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BIOSOCIAL ECONOMY AS A MECHANISM FOR TRANSITION TO SUSTAINABLE DEVELOPMENT

The theories and concepts of bio-economy, ecology-friendly economy, green economy, neo-economy are known as those that pronounce modern approaches of sustainable development of the world's economies. They also attempt to suggest the mechanisms of transition to new principles of production, consumption and distribution. This quest is determined by a number of factors and is emphasised by unemployment and population growth, accelerated appearance and growth of new technologies, climate change, etc. At the same time one needs to keep in mind security restrictions (e.g. energy and food security). This study attempts to scientifically interconnect the above-mentioned concepts and arrive at a unified understanding of the transformations that are occurring in economy. We also aim to define the role and place of the biosocial economy in the current world processes.

In this study, biosocial economy was identified as a mechanism for sustainable development implementation. In the process, we outlined the key features of biosocial economy formation and main differences with other approaches.

Key words: *sustainable development, biosocial economy, green economy, bio-economy, biotechnology, biosocial economy system, definition genesis, strong social stability.*

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БІОСОЦІАЛЬНА ЕКОНОМІКА ЯК МЕХАНІЗМ ПЕРЕХОДУ ДО СТАЛОГО РОЗВИТКУ

Сучасні теорії та концепції біоекономіки, екологічно орієнтованої економіки, неоекономіки є сучасними підходами до розвитку світової економіки через реалізацію концепції сталого розвитку. В рамках цих теорій ведуться пошуки механізмів переходу до нових принципів виробництва, споживання та розподілу. Вирішення цього завдання визначається і посилюється низкою факторів: зростанням населення і безробіття, появою нових технологій, кліматичними змінами тощо. У той же час необхідно брати до уваги усе більшу зростаючу потребу у забезпеченні продовольчої та енергетичної безпеки. Це дослідження є спробою об'єднати вищезгадані теорії під єдиним поняттям (біосоціальна економіка) з метою досягнення цілісного розуміння перетворень, які відбуваються в економіці в цілому і в сільському господарстві зокрема. Також зроблена спроба визначити роль і місце біосоціальної економіки у поточних світових процесах. У цьому дослідженні біосоціальна економіка була визначена в якості механізму для реалізації сталого розвитку. Виявлені ключові особливості формування біосоціальної економіки і основні відмінності від інших підходів. Визначені ключові точки, які формують перехід від суспільства споживання до стійкої моделі соціального та економічного розвитку. Проведено огляд процесів, здатних сформувати основу для механізму реалізації біосоціальної економіки.

Ключові слова: *сталий розвиток, біосоціальна економіка, зелена економіка, біоекономіка, біотехнології, біосоціальна економічна система, генезис визначень, соціальна стабільність.*

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БИОСОЦИАЛЬНАЯ ЭКОНОМИКА КАК МЕХАНИЗМ ПЕРЕХОДА К УСТОЙЧИВОМУ РАЗВИТИЮ

Современные теории и концепции биоэкономики, экологически ориентированной экономики, неоэкономики служат современными подходами к развитию мировой экономики путем реализации концепции устойчивого развития. В рамках этих теорий ведутся поиски механизмов перехода к новым принципам производства, потребления и распределения. Решение этого задания определяется и усиливается рядом факторов: увеличивающимся населением и растущей безработицей, появлением новых технологий, климатическими изменениями и пр. Одновременно необходимо принимать во внимание возрастающую потребность обеспечения продовольственной и энергетической безопасности.

Данное исследование – это попытка объединить вышеупомянутые теории под единым понятием (биосоциальная экономика) с целью достижения целостного понимания преобразований, которые происходят в экономике в целом и в сельском хозяйстве в частности. Также эта работа – попытка определить роль и место биосоциальной экономики в текущих мировых процессах. В этом исследовании биосоциальная экономика определена как механизм реализации устойчивого развития. Выявлены ключевые особенности формирования биосоциальной экономики и основные отличия от других подходов. Определены ключевые точки, формирующие переход от общества потребления к устойчивой модели социального и экономического развития. Выполнен обзор существующих процессов, способных сформировать основу для механизма реализации биосоциальной экономики.

Ключевые слова: *устойчивое развитие, биосоциальная экономика, зеленая экономика, биоэкономика, биотехнологии, биосоциальная экономическая система, генезис определений, социальная стабильность.*

Introduction. The global challenges to the human civilisation such as climate change, depletion of natural resources, food security risks, speedy growth of population, environmental pollution, poverty and inequality in distribution may be addressed only on the basis of multidisciplinary synthesis of knowledge and prioritised advance in new technologies.

Nowadays we should refer not merely to novel technologies, but those innovations that can provide a breakthrough advance that can efficiently oppose the consequences of the negative processes [1].

Nanotechnologies, biotechnologies, gene engineering, cloning, stems cell technologies, etc. may principally affect life quality in the 21st century.

Modern biotechnologies utilise biological methods for fighting pollution, protecting crops from pests and diseases, manufacturing bio-active substances (like antibiotics, ferments, hormonal drugs) [2]. Genetically modified plants are resistant to herbicides, insects, bacteria, viruses, and other unfavourable natural factors. This may help to resolve most problems of food crisis and environmental pollution [3].

Nevertheless, new problems are growing which endanger the quality of human life. For example, water and soil pollution, excessive use of pesticides and fertilisers of doubtful quality lead to production of food of poor quality. In turn, this is interconnected to the pricing of agricultural products and farming profitability. Animals' disease epidemic and quarantine lead to a variety of problems, e.g. financial losses, which are difficult to foresee in business plans and hedge with insurance. If occurring on a big scale, such issues may lead to massive bankruptcy in national farming sector, hence unemployment growth, increased food imports and decline in the national food security.

The development of modern society goes beyond consumption and wealth accumulation but more and more focuses on keeping balance through the rational use of the planet's resources. This, in fact, is defined in the concept of sustainable development (the Concept in what follows) [4]. In the conditions of crisis ignited by climatic, ecological, social and economic processes, the sustainable development of humankind, according to the Concept, is recognised as the only possibility in the long term (table 1) [5].

Respectively, the global social and economic transformation processes involve the following:

- In economic context: The quest for, and implementation of theoretical foundations and strategic resolutions aimed at transformation of conventional management, (which mainly seeks income and enrichment) towards social market economy, systems of collective regulation, planning and economic growth.

Factors Influencing the Socio-Economic Changes

	FACTORS	SOCIO-ECONOMIC CHANGES	INFORMATION SOURCES
1	Climatic	• The global economy slowdown due to global warming is estimated at 1.5% of GDP or $ 1.2 trillion per year. • The average temperature increase and environmental pollution will lead to a reduction in global GDP growth of 3.2 % in 2030, for the poorest countries, it will be 11 % of GDP	http://www.hm-treasury.gov.ua; DARA group & Climate Vulnerable Forum
2	Demographic	• The world's population increases by more than 30 % that more than 9 billion in 2050 (forecast for the next 40 years). As a result, food demand will increase on 70 % with increasing global consumption of meat twice, inclusive	United Nations Department of Economic and Social Affairs Population Division, World population prospects: The 2010 revision. (2011).
3	Resource and Ecological	• Predictions of the OECD indicate that the existing production methods and consumption will lead to the loss of two-thirds (61–72 %) of the world's flora and fauna by 2050 compared to the beginning of the XXI century. It's possible through the irreversible loss 7.5 million km ^{2} from the conservation natural areas	http://www.oecd.org OECD
4	Crisis economic and financial processes	• Reducing the welfare by 5.2 % of mid-2011 to 2012 (up to 223 trillion. U.S. dollars), which corresponds to parameters 2007–2008; • In 2013, the number of unemployed people in the world rose by 5 million compared to the previous year and amounted to 202 million official unemployed	Global Wealth Report, Credit Suisse; The report of the International Labor Organization (ILO), 2014
5	The Balance Between Food Security and Energy Crisis	• The world market price of oil reached $ 147/barrel in July 2008 respectively the price of corn rose to $ 8/bushel. In November 2008, the price of oil dropped to $ 60/barrel and corn was less than $ 4/bushel; • In January 2011 the FAO food index was as high as 231 points, which is the highest ever value of the index (since introduction in 1990). This extraordinary value indicates the proximity of a food crisis	http://www.grida/no; Bloomderg; JoachimvonBraun, November 2011
6	Development of nano- and biotechnologies	• Biotechnological production of polymer market in the U.S. has increased from 1% to 15 % from 2001 to 2010 and according to prospective assessments will reach two trillion. U.S. $ to 2025; • Distribution of Bio-technology (genetically modified) crops in 2012: soybeans – 80 million hectares; corn – 60.0 million hectares, cotton – 20.7 million hectares, rape – 7.3 million hectares	http://www.riss.ru/analitika; http://dt.ua/ECONOMICS/agrarni-biotehnologiyi-maybutnye-ukrayinskoyi-agroekonomiki-1211-00_.html
7	Responsible management and use of resources at government level	• International guidelines and policy documents, standards and eco markers	http://ictsd.org; General guidelines on principles, systems and supporting techniques.

Source: own design

- In social context: introduction of new forms of management which take into account not only interests of the business owners and employees, but also the interests of the clients and surrounding society. The management tools should comply with the global cultural values, incorporating such management into sustainable development tools. For example, the goals of the agriculture will be defined as supply of food, acquiring food security, preserving the biodiversity, supporting ecological balance for the generations to come.
- In ecological context: preserving eco-balance, biodiversity, justifying biotechnologies, introduction of adaptive approaches that account for climate change, increasing of the efficiency of natural capital utilization, [6].

The modern Science provides wide spectrum of the theoretical approaches for the Concept implementation, e.g. described in [7]. In this paper we shall discuss the most important of them: Bio-economy and Green Economy. As a result of revealing the conceptual differences and dissimilarities in objectives, we conclude that the social aspect is attended to exclusively via ecological parameters, i.e. case of the Green Economy, [16]. These approaches are essentially restricted by the traditional assessment (e.g. GDP per capita or the number of new jobs created in biotechnological industries), i.e. in case of Bio-economy. Both approaches do not reflect in full the priority of developing a fair and balanced society, which is a key concept of the social component of the Concept. The design of the approaches aimed at parity of all three sub-systems in economic growth and growth of quality of life of all society members is the principal task of this study.

The main objective of the study is the justification of Biosocial Economy definition so that it fully aligns to the criteria of sustainable development. According to these, the following issues require identification:

- review of implementation tools and approaches, that fully correspond to the three main aspects.
- comparative analysis of approaches for realisation of Sustainable Development Conception.

Particularly this will assist in the formation of legal tools supporting and stimulating the transformation of society, especially in the case of emerging and developing economies.

Method and Materials

Genesis of the concept «sustainable development». The idea of preserving a balance between satisfying current needs and protection of the interests of future generations within the boundaries of the planet's self-regeneration ability was introduced at the end of the 19th century by Vernadskiy [1, 8]. Sadly, in the first half of the 20th century many countries faced vitally critical conditions that dictated the need for extensive economic growth, completely ignoring ecological considerations. Later (end of 20th century) the studies by H Daly and his innovative economic theory [5] formed the foundation of the Concept in a wider sense.

This study is based on the understanding that the Concept is a common functional model of systems at different levels: macro (state, international and regional unions, world as a whole) and micro (subjects of economic activities, and households). The mechanisms of achieving this goal are contained in various economic categories: bio-economy, green economy, biosocial economy, structured economy (Fig. 1).

At present, the Concept is materialized mainly via bio-economy [7] and green economy [16]. Nevertheless, world science did not suggest commonly accepted definitions of these terms (e.g. see [10]), which fully correspond to the main objectives of Concept including the social component. As a result, there is an evident need to look for a rigid and clear definition which will combine the three aspects: ecological, economic and social [11]. Naturally, the components are interrelated and overlap at the societal level.

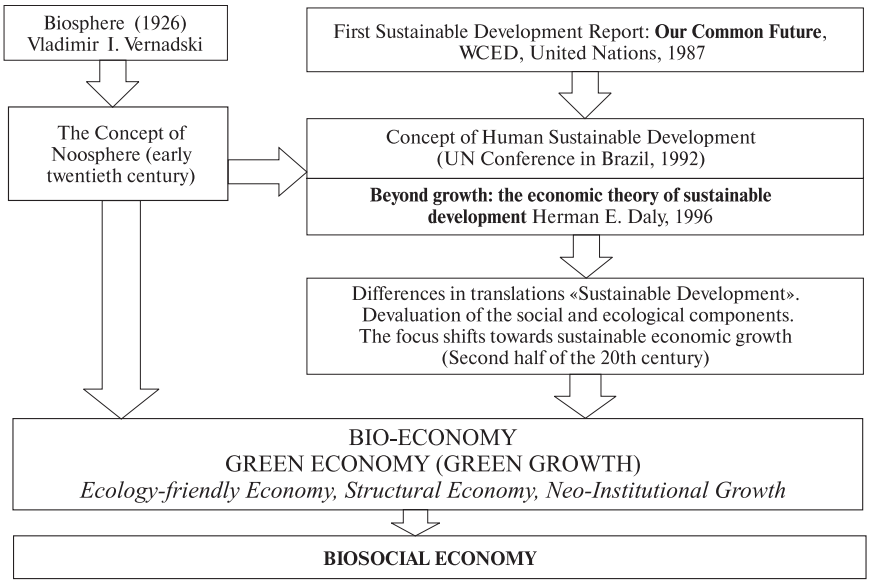

Fig. 1. **Sustainable Development Genesis Definition**

Source: own design.

Most of the modern studies investigate the interaction of economic and ecological components. Often this is done in response to the need of new markets, maximization of profits from national and international projects aimed at preserving

the environment and minimization of the «ecologic» penalties and taxes [7], optimization of energy balances of individual companies and enterprises. Minimal consideration and analysis is given to the social component [12].

In most cases the social aspect is mainly defined by the presence of «social capital», which in turn points either to «strong» or «weak» sustainability [7]. The concept of «social capital» also does not have a single definition in modern studies. Mainly it refers to the social system and is characterised by the degree of mutual trust between individuals in a given society and the range of the problems that can be resolved at a «social» level [14].

From a practical viewpoint the «strong social stability» in the biosocial model aims at flattening the global inequalities in consumption of resources, commodities and services. The official statistics claims that in 2005 the wealthiest 20 % of the planet's population consumed 76.6 % of goods and services of the global economy, while the poorest 20 % have access to only 1.5 % of the world wealth.

We suggest terming the Bio-social Economy as the form of management based on interaction of the three subsystems (Fig. 2): Economic, Ecological and Social, which is characterized by mutual processes of circulation of renewable bio-resources aiming at securing high quality of life, preserving biodiversity and balanced ecosystem for the generations to come.

Thus, the easiest way to understand the most common categories is via paired comparisons:

- Bio-economy – Biosocial economy: Bio-economy is based on the use of bio-technologies, both intelligent and aggressive, which create a danger of biological threats. One of the reasons for the rapid growth of biotechnologies was the aspiration to win

new markets and world dominance. Clearly the ecological and social aspects were mostly ignored [13], [15].

- Green Economy – Biosocial Economy: The ecological aspect is a cornerstone of the Green Economy. At the same time the critical economic transformations require societal «reprogramming» and require specific mechanisms for that [16].
- Then, in the implementation of the Green Economy the social aspect is seen as an extra benefit of outcome rather than an essential component required for the balanced development.

In turn, the ecological aspect is applied to economy as a whole, including the industry. To the contrary, the Biosocial Economy aims at implementation of bio-technologies in the first place in energy and rural context (agriculture, forestry, water resources, and rural development).

Biosocial Economy assumes that the humankind is an integral part of the biosphere, and our evolution should be synchronised with the biological system of the planet. This will guarantee the balanced development in the long run [12].

Biosocial Economy as a mechanism of execution of sustainable development demands a unified and systematic approach. Only under such conditions can we integrate the three subsystems on regional and local levels. The scenarios of systems transformations should be based on optimisation principles and models.

That is why the basic mechanisms of the implementation of the biosocial economy are processes of mutual circulation, which establish interrelations between the subsystems (shown by arrows on the Fig. 2). Such mechanisms secure the stability of the subsystems (e.g. use of biomass for energy production, reuse of waste, and therefore increased employment in bio-industry, labour migration, etc.).

So, the materialisation of the Concept requires establishing vertically interrelated functional links at all the levels of each subsystem with overall effect. As an example of such a subsystem we refer to the international market of quotas on food products or emission of greenhouse gasses. Structurally the introduction of a stable economic process is characterized by the following three phases: (a) creation of a new value chain based on innovative biotechnologies and approaches ; (b) assessment of the product value accounting for

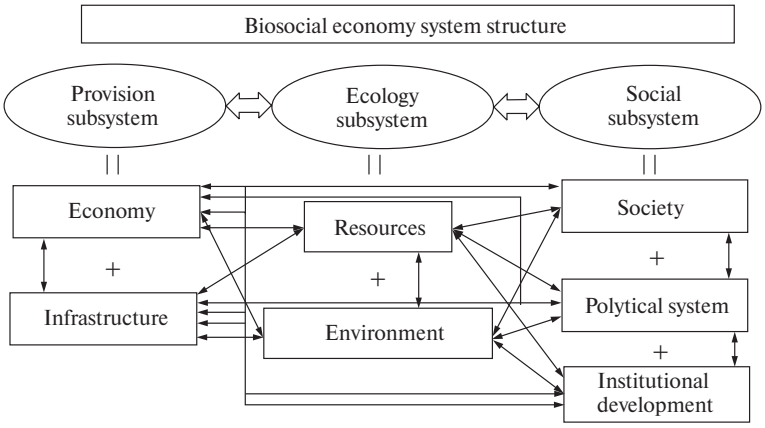

Fig. 2. **The Structure of the Biosocial Economy System**

Source: own design.

external effects (c) formation of new and/or transformation of existing markets [6]. Ecological process requires modeling and generating of a new value chain in correspondence to balanced energy and resource consumption in the framework of existing ecosystems, [15]. Formation of structures of social partnerships, such as agro-block-clusters is typical for the social aspects. The agro-block-clusters become the conductors of the new economic and ecological initiatives [17].

Developing of these routes were foreseen by the Seventh European Union Framework Program (EUSFP), Program LEADER+ and supported by European funds of social development and regional development, [18], American National Program Leader for Sustainable Biobased Economies [19]. Therefore, the design of the strategy for unified and all-inclusive transformation of the economic growth towards biosocial economy requires the mosaic utilisation of biosocial clusters [14]. The theoretical foundations of such systems are derived from the theory of self-organising systems (Synergetics) [20]. At the moment, the Seventh Framework Program found its continuation in «Horizon 2020» [21] and «The CAP towards 2020» [22].

Key aspect which need transformation		Implementation ways
Consumerism	→	Promotion of sustainable consumption
Sharing and Resoursce Management	→	Formation mechanisms of rational and fair distribution of public goods and common resources
Full Cost of Losses for humans and the planet	→	Valuation of externalities
The Range of Policy Instruments	→	Harmonization of regulatory mechanisms and support for their compliance
Market Forces as an Environmental Protection	→	Using market based incentives and instruments: fiscal, pricing, quoting, product differentiation ets.
Evaluation System: economic, social and environmental indicators	→	Re-evaluating indicators (from GDP to GS)
The Emerging Markets Impact on global sustainability	→	Alignment economic activity Emerging countries to international standards
Understanding the value of biodiversity	→	Environmental evaluation
Boottom Levels	→	Innovation value add chain for small business in local level

Fig. 3. **The key Aspects of Transformation towards the Biosocial Economy**

Source: [6].

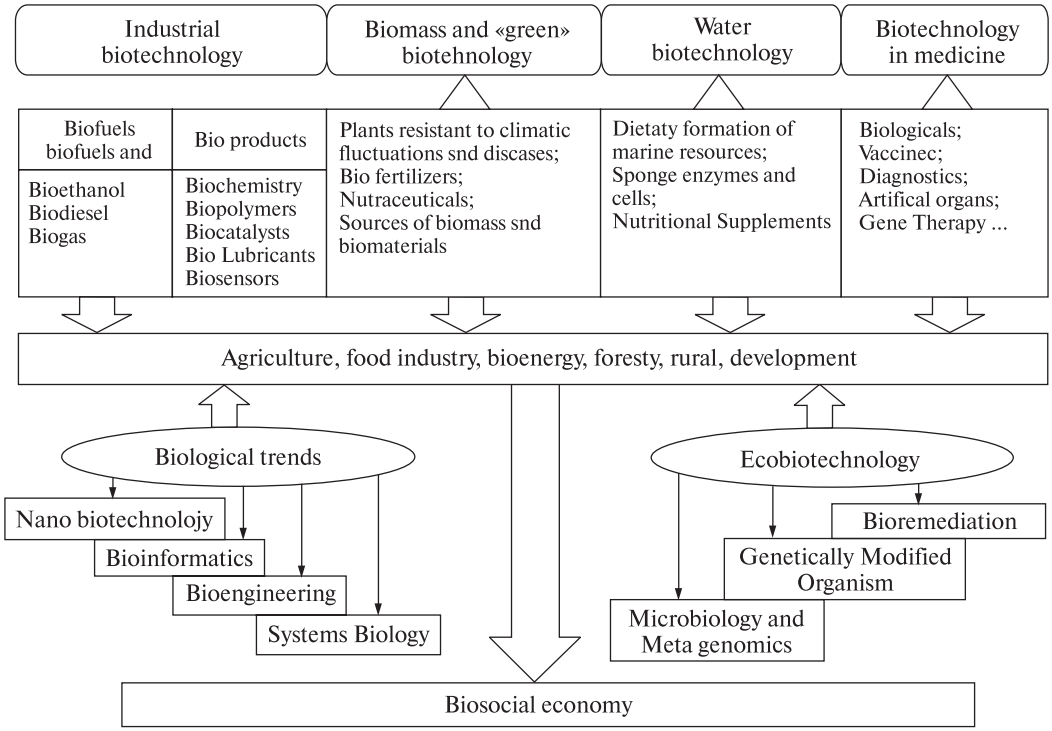

Fig. 4. **The role of biotechnology in the biosocial economy formation**

Source: own design.

At the same time the indicators of sustainable development, modern methods of analysis and modeling (e.g. LCA [12], development in innovative approaches in farming and energy sector will serve as instruments of the implementation Two of them link the subsystems into the Bio-social System: biotechnological innovations (including bio-informatics) and Corporate Social Responsibility (CSR) [6]. At the same time the crucial role in the Biosocial Economy is in the transformation of the basic economic variables (Fig. 3).

The Role of Biotechnologies in Biosocial Economy. Nowadays the most active transformations towards biosocial economy are occurring in the sectors which employ means of production that depend on the state of environment and have strategic value in terms of life support and renewability [12], namely in Farming and Energy sectors. These transformations are ignited mainly by the growth of biotechnologies.

The advancement of biotechnologies secures a number of economic, social and ecological advantages, creating a background for inter-sectorial interactions.

Substantial reduction of industrial pollution and decreased emission of toxic chemicals, water savings of about 20–50 %, efficient energy usage (10–80 % savings), lower production costs (10–15 % less) this is far from complete list of advantages. These were declared by the OECD. Also, as per Program on Bio-based Economy in Europe 2020 [11] the number of jobs related to biotechnologies will exceed 16 million in EU alone.

Subsequently the biotechnologies act as a key instrument in food security in the conditions of rapid population growth and reinforce technologies in food-production sector.

The leading world economies are employing state support programs towards supporting the advance of the biotechnologies. For example the EUSFP project had a budget of 50.52 billions of Euro for seven years (completed in December 2013). «Knowledge-Based Bio economy» – was the second (of ten) themes of this project aiming at biotechnology research in agro-industry, fishery, aquaculture, forestry and food industry (Fig. 4).

A solid position in biotechnologies belongs to the USA. This advancement started in early 1990 and the main progress is recorded in animal farming, bio-production, bio-energy, genomes of marine organisms, obesity and biosynthesis.

Russia, Canada, India, China and Argentina agreed on joint state development programs in biotechnology. In these programs they defined the mechanisms of the state support for efficiency at all stages. Nevertheless it is still obvious that all directions (as visualised on Fig. 4) cannot be equally supported by a single country. The prioritising at medium to long term planning becomes imperative. Priority is granted on the basis of the resource, social, economic and scientific potential of developed, developing and poor countries.

At the moment the production of biofuels is the most advanced sector from the bio-social point of view. This production is stimulated by the following three major factors: diversification of energy-related risks, economic effects from practical implementation and reduction of harmful emissions. In Brazil the main source of biofuels is sugar cane. At present the by-products of farming of corn and soya constitute major source for biofuel production in USA. According to the state development programs the American biofuel sector should provide one billion ton of dry biomass, which in turn will contribute 5 % to electricity production, 20 % of vehicle fuels, and 25 % of biochemical commodities [14].

Apart from the state programs, due to electricity markets liberalisation, modern methods of generation allow production of electricity almost on a DIY (Do It Yourself) basis. This makes the generation of electricity very «social», that is, industry independent and very soon small communities (e.g. agricultural cooperatives, farms, kibbutz, and even private households) will be able to produce all required electricity and provide full service and maintenance to own equipment.

On the other hand the growing demand for biofuels may radically change the global land-use structure as a result of negative impacts on the environment and eventually lead to social deformations (forced migration, health threats). Some recent studies [15] conclude that the effect of the reduction in atmospheric emissions is lower than was expected and insufficient to compensate the detriments of the extensive land-use. Apart from that, the problem of invasion of alien plants is not sufficiently studied.

The issue of the access and the distribution of fresh-water resource is still very relevant and urgent, potentially leading to social, political, economic and ecological consequences, which may be aggravated by the climatic changes [14]. This aspect directly affects the biomass production and requires rigorous selection of the plants to be cultivated. The preliminary estimations show that approximately 9 to 400 cubic meters of freshwater is required to produce a GJ of energy. For example, the miscanthus requires twice as much water as corn [15].

Consequently, taking into account active political, state and institutional support and the desire from private businesses to invest into bioenergy, this seems to be the most streamlined way towards stable biosocial clusters. Still the main condition for this is a deep and comprehensive analysis based on optimisation models accounting for all potential risks and consequences in social, economic and ecological aspects.

Conclusions. The development of a Biosocial Economy is usually associated with resolving of the global problems of humankind: food shortages, energy deficiency, and depletion of resources, environmental pollution, poverty and quality of life.

The recognition of the biosocial economy as an alternative route for restructuring post-recession economy may lead to resolving most critical problems of modern society (in social, ecological and economic aspects). The materialisation of these aspects requires corporate and social responsibility, biotechnological innovations, and sets the foundations for the mechanisms of Biosocial Economy.

The transition assumes a special practical effort towards replacing the traditional economic techniques with bio-economic ones, drawing optimisation models suitable for conditions of global climatic changes and creating biosocial clusters from local to international levels.

Expected effects of employing the biosocial economy should be viewed in the three dimensions: socio-economic, economic-ecologic, and socio-ecologic:

- Diversification in the Agricultural sector and as a result unemployment reduction and increased well-being;
- Lowering of production costs and quality enhancing;
- Widening of the markets and creation of new value adding chains;
- Rural development;
- Diversification of energy and food risks, decrease in resource loads;
- Prevention of environmental pollution, reduction in greenhouse gas emissions and other damaging chemicals;
- Adaptation of economies to climatic changes;
- Quality of life growth, health hazards reduction via improved environment;
- Preserving biodiversity.

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