Ukraine has a great potential for producing solid biofuels. The resources of the country allow to harvest more than 4 million tons of wood waste and more than 22 million tons of agricultural waste annually. From the first, only in Zhytomyr oblast annually it is possible to receive about 536.7 m<sup>3</sup> of energy wood and waste: firewood, cod, sawdust, hillocks, etc. Wood processing residues, which are formed in large quantities in forestry, processing industry and other industries have a large energy potential and are the raw material base for pellets production. Thus, waste, which is regarded as garbage, becomes a valuable resource and transforms into an ecological energy carrier. Currently, 150 pelletizing factories in Ukraine produce about 240 annually thousand tons granules. This is much less than in the EU, where about 650 pelletizing factories produced over 10 million tons of pellets in 2009. However, the Ukrainian market of pellets began to develop quite recently, while in many European countries it has been developing for over 25 years.

So far, the market is at an early stage of development and grows annually by 15-20%. Moreover, theoretically there is a significant growth potential. The researchers estimated that about 20 million tons of grain straw, 2 million cubic meters of wood waste and up to 1.5 million tons of sunflower husks remain in fields or in forests. Of course, the production of pellets is one of the possible options for using this biomass (Kuznets 2012, P.6).

The main driving force for the development of inner pellets production actually is the European Union as a main importer of Ukrainian pellets. The EU price of pellets can exceed 115-150€ per ton, depending on the

location and the sort of pellets. These prizes make pellet production very attractive to Ukrainian producers. On the other hand low salaries, the low cost of electricity and the availability of wood wastes provide financially attractive conditions for wood pellet production in Ukraine. Probably the high price of pellets in Europe would probably drive up the price of pellets in Ukraine. That, combined with the previously described conditions, is probably obstructing the utilization of wood pellets in Ukraine.

The current problem identified today is the creation of transparent conditions in the procurement market for raw materials and the technical equipment of the enterprises by the necessary lines for wood pellet granulation, as well as other equipment (drying, crushing, screening and sorting aggregates). In total, with 26 million tons of potential annual waste generation, Ukraine consumes less than 2.2 million tons, more so than wood and sunflower, while straw is consumed in insufficient quantities. Its reserves allow producing annually about 10 million tons of pellets and briquettes, but today, the potential of straw is used by about 1-2% (CEN Tecnn, P.23).

In CEN/Technical Specification 14961 Solid Biofuels – Fuel specifications and classes densified biofuel is further sub-divided into briquettes, which have a diameter larger than 25 mm, and pellets, which have a diameter of less than 25 mm. The same technical specification also provides (in Table 1) more details on the specifications of properties for wood pellets. Requirements and classes are formulated for diameter, moisture content, ash percentage, sulphur contents, mechanical durability, amount of fines, additives, and nitrogen content Furthermore the definition of biofuel pellets by this specification is as follows: densified biofuel made from pulverised biomass, with or without pressing aids, usually with a cylindrical form, random length typically 5 to 30 mm, and broken ends (Geletukha 2013, P.8).

Table 1

**Comparative characteristic of technical and economic parameters of some types of pellets**

Characteristic	Wood	Straw
World market's volume	96%	1%
Buffer storage duration period	1 month	12 months
Processing capacity	100 kWt/t	130 kWt/t
Ash content	1%	8-12%

Heat capacity	18 MJ/kg	17 MJ/kg
Humidity	50%	4-7%
Ecological safety	Balanced	removes minerals from the soil
Specificity of burning	no cost required	specialized boilers
Cost of processed biofuel pellets	50-56 Euro/t	78-82 Euro/t

Source: own interpretation by (What is Waste).

The new Energy Strategy of Ukraine till 2035 suggests that the use of all types of renewable energy sources will become one of the tools for guaranteeing the energy security of the state. In the short and medium horizon (until 2025), the National Action Plan projects a growth of renewable energy to 12% of total primary energy supply and at least 25% to 2035 (including all hydro generating capacity and thermal energy). Concerning the biomass energy production, the growing perspective of biofuel consumption will be conditioned by the relative sustainability of production (in the presence of the resource base) and the tendency towards the formation of local generating capacities. The advantage will be given to the simultaneous production of thermal and electric energy in cogeneration units and replacement of hydrocarbon fuels (Energ 2017, P.37).

It is positive that among the main measures for the implementation of strategic goals in the bioenergy sector of Ukraine, increased use of biomass in the generation of electricity and heat. This can be achieved by: a) encouraging the use of biomass as a fuel in plants where biomass is a residual product; b) informing about possibilities of using biomass as a fuel in individual heat supply; c) promoting the creation of competitive markets for biomass.

It's obviously necessary to take into account that turning biomass which is residual product or waste into a resource is one key to a circular economy. This is extremely important for Ukraine in the context of its path to European integration. According to

the objectives and targets set in European legislation, there are key drivers in the primary energy sector such as: instruments to improve waste management, paths to stimulate innovation in recycling, models of limitation the use of landfilling, and creation incentives to change consumers' behaviour. If one remanufactures, reuses and recycles, and if one industry's waste becomes another's raw material, the system can move to a more circular economy where waste is eliminated and resources are used in an efficient and sustainable way.

So the European Commission adopted an ambitious Circular Economy Package, which includes revised legislative proposals on waste to stimulate Europe's transition towards a circular economy which will boost global competitiveness, foster sustainable economic growth and generate new jobs (Kompleks 2016, P.13).

The European Union's approach to waste management is based on the «waste hierarchy» which sets the following priority order when shaping waste policy and managing waste at the operational level: prevention, (preparing for) reuse, recycling, recovery and, as the least preferred option, disposal (which includes landfilling and incineration without energy recovery).

The EU Waste Framework Directive (2008/98/EC) prescribes a certain hierarchy of wood waste use, in which cascading should be envisaged: waste management options are ranked in order of environmental preference with the first priority being waste reduction (figure 2).

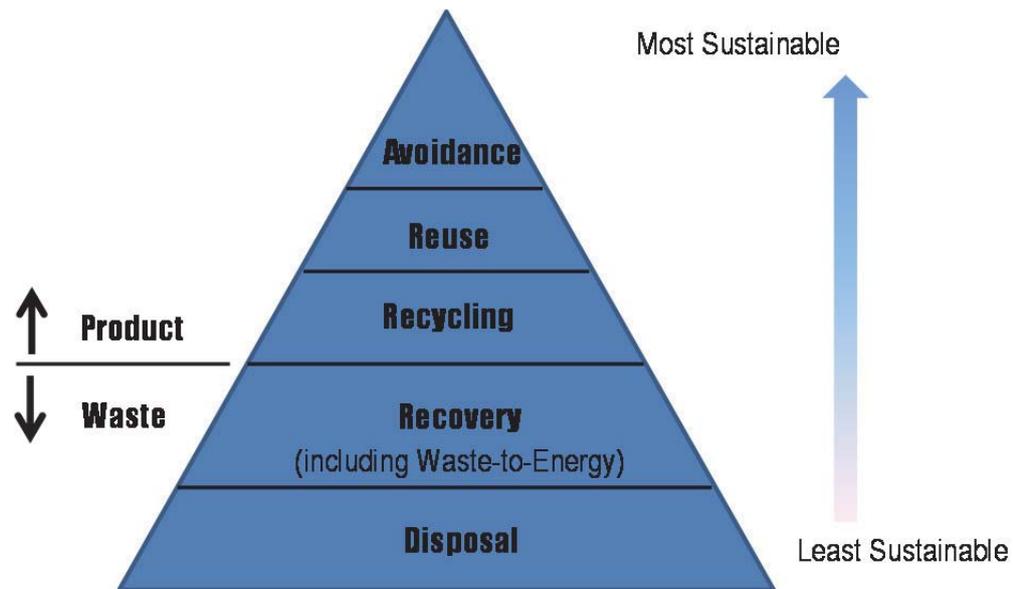


Figure 2. EU Waste hierarchy (Compet 2013, P.9).

In line with this the 7th Environment Action Programme sets the following priority objectives for waste policy in the EU:

- To reduce the amount of waste generated;
- To maximise recycling and re-use;
- To limit incineration to non-recyclable materials;
- To phase out landfilling to non-recyclable and non-recoverable waste;
- To ensure full implementation of the waste policy targets in all Member States (What is waste).

In the works of domestic researchers we find confirmation that Ukraine has a certain potential in the production of renewable energy sources, especially biofuels from organic raw materials, and opportunities for its realization. However, there are a number of regulatory problems (gaps in the legislative field, lack of explanatory subordinate acts, complex bureaucratic procedures regarding the legal registration of business entities in the industry, etc.), there is no industry infrastructure and framework conditions for the internal market for biofuels, there is lack of technical regulations and certification, which entails problems of non-compliance with world standards. All this prevents the full use of the potential of the biofuels industry. In connection with this, the adoption of amendments and amendments to the current legislation, the development of new regulations, which will serve as an explanatory and auxiliary function in the development of

the industry, as well as the introduction of financial incentives and mechanisms and innovation and investment support in the field of biofuel production, will become particularly relevant.

Ukraine has no tools that would allow for effective economic activity in the field of production and consumption of biofuels. The main reason for the situation described above in the biofuel industry is the lack of standardization in the following areas:

- The process of biofuel production
- Quality control of biofuel products
- Warehousing and logistics system

The availability of standards will allow the consumer to choose quality products, to be sure of the delivery system, which will increase the interest in biofuels in the domestic market and crowd out the players who offer poor-quality products. Manufacturers and traders will be able to increase prices for products abroad and increase their profitability.

Currently, in Ukraine there are almost no approved quality standards. The Ukrainian biofuel industry needs the introduction of ENplus certification, in line with the best world standards of solid biofuels' quality – EN 14961 and ISO EN 17225. Instead, there are technical standards of product quality (the so-called TU), which properties are somewhat different from European ones. Actually Ukraine hasn't defined mandatory for the implementation of the state standard on wood

pellets. There is a state standard DSTU EN 15234-2: 2013, Solid biofuels. Quality assurance. Part 2. Wood Pellets for Non-Industrial Use (EN 15234-2: 2012, IDT), but it only concerns the limited issue of certification / quality control in the production of wood pellets. Therefore, the issue of certifying whether or not its products remain on the manufacturer of pellets. Most pellet producers

do not certify their products and work with traders because they cannot find a buyer to sell their uncertified products directly without intermediaries.

The Table 2 shows the difference between the quality standards of wood pellets in Ukraine and EU in order to figure out the landmarks for pellet producers that sell pellets for export.

Table 2

Specification of EU and Ukrainian standards for quality of wood pellets

Nº	Quality standard	EN plus A1	EN plus A2	EN-B
1	Diameter, mm	6 to 8	6 to 8	6 to 8
2	Length, mm	3,15 ... 40	3,15 ... 40	3,15 ... 40
3	Absolute humidity, %	<10	<10	<10
4	Bulk density, kg/m <sup>3</sup>	>600	>600	>600
5	The content of fine fraction / dust, %	<1	<1	<1
6	Mechanical stability, %	>97,5	>97,5	>96,5
7	Heat capacity, MJ/kg	>16,5	>16,3	>16,0
8	Ash, %	<0,7	<1,5	<3,0
9	The threshold of ash melting, °C	>1200	>1100	>1100
10	Cl, %	<0,02	<0,02	<0,03
11	S, %	<0,03	<0,03	<0,04
12	N, %	<0,3	<0,5	<1,0

Source: (Kolomiychenko 2015, P.11)

Like in any other market, there is a chain of value in the bioenergy market - the distribution of market participants according to the stages of creating value added from primary raw materials to the end user. The cost chain in the bioenergy market includes the following links: raw material holders - raw material purchasers - biofuels producers - biofuels traders - biomass heat producers - consumers (Figure 3).



Figure 3. The chain of value added on the biofuel market

The analysis of the participants in the market of wood pellets in Ukraine, represented by links in the value chain, made it possible to make the following conclusions:

1. A complete chain of value has been formed in the bioenergy market:
  - all links of the value chain are represented on the market;

- different business models are presented on the market – from one link to full vertical integration (from own raw material to heat production to final consumers).
- 2. The “manufacturer-trader” model dominates the market:
  - the vast majority of market participants (quantitatively) are engaged in the production of chips, pellets and briquettes

- and supply their products directly to end users;
- the research did not reveal powerful traders who could dominate the market and act as market makers;
  - the vast majority of biofuels producers are moving up the value chain (trying to control access to raw materials, co-called "upstream") – we can assume that additional resources are needed to move down the chain (before heat production);
  - at the same time, it is evidence of the readiness of private capital to actively participate in harvesting and growing of raw materials.
3. The market has a few powerful players specializing in a specific link:
- the bioenergy market is young, is in the stage of formation - in general there are only a few powerful players in the market;
  - there are few players on the market who are clearly focused on a particular link in the value chain – the majority either works in multiple links, or actively expands to other links, or relatively newly created for a clear definition of the strategy;
  - the lack of specialized players is unhealthy for the market as a whole – specialized in certain segments of the company play the role of development engines of other tangential units, actively forming the market themselves.
4. Nearly missing links of purchasers:
- given the opacity of the market, which many researchers wrote [Kuznets 2012; Geletukha 2013; Kompleks 2016; Kolomyichenko 2015], few companies position themselves as growers.
5. Unformed link of heat producers from biomass:
- few players (quantitatively) in the chain of heat producers from biomass;
  - formation of rules of the game on this segment of the market and its expansion

prompts tangent links to development - can become a strategy of market formation to development;

- market imperfections determine the significant volumes of biofuel exports from the region;
- the link has a significant margin to create a business (with a corresponding contribution to GRP, workplaces and tax base).

Thus, based on the material presented, we can outline some key statements about the specifics of the wood pellets' production in Ukraine and their appropriate place in the circular economy. These statements can be more intensively disclosed in further scientific studies, but as conclusions from our analysis, they are extremely relevant for the steady development of the bioenergy industry in Ukraine now:

- based on the value chain and the intended end-use of the material, an energy pellet from post-consumer wood waste is likely to fall under the end-of-waste criteria and thus no longer considered waste; This means that the energy pellet could be considered a product only under the condition that the exporting country shares the same view (and does not consider the energy pellet as waste either);
- imported wood energy pellets are not considered waste in most European countries when they meet the DIN standard. This is the general norm for industrial pellets to place them on the market; In all cases, the energy plant needs to have the right permits to burn wood waste (or energy pellets).
- industrial timber residues are not defined as waste. They are an important resource for energy wood pellets and therefore shortly discussed here. Supply of industrial residues is directly dependent on the input of raw material and the output of products in the forest industries.

## Conclusions

Wood pellets made from wood biomass as waste or by-product of the forest industry and/or wood processing enterprises are sustainable good, which is supporting the principles of circular economy. Understanding the key trends in the pellet market and the search for managerial approaches to the production and logistics process lead to the flexibility and rapid reaction of producers who, on the one hand, produce finished products (pellets), and on the other - they continue the life cycle of the woodworking process (closing the chain of value creation at harvesting of the forest).

The area of pellet production is relatively young in Ukraine, despite the fact that wood as an energy resource is used for centuries. The main obstacle and constraints for the development of pellets, as has been investigated, are the following:

- 1) complexity with the collection and availability of raw materials.
- 2) technological features of wood waste processing in granular fuels.
- 3) the absence of a state standard of certification, which complies with generally accepted world (European) norms.
- 4) the opacity of biomass raw material harvesting schemes and the inconsistency of public policy in the field of renewable energy sources.

Pellet production management is a complex system of operations and takes into account all the features of the production and logistics process in the solid biofuel industry. In particular, placing emphasis on the correct and timely harvesting of raw materials, sorting them and differentiating the production range of pellets are necessary for the formation of the enterprise's competitiveness and ensure a stable demand for its products in circular economy.

## References

1. Problemy sovremennoy ekonomiki : monogr. / M. M. Brutyan, M. P. Vakhromeyeva, T. M. Vorozheykina i dr. ; [pod obshch. red. S. S. Chernova]. – Novosibirsk : Izd-vo TSRNS, 2016. – 262 s.
2. Chudesa tsirkulyarnoy ekonomiki: obuv' iz ispol'zovannykh butylok i shin [Elektronnyy resurs]. – Rezhim dostupa : <http://www.bakertilly.ua/ru/news/id1065>
3. 7 Incredible Examples of Circular Economy [Electronic resource]. – Mode of access : <http://www.bio-bean.com/2016/06/10/7-incredible-examples-companies-embracing-principles-circular-economy/>
4. Leek N. De markt van gebruikt hout en resthout in 2014 / N.A. Leek, J. Oldenburger and A. Winterink. – Belgium: HNP Publish house, 2015. – 235 p.
5. Competition in wood waste: inventory of policies and markets. Focus on energy and climate change / NL Agency. Ministry of Economic Affairs. – Netherlands, April 2013 : [Electronic resource]. – Mode of access: <https://english.rvo.nl/sites/default/files/2013/12/Competition%20in%20wood%20waste%20June%202013.pdf>
6. Rukovodstvo po obespecheniyu bioenergiyey na mestnom urovne na osnove drevesnoy biomassy / BE2020+, Metla VTT : [Yelektronniy resurs]. – Rezhim dostupu: [http://www.promobio.eu/en/document/cfm?doc=show&doc\\_id=199](http://www.promobio.eu/en/document/cfm?doc=show&doc_id=199)
7. Biomass: wood and wood waste [Electronic resource]. – Mode of access: [https://www.eia.gov/energyexplained/?page=biomass\\_wood](https://www.eia.gov/energyexplained/?page=biomass_wood) / Last updated: May 30, 2017.
8. Anna Kuznetsova. Vyrobnystvo pelet v Ukrayini: prybutkovyy variant staloho rozvytku // A. Kuznetsova. Hrupa Ukrayins'ko-Nimets'kyy ahrarnyy dialoh (seriya konsul'tatyvnykh robit). – K.: 2012. – 24 s.
9. CEN technical specification for solid biofuels –Fuel specification and classes // Biomass and Bioenergy. – Volume 30(11). November 2006. – P. 908-914.
10. Geletukha G.G. Perspektivy proizvodstva teplovoy energii iz biomassy v Ukraine / G.G.Geletukha, T.A.Zheleznyaya, Ye.N.Oleynik // Analiticheskaya zapiska Bioenergeticheskoy assotsiatsii Ukrainy №6. – 2013. - №6. – 24 s. : [Yelektronniy resurs]. – Rezhim dostupu: <http://www.uabio.org/img/files/docs/position-paper-uabio-6-ru.pdf>
11. What is waste [Electronic resource]. – Mode of access: <http://ec.europa.eu/environment/waste/>
12. Enerhetychna stratehiya Ukrayiny do 2035 roku: bezpeka, Enerhoefektyvnist', konkurentospromozhnist' (proekt)
13. Kompleksnyy analiz ukrayins'koho rynku pelet z biomassy (vyznachennya tochok zrostannya) / Avt. kol. H.Heletukha, V.Kramar, O.Epik, T.Antoshchuk, V.Titkov (na zamovlennya proektu Prohramy rozvytku Orhanizatsiyi Ob'yednanykh Natsiy «Rozvytok ta komertsializatsiya bioenerhetychnykh tekhnolohiy u munitsypal'nomu sektori v Ukrayini». – K.: NTT S «Biomasa», 2016. – 336 s.
14. Kolomyichenko M. Ekonomichne obhruntuvannya dotsil'nosti perekhodu na opalennya tverdym biopalyvom. Harmonizatsiya ukrayins'kykh standartiv ta standartiv YES. – Ukrayins'kyy Peletnyy Soyuz. – S.11.