

Circular economy and "green technologies"

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Abstract. The feature of the circular economy is the restorative and closed nature of the production cycle with the "green" nature-like technologies application which reduce greenhouse gas emissions, slow down the temperature rise on the planet and preserve the environment. The circular economy approaches correspond to the concept of goal-setting of the United Nations Organization in the mainstream of sustainable socio-economic development and are widely used in the countries of the European Union. As a part of their research, scientists have defined a circular economy as the economy which involves the total multiple processing of the resources applied and provides energy savings. In this regard, the circular economy is called "green", i.e. preserving the natural resources of the planet and the environment on the basis of information technology. Currently, there is enough evidence that circularity has begun to permeate linear economics and that innovative products and contracts are already available in various forms.

1 Introduction

Currently, the tendencies of humanization and human-centricity in the development of socio-economic systems of different levels are becoming fundamental [1, 2]. The next phase transition of the world economy was discussed by the countries of the United Nations (UN) at the international economic forum in Davos (Switzerland) in 2016. The protection of the environment and the fighting against climate change were the main questions in the field of sustainable development. At the same time, goals were formulated which ensure economic growth and liquidation of poverty, an increase of well-being while simultaneous protecting the planet from the negative influence of the consequences of economic activity.

At the present stage, there is an aggravation of global environmental problems, such as the reduction of biodiversity and pollution of the natural environment. The lack of universally introduced environmentally neutral technologies causes pollution of the atmosphere, water bodies, as well as the increase of waste production [3, 4]. In this regard, the disturbance of natural balance occurs, what will call into question the further development and prosperity of mankind.

The indicator of air pollution is the growth of greenhouse gas emissions and the associated global warming process. To solve this problem, today "green" technologies are actively promoted and developed, which are designed to reduce greenhouse gas emissions and slow the rise of the temperature on the planet. The reason for the pollution of water bodies and soils is the increasing volumes of waste production, as well as the lack of its

proper disposal. This is connected with the reverse side of progress. Humanity throws out 1.3 trillion tons of waste annually, most of which are kept on landfills, what leads to the poisoning of the entire ecosystem [4]. Despite the existence of individual variants for solving the problem of waste generation, for example, such as recycling waste or using waste by burning to produce electricity, these methods of waste management are common mainly in developed countries. In developing countries, such technologies are lacking, what negatively influences both the health of the local population and the environment. This situation inevitably leads to the destruction of natural technologies.

In searching the way out of the global crisis, at the end of the last century, organizations appeared which were developing concepts for the transition to global equilibrium. For example, in 1968 such an organization was the Club of Rome, organized by the Italian industrialist Aurelio Pecci. The idea of global equilibrium was presented in the first report "The Limits to Growth" under the direction of D. Meadows to the Club of Rome in 1972 [5].

2 Methods and Materials

In recent years, the concept of a circular economy has attracted increased attention. This concept is defined as an economy which is restorative and regenerative in its design and is aimed at products' maintenance, components and materials at their maximum usefulness and value at all times, separating the technical and biological cycles. It is conceived as a continuous positive development cycle which preserves and enhances natural capital, optimizes resource yields and minimizes systemic risks by managing final stocks and renewable flows. It works effectively at any scale. This economic model is tended to ultimately separate global economic development from final resource consumption.

The circular economy is oriented on the implementation of the approach which ensures the return of unused resources to production and their reuse in a new quality. Currently, research conducted by the Ellen MacArthur Fund has provided enough evidence that circularity has begun to permeate into linear economics and that it has gone beyond a proof of concept - a number of businesses are already flourishing on it, and politicians are recognizing the economy's circular potential to achieve key political goals. Innovative products and contracts designed for the circular economy are already available in a variety of forms, from innovative materials and products (such as biodegradable food packaging and easily disassembled office printers) to pay-as-you-go contracts (for example, tires). Obviously, what these examples have in common is that they focus on optimizing the overall system performance rather than the performance of a single component [6].

The convincing business foundation for a circular economy presented in a study by the Ellen MacArthur Fund allows to paraphrase the discussion on speed of transition. This speed, in its turn, determines the cost of the transition. Transition expenses can include investment in assets or investment in the new digital infrastructure, R&D, retraining, support to facilitate market penetration of new products, or temporary support for affected industries. Accelerating the transition to a circular economy beyond normal replacement cycles will increase these transition expenses and create non-recoverable assets. It remains to be assessed to what extent these costs are additional compared to other development scenarios and to what extent they can become a stimulus for economic stagnation. Undoubtedly, there are risks to consider in a systemic transition like this. Existing industries will have to adapt their business models, and the transition to these business models can create a redistribution effect in the economy. Balancing the redistributive effect of the changes that the implementation of a circular economy can produce for consumers, businesses, and countries will be crucial.

While companies play a key role in the transition to a circular economy, governments play an equally important role. Indeed, successfully addressing the systemic restructuring of the production and consumption model which has dominated the past 250 years requires a clear agreement of demand, supply and policy. This means that governments must use their powers to form market conditions nationally and even globally to create the proper conditions for changing. It also means that they are implementing a circular economy in their own large organizations and supply chains through such areas as state procurement. According to a recent study by Accenture and United Nations, 83 percent of business leaders believe that governments are to activate their efforts to create a favorable environment for business sustainability efforts. These leaders also believe that only with more active government intervention (at the global, national, and local levels) can sustainability move from individual to gradual achievements of collective and transformative impact. They also want clear policies and regulations which can ensure the long-term stability of investment, to accelerate the pace of change and increase the volume of investment. And they call for active intervention by governments and politicians (in collaboration with business) to agree public policy with sustainability at the global, national, and local levels, including the adoption of important regulatory, standards, and tax measures [7, 8].

In the mainstream of sustainable socio-economic development, circular economy approaches correspond to the UN goal-setting concept and are widely used in the EU countries. This is facilitated by the existing legal regulation, economic motivation of states and financial stimulation for investment projects carried out for the development of a circular economy, both in the EU countries and in other developed countries which support resource-saving and nature-like technologies [7].

A closed cycle of economic activity is mostly acceptable in such types of activities as recycling of waste and used products or recycling the application of direct virtual technologies (books, cinemas, museums and exhibitions), the application of indirect virtual technologies (online stores, services); incorporation or inclusion in the process of other participants of the cycle; the application of a variety of virtual financing mechanisms (including PPP); flexible differentiation of participants, consumers and financial instruments; remanufacture of components and refurbish of products and some others [8]. These types of activities can be realized in a mass scale only within the framework of «Industry 4.0».

Within the circular economy, closed production cycles combine both the processes of direct supply of raw materials and reverse flow processes which serve the application and consumption of finished products, as a result of which waste is generated.

The demand of modernity, the current state of the environment, the interests of mankind, put on the edge of survival, dictate to scientific communities around the world the necessity to study the prospects for the development of a circular economy. According to studies [11, 12], based on the analysis of the number and location of scientific publications on the described problem, results were obtained which show the interest to this topic in different countries. These studies revealed the following pattern: the more extensively the environmental aspects are integrated into the various directions of state policy, the more researchers are engaged in this problem investigation [12]. The leaders are China and the European Union, while Russia currently has only three or four researchers strongly involved in this activity.

However, the scientific literature also highlights the problems and limitations associated with the concept of a circular economy, [13], consisting mainly in the differentiation of approaches to the "green" technologies' application, taking into consideration the peculiarities of the economic development of individual countries, limited natural

resources, lack of information base for joining efforts and coordination of actions of producers and consumers of products, etc.

3 Analysis, Results and Discussion

Innovative and technological orientation, rational nature management, humanitarian maintenance and the reduction of such global environmental threats as global warming and waste pollution of water, soil and air are considered to be the main advantages of the circular economy. The principles of the circular economy, seeing great prospects in it, are shared by the world's leading consulting companies - McKinsey, Ernst Young, KPMG, Deloitte, PWC. One way or another, such global corporations as the MacArthur Foundation, Philips, Ellen, Statoil, Unilever, Accenture, etc. have included in their strategies the approaches of the circular economy. Denmark, Scotland, and Finland are striving for global leadership in the newly formed circular economy. China is undertaking serious development programs in this area. The principles of the circular economy, because of its great prospects, are shared by the world's leading consulting companies - McKinsey, Ernst Young, KPMG, Deloitte, PWC. One way or another, such world-wide corporations as the MacArthur Foundation, Philips, Ellen, Statoil, Unilever, Accenture, etc. have included in their strategies the approaches of the circular economy. Denmark, Scotland, and Finland are striving for global leadership in the newly formed circular economy. China is taking serious development programs in this sphere.

The main risks of a circular economy are its difficulty, manufacturability, complexity, as well as the cost of implementation at the first stage. It is necessary not only to change individual elements of the economic model - a complete structural and ideological reorganization is required, including the consciousness of both consumers and producers of goods.

Products with the longest life cycle are the basis of the circular economics. In this regard, the production of goods should be carried out taking into consideration the full volume of recyclable materials, which must be designed and made with high quality [14].

At the same time, motivated by getting momentary benefits, many manufacturers do not seek to incur extra production costs - this is a problem of regulatory government, corporate and tax procedures. The factors which negatively affect the development of "green" technologies can also include the requirements of the fashion industry and established consumption patterns in the society. In addition, the opposite effect of the digital economy can also be attributed to the explosive growth in the production of rare earth metals used in electronics, since all chains of creating a "green" product must be digitized.

According to the report of the Center of Strategic Research (CSR) at the Russian Export Center (REC), the Russian Federation in 2018 ranked 72nd in the world in terms of exports of goods and services per capita. At the same time, in Russia, in such industries as the nuclear, defense and space industries, there is a large unrealized potential, which consists of modern technologies, patents and know-how, and human capital with appropriate professional competencies. [15].

In this regard, according to the CSR experts, Russia is able to almost equal the export of products realized in the "Industry 4.0" format with the volume of raw materials export and multiply the volume of non-primary non-energy export of goods and services by 2025.

4 Conclusions

The adequate understanding of the conditions for increasing economic growth and separating it from the consumption of natural resources, especially in the sphere of big

business, is currently the most important problem of the world community. It is necessary to solve this problem in the next decade, since according to some estimates, by 2050, as a result of the dominance of a linear model of economic development, further excessive consumption of natural resources and the ongoing aggravation of environmental problems will inevitably lead to a resource crisis, natural disasters and put humanity on the verge of survival. In this regard, at the present stage, the main driving force of world technological progress is the approaches and principles of a circular economy that ensure the application of "green" technologies, which can be realized by organizing the production process, taking into consideration the full volume of recyclable materials.

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