

THE FINANCIAL EDUCATION - PART OF CORPORATE SOCIAL RESPONSIBILITY FOR EMPLOYEES AND CUSTOMERS

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Abstract: Nowadays, some categories of the population tend to become economically vulnerable because of a complex set of factors, which include insufficient financial education. The paper consists in an analysis on the importance of financial education as a tool for reducing the vulnerability of the population, detailing key components of this component of corporate social responsibility and highlighting the efforts made on this issue at international level and in Romania. On the one hand, the companies develop financial education programs for employees so that they reach a certain level of wealth and to be able to provide a decent living even after retirement. On the other hand, other categories of financial education programs targeted are banks' clients (customers) and potential portfolio investors on the stock market. The article also highlights the relevance of financial education in the broader context of the Romanian consumer protection, drawing a few lines of action required in this area. From the results recorded internationally on financial education for certain categories of stakeholders, the authors propose and analyze the specific situation of the Romanian economy. In our country, the main promoters of financial education are banks which conduct various social responsibility programs to familiarize the population with specialized terms, raising awareness of customers about the risks posed by credit products offered by financial institutions. Efforts should be intensified and concerted by banks considering that in our country, about half of the population is not banked and a quarter is considered to be

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over-indebted. Financial education to familiarize the population with banking products must be completed taking into account the other components of the financial market - namely capital market and insurance market, so people are able to invest the savings available for financial gain during active life and to achieve a certain level of financial stability so necessary after retirement.

Keywords: *financial education, banks, corporate social responsibility, financial vulnerability*

JEL Classification A2, G2

Introduction

Worldwide, there is a shift in consumer behavior taking into consideration the actions of many stakeholders and the pressures exerted at international level. The consequences are multiple and are targeting lifestyle changes and adoption of a new values system (Sima, 2014, Volosevici, 2013). Behavior change does not only imply the orientation to green products or goods made by socially responsible companies, but also a financial accounting and increased financial capability of consumers who must adapt to the challenges imposed by the spectacular development of the financial market and the international financial crisis. Intensifying competition among banks and between banks and exchanges led to the emergence of many new financial products by hedging or speculation, characterized by a high degree of complexity. We observe an increased accessibility of financial products for small investors. Availability of complex financial products on the retail market could generate major difficulties in investment management (Lusardi, Mitchell, 2007).

Placing savings can be achieved by individuals within the banking or capital market operations both by spot or derivatives contracts (forward, futures or options). Investors need to understand and evaluate the major differences that exist between the two markets regarding the investment risk and the direct relationship between risk and return of financial products. Since the risk of losing the invested money exists, the retail customers should be aware that they have to invest only the money saved, even if the stock market offers attractive opportunities such as buying on margin. These transactions show the complex mechanisms of implementation, and specific leverage can manifest itself not only in a positive sense, but also negatively, resulting in considerable losses. Therefore, the financial education should target both the savings and the realization of investments.

International concerns regarding improvement of financial education

In another train of thoughts, the financial education must rely on the concerted efforts of public authorities and private companies which, with specific tools, should consider increasing consumers' awareness on the importance of financial problems. A starting point is launching a national strategy for financial education. Some steps have been taken in this area since, since OECD launched an international programme on financial Education in 2003 and promoted the development of national strategies globally. The initiation of this work is carried out at intentional level taking into consideration the need to protect consumers in a market characterized by a high degree of complexity and instability; in addition, the irrational financial behavior has repercussions on consumers' quality of life. The lack of a certain financial stability for consumers cause chain reactions not only in companies that will not have prospective clients but also in public authorities who will have to support the disadvantaged population. Hence, the need for a public-private partnership to support financial education of children and young people and employees taking into account not only short-term stability objectives, but the long-term ones in order to prepare their retirement.

Given the target group, financial education strategies must be designed on two levels:

- school education; so besides the financial authorities, the ministry of education should be involved in developing and implementing specific school programs;
- lifelong learning, which implies different stakeholders like governmental authorities, consumers, financial expert, financial institutions.

In the European Union, the authorities' efforts have resulted in the development of national strategies for financial education generally sustained by financial market authorities, central banks or finance ministries. The leading role in this area is played by the United Kingdom and Ireland, but notable efforts are also made in countries from previous communist regimes such as the Czech Republic and Hungary where the need to increase the level of financial literacy is more importance because the education regarding specific market economy is at low levels. Studies conducted worldwide (Lusardi *et al.* 2010) have demonstrated that the level of financial education has connection with that development level of a country, but knowledge of certain financial aspects have particularities in each country. Thus, in like Japan, consumers do not know much about inflation because this country was faced with the phenomenon of deflation. The same situation occurs in countries like Russia and Romania, where the inflationary phenomenon was not known during the centralized economy.

Considering the factors that led to the financial crisis but also international scandals involving various financial institutions there is a noticeable decline in public trust in the financial system. For this reason, the financial education programs implemented by authorities and financial institutions must have a new component namely increasing consumer confidence in the financial market with beneficial effects on stability and growth. So, the endogenisation of financial knowledge is an important factor for the welfare of the consumers.

National financial education strategies should be based on inclusiveness, cooperation and continuity. So, the educational programs must:

- cover all segments of the population, all financial products and services, but approaches must be differentiated by age, gender, income, etc.
- be based on the cooperation between private and public entities like financial supervisors, public authorities, companies, universities and schools.
- require a complex implementation, because the financial education must be a lifelong learning process that must be adapted to the evolution of financial market.
- be adapted to specific target groups taking into account the differences between men and women, rural and urban people, employees and the self-employed on the one hand and the non-employed on the other hand (Lusardi, Mitchell, 2007, Lusardi *et al.*, 2010). Also, studies conducted worldwide have shown relevant and specific geographic differences in the case of countries like Italy, Romania or the USA and ethnic differences observed in the USA in Afro- American and Hispanic communities.

Financial education programs can and divided into three categories (Fox, Bartholomae, Lee and Jinkook 2005):

- general programs aimed at improving financial literacy and addressing topics such as budgeting, saving, and credit management,
- specific programs encouraging saving process, including the initiation of saving and retirement plans,
- specific programs for the purchase of a house (these programs are considered first financial education programs carried out in the US considering the provisions of the Housing and Urban Development Act of 1968).

The low rate of national savings can be considered a signal of poor financial education of people on the labor market. In literature, it is post-War increase in saving by Japanese households have some determinants like extensive educational and promotional campaigns (Bernheim, Garrett, 2003). Studies conducted mainly in developed countries stressed the limitations of the impact of financial education on

saving. For example, B.D. Bernheim, D.M. Garrett suggest in their work (2003) “the response to education may vary systematically across the population”. There was an increase in the saving process due to financial education programs for people who previously only saved less.

Key-aspects of Financial Education and Consumer Protection in Romania

According to international studies, financial education in Romania is very low, as Romania ranks the 124th of 143 in a global ranking by Standard & Poor’s Ratings and ranking last among the EU countries (Rangu, 2016).

In 2009, the World Bank published a Review on Consumer Protection and Financial Literacy in Romania which was based on a set of international good practices as a reference point (World Bank, 2009a). The review assessed five segments of the financial sector: banking, securities, insurance, private pensions and non-bank credit institutions, concluding that although the basis for consumer protection and financial literacy exists, further efforts are needed to strengthen this framework.

The 2009 World Bank Report on Romania highlighted the need for action in this field from all stakeholders (World Bank, 2009a): national agencies, professional associations, regulators and supervisory agencies.

The second part of the same report (World Bank, 2009b) suggests that a national survey of the levels of financial literacy is required in order to define and evaluate a national program of financial education.

The World Bank Report on Romania also highlighted the role of the National Bank (BNR) in identifying customers complaints in this field and the lack of effective consumer awareness or literacy campaigns (World Bank, 2009b) at that time.

As financial institutions have expanded their activity in Romania in the last decade, the number and the complexity of products increased, but customers are relatively poorly informed or trained to use them.

In this context, measures for consumers financial education aim at increasing the population capacity to take sound financial decisions so as to reduce the level of indebtedness and increase the overall use of financial services in terms of lower risk, and educating existing or potential customers and specific vulnerable groups such as young customers in financial difficulty, card users, customers buying their first home, low-income clients etc.

The main measures for consumers' financial education imply training, information and advice, delivered through various public educational institutions, regulatory bodies, financial and banking institutions, NGOs, mass media etc.

As the study "The level of financial literacy of Romanians" commissioned by the Romanian Banking Association (ARB) and conducted by GFK Romania shows, more than half of "bancarised" population carried out no offer comparison before buying a financial bank product, while only 41% of respondents declared they fully read the contract (GFK, 2011). Eight out of 10 users of banking products read the contract at least partially, of which 80% say they have found little or no lack of clarity in the document.

Also, half of respondents in this study believe that educational institution should provide financial literacy for the population, followed by mass -an media and banks, taking responsibility for financial education.

The Romanian Banks Association (ARB) underlines the fact revealed by the conclusions of specialized studies on the level of financial education in Romania: there is a low degree of consumer financial education and a reduced ability to make financial decisions in an informed manner. As also stated at international level, ARB considers that regulation is insufficient without adequate information so that financial education (provided at a dedicated website by this institution - <http://www.educatiefinanciara.info>) and hence awareness should gain priority.

Also providing information regarding the consumer financial protection through a dedicated website, the Romanian Banking Employers Council (CPBR) considers that one of his its important missions consists in actively participating in assisting groups interested in financial education in order to contribute to the development of a healthy economic society and that financial education should start from an early age, to help children be better prepared for their life of adults.

In Romania, the National Authority for Consumer Protection (ANPC) is the central authority in the consumer protection field, but given the complexity of its activity, the available resources to cover all areas are limited.

There is an extensive legal framework governing consumer protection in the financial system. The key laws and provisions relating consumer protection in the financial system include:

- Ordinance no. 21/1992 on consumer protection;
- Emergency Ordinance no. 50/2010 on consumer credit;
- Law no. 148/2000 on advertising;

- Law no. 193/2000 on unfair terms in contracts concluded between traders and consumers;
- Ordinance no. 51/1997 on leasing operations and leasing companies;
- Decision no. 105/2007 regarding the processing of personal data carried out in the evidence systems of credit bureaus.

The national consumers protection framework also incorporates non-governmental organizations focusing on defending consumers' rights and legal interests on the financial market as well. Besides other attributions, consumer associations provide tools for consumers' financial education, developing and implementing projects for consumer education and information, and representing consumer interests in consultative bodies organized at central and local level.

Following the alarming results of nationally and internationally studies conducted on Romanian population, as well as the recommendations of the World Bank, a series of steps have been taken at the national level improving financial education and consumer protection in this area .

In this regard, The Association for Consumer Protection in Romania (APC Romania) collaborated with ANPC as initiators and partners in the National Program for Financial Education "Family Budget", participating in drafting the National Strategy for Financial Education, together with the National Bank of Romania, commercial banks and with the support of the Ministry of National Education and Scientific Research (MENCS). In 2010, APC Romania announced the re-launching of www.bugetulfamiliei.ro website, which was been completely restructured.

Another important consumer association at national level, The National Association for Consumer Protection and Promotion of Programs and Strategies in Romania (ANPCPPSR – InfoCons) created a dedicated website: <http://buget.infocons.ro/> on three major areas: budget, credit and savings.

Following an ANPCPPSR initiative, the Advisory and Consulting National Center was created in 2013, in partnership with the National Bank of Romania. In the project, consumers have access to a single phone number - 021.9615, for complaints in the banking field; consumer information and advice are given free of charge and help them make arrangements for alternative dispute settlement between consumers and banks.

In recent years, financial education has become a priority for all actors in the financial market (banks, authorities) which became constantly concerned about this issue, combining their efforts in order to raise awareness for the population.

In this regard, the BNR and the MENCS are currently running a project implementation at primary school level, introducing "Financial Education" as optional subject. As a result of the project, the discipline was gradually introduced in schools and auxiliaries/promotional materials were developed. Starting in the 2015-2016 school year, the project was extended to the entire primary education (including preparatory class, first and second grade).

The Financial Supervisory Authority (ASF) was founded in 2013 as an autonomous administrative authority, contributing to an integrated framework of operation and supervision of non-bank financial markets, of participants and operations within these markets. The ASF is concerned with enhancing financial consumer protection, by including within its duties the contribution to improving the financial education of the public (through its Consumer Protection Department). Along with relevant consumer protection associations, as well as those in the financial services industry, the ASF established a Consultative Group to achieve better collaboration regarding consumers protection and their financial education.

Five years after the initial study, the 2016 GFK study for Romania on financial education shows that the use and the knowledge of financial products have increased from 2011, but less than half of the consumers possess advanced information on term deposits, savings account, credits, contributions to privately managed mandatory pension or investments in shares, bonds, investment funds.

Although the interest in banking products increased in 2016, the knowledge of financial terms related to financing products remained relatively constant compared to 2011 and, overall, the survey data underlines the fact that Romania still is in great need of financial education (Oprescu, 2016).

Conclusions

At present, many consumers tend to be vulnerable to financial engagements due to their low level of financial literacy, which generates high risks and serious consequences for their economic welfare. So, there are many costs generated by financial ignorance and many consequences on quality life of employees/consumers.

Global and national context requires adequate initiatives and policies focused on financial education and consumer protection, complementing regulation and supervision framework for the financial market.

On one hand, the consumers must be aware of the importance of some decisions like the purchase of a house, using a bank loan or the set up of an investment plan. A problem could arise from the consumers' overconfidence regarding their financial knowledge. There are consumers that are not seeking out professional advice. Taking

account these considerations, many companies have initiated financial education programs in order to improve the knowledge of the employees in this field. These programs are focused on retirement investment plans, because the transition from active life to retirement raise some challenges related to the occurrence of medical problems and the desire to preserve the previous standard of living .

On the other hand, the financial institutions must have an ethical behavior and must offer consumers all information regarding their products and also proper and responsible advices. In addition, the financial market authorities must fulfill all the obligations of supervision and control of this market that is characterized by a high degree of complexity and dynamism.

Whereas financial markets become more complex in the last decade, strengthening financial consumer protection started to benefit from increased importance internationally and nationally, and, as a consequence, financial education is considered necessary tool for ensuring both adequate levels of investor and consumer protection and the proper functioning of financial markets.

Relevant stakeholders - governments, credit market participants, social and business partners – play a specific role in financial education and awareness raising.

We assist to the proliferation of financial products that are unsuitable, unnecessarily, costly or abusive for some categories of consumers.

Toxic financial products affect vulnerable consumers, cause market instability and loss of consumer confidence and impair the functioning of financial markets. That is why ensuring financial consumer protection through financial education is a basic pillar for public confidence and financial stability. The financial education programs should not be limited to transmitting information but should help consumers become aware of the quality and quantity of information held in relation to the complexity / toxicity that presents financial products.

The consumers should be made aware of the importance of financial education as a life-long pursuit.

References

- Bernheim, B. D., & Garrett, D. M. (2003). "The effects of financial education in the workplace: Evidence from a survey of households." *Journal of public Economics*, 87(7), 1487-1519.
- Cambir, A., & Vasile, V. (2015). "Material Dimension of Life Quality and Social Inclusion". *Procedia Economics and Finance*, 32, 932-939.
- European Banking Authority, (2016a). *Consumer protection and financial innovation*, available at <https://www.eba.europa.eu/regulation-and-policy/consumer-protection-and-financial-innovation>
- European Banking Authority, (2016b). *EBA Consumer Trends Report 2016*, 21 June 2016.

- European Credit Research Institute, (2006). *Consumer Financial Capability: Empowering European Consumers*, available at http://www.ecri.eu/new/system/files/FinCap_Workshop_1_papers.pdf
- European Commission, "First Meeting of the Expert Group on Financial Education", (2008), Brussels, *National Strategies for Financial Education Report*
- European Parliament, (2014). *Consumer Protection Aspects of Financial Services*, Directorate General for Internal Policies, IP/A/IMCO/ST/2013-07 February 2014, available at <http://www.europarl.europa.eu/studies>
- Fernandes, D., Lynch Jr, J. G., & Netemeyer, R. G. (2014). "Financial literacy, financial education, and downstream financial behaviors". *Management Science*, 60(8), 1861-1883. Financial Literacy and Education Commission, *Promoting financial success in the United States, National Strategy for Financial Literacy 2011*
- Fox, J., Bartholomae, S., & Lee, J. (2005). "Building the case for financial education". *Journal of consumer affairs*, 39(1), 195-214.
- GFK, (2011). *Nivelul de educatie financiara al romanilor*, report commissioned by the Romanian Banking Association, available at <http://educatiefinanciara.info/wp-content/uploads/2015/03/Studiu-GFK.pdf>
- Lusardi, A., Mitchell, O. S., & Curto, V. (2010). "Financial literacy among the young". *Journal of Consumer Affairs*, 44(2), 358-380.
- Lusardi, A., & Mitchell, O. (2007). "Financial literacy and retirement preparedness: Evidence and implications for financial education". *Business economics*, 42(1), 35-44.
- Nica, E. (2015). "Public Administration as a Tool of Sustainable Development", *Journal of Self-Governance and Management Economics* 3(4): 30-36.
- Organisation for Economic Co-operation and Development, (2009). *Financial Literacy and Consumer Protection: Overlooked Aspects of the Crisis*, June 2009, available at <http://www.oecd.org/daf/fin/financial-markets/financialconsumerprotection.htm>
- Opreescu, S., 2016. *Educatia financiara prin reglementare*, June 2016, available at <http://www.ibr-bri.ro/site/wp-content/uploads/2016/05/Sergiu-Opreescu.pdf>.
- Popescu, G. H. (2015). "Sustainable Development and the Implementation of Citizen-oriented Services", *Journal of Self-Governance and Management Economics* 3(4): 70-78.
- Rangu. C. M., (2016). *Educația financiară – o necesitate*, mai 2016 <http://i0.1616.ro/media/2/2621/33306/15437958/2/calin-rangu.pdf>
- Rodica, I. D. (2014). "Financial Performance In Credit Institution Management". *Annals-Economy Series*, 354-357.
- Rutledge, S.L., (2010). *Consumer Protection And Financial Literacy : Lessons From Nine Country Studies*. doi:10.1596/1813-9450-5326, available at <http://elibrary.worldbank.org/doi/abs/10.1596/1813-9450-5326>
- Sima, V. (2014). "Green Behaviour of the Romanian Consumers". *Economic Insights-Trends and Challenges*, 3(3), 77-89.
- Volosevici, D. (2013). "Corporations-between Governance and Social Responsibility: the European Commission Approach". *Economic Insights Trends and Challenges*, 124-135.
- World Bank, 2009a. *Romania - Diagnostic review of consumer protection and financial literacy : Key finding and recommendations*. Washington, DC, available at <http://documents.worldbank.org/curated/en/316551468032370749/Key-finding-and-recommendations>
- World Bank, (2009b). *Romania: Diagnostic Review of Consumer Protection and Financial Literacy, Volume 2. Comparison against Good Practices*. Washington, DC., available at <https://openknowledge.worldbank.org/handle/10986/12916>
- Zaman, G., & Vasile, V. (2014). "Economic-financial and Social Vulnerabilities of Romania in the Period 2013-2020". *Procedia Economics and Finance*, 15, 4-18.

ECO-INNOVATION PROMOTING THE CIRCULAR ECONOMY IN ROMANIA

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Abstract: *The development of eco-innovation parks in our country may be a key to regional as well as national sustainable development, due to their special features and opportunities for industrial synergy. Implementing a circular and green economy is also a current important challenge to a systemic transformation agenda in the European Union. Therefore, a main objective of this paper is to analyse from the viewpoint of the circular economy principles (closing-the-loop in the resource management) the strategic role of eco innovation parks as a community of manufacturing and service enterprises seeking enhanced environmental and economic performance through collaboration in managing environmental and resource issues including energy, water, and materials. In this respect we analyse both the conceptual and practical importance of eco-innovation for the circular economy and point out the character of the industrial ecosystem, as a regional metabolism in fostering both eco-innovation and industrial synergy of the SMEs and organisations involved. The case studies and conclusions recommend the urge to identify, design and plan industrial ecosystems within an eco-innovation park as an important way promoting circular economy on regional, microeconomic and sectoral scale in Romania.*

Keywords: *sustainable development; circular economy; resource efficiency; eco-innovation park; industrial symbiosis*

JEL Classification: O44; O47; Q32

1. Introduction

In this paper we have resumed our research in the fields of sustainable economic growth, resource-efficiency and eco-innovation, by adopting a new research objective: grounding and analysing the concepts, principles and implementation issues of the circular economy. The secondary objective of this paper is a deeper analysis of the eco-

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innovation and eco-innovation park' potential to play a decisive and major role in the transition to a green economy in Romania, by implementing industrial symbiosis as a high form of circular economy.

This reinforces the strategic role developing eco-innovation parks as industrial ecosystems for the manufacturing and service enterprises and the local authorities seeking enhanced environmental and economic performance through closer collaboration in managing environmental and resource issues.

We detail some of the characteristics and relationships for the green economic growth, focusing on the concepts of circular economy, eco-innovation, eco-industrial parks, resource efficiency industrial synergy. Special attention is given to the concept of circular economy, as one of the revolutionary paradigms of sustainable economic development and a priority of the EU policy agenda.

Based on our previous research outcomes which have proved a direct, positive correlation between the number of existing eco-innovation parks EInvP and the national level of resource productivity (as a macroeconomic indicator of the resource-efficiency) in European countries included in the analysed sample (Frone Simona, 2015), a deeper analysis emphasizing especially the synergic features of the eco-innovation parks (EInvP) in re-cycling and re-using the resources, so closing-the-loop as desired in the circular economy.

The methodological approach will be based on literature review, mostly on some European Commission documents, our recently published theoretical and empirical research findings to be reanalysed and developed from a new viewpoint, and on a case study. In the case studies we give examples of good practice, with the first circular economy workspace and with the ecosystem of industrial symbiosis in Suceava, which, according to our conceptual framework, may be considered an eco-innovation park.

The theoretical and empirical outcomes of previous research, the current analysis and synthesis, the data analysis in tables and graphs or figures and the evidence from the case study referring to the enhanced resource-recovery and other significant environmental and socio-economic performances within the ECOREG eco-innovation park support the research objectives of the paper.

2. Conceptual research framework

2.1. General background concepts

Sustainable development now involves carrying out a green economic growth. This new paradigm is due to the fact that, as stated in the strategic documents for economic

development (EC COM(2011) 571 final), sources of minerals, metals and energy, as well as stocks of fish, timber, water, fertile soils, clean air, biomass, biodiversity are all under pressure, as is the stability of the climate system.

If we carry on using resources at the current rate, by 2050 we need, on aggregate, the equivalent of more than two planets to sustain us, and the aspirations for a better quality of life will not be achieved. To avoid this unsustainable outlook, resource-efficient economy is strongly required, close to ideal concepts like a 'green economy' or a 'circular economy' (Frone Simona, Frone D.F., 2015) for promoting a systemic transformation in the way resources flow through the economy and society, as we shall further analyse in detail.

This approach leads to the need of a deeper analysis and understanding of the eco-innovation, eco-innovation parks and industrial ecosystems, as some important concepts related to the complex changes paradigm required by the green economy (Frone Simona, 2015). The green economic growth presents an alternative to the conventional economic paradigm of resource exploitation and is built around a theory of growth that integrates concepts such as the sustainable use of natural resources, including greater energy and resource efficiency and improved natural capital as drivers of growth.

The general methodological approach (Table 1) is based on literature review and mostly on some own recently published theoretical and empirical research findings, to be reconsidered and developed from a new viewpoint.

Table 1 - General background concepts of the present research

| Concept | Definition or characteristics |
|--------------------------------------|--|
| Sustainable development | "Development that meets the needs of the present without compromising the ability of future generations to meet their own needs."— from the World Commission on Environment and Development's (the Brundtland Commission) report, <i>Our Common Future</i> (Oxford: Oxford University Press, 1987) |
| Eco-efficiency (Resource-efficiency) | Eco-efficiency may be acknowledged as a more general expression of the concept of resource efficiency , minimizing the resources used in producing a unit of output ,and resource productivity ,the efficiency of economic activities in generating added value from the use of resources. Eco-efficiency is achieved through the delivery of "competitively priced goods and services that satisfy human needs and bring quality of life while progressively reducing environmental impacts of goods and resource intensity throughout the entire life-cycle to a level at least in line with the Earth's estimated carrying capacity"(WBCSD). |
| Resource productivity | Resource productivity is defined as the ratio of GDP to domestic material consumption. Domestic material consumption measures the total amount of material directly used by an economy, such as biomass products, metal ores, |

| Concept | Definition or characteristics |
|-------------------------|--|
| | fossil fuels, non-metallic minerals, petroleum resources etc. and is equal to domestic material extraction plus imports minus exports. |
| Industrial ecology (IE) | Industrial ecology explores the assumption that the industrial system can be seen as an ecosystem. Industrial systems, just as natural ecosystems, can be described as a particular distribution of materials, energy, and information flows. Furthermore, the entire industrial system relies on resources and services provided by the biosphere, from which it cannot be dissociated. Industrial ecology suggests using the design of natural ecosystems to guide the redesign of industrial systems and offers opportunities and solutions to turn industrial parks into eco-industrial parks. |
| Circular economy | In a circular economy, the value of products, materials and resources is maintained in the economy for as long as possible, and the generation of waste minimised. It is an essential contribution to the EU's efforts to develop a sustainable, low carbon, resource efficient and competitive economy, ultimately the green economy (COM/2015/0614 final). |
| Green economy | In a green economy the growth in income and employment is driven by public and private investments that reduce carbon emissions and pollution, enhance energy and resource efficiency, and prevent the loss of biodiversity and ecosystem services. The UNEP working definition of a green economy: an economy that results in improved human wellbeing and social equity, while significantly reducing environmental risks and ecological scarcities. In its simplest expression, a green economy can be thought of as one which is low carbon, resource efficient and socially inclusive (UNEP, 2011). |

Source: Own synthesis mainly based on references.

As we see in Table 1, the green economy requires step changes in resource efficiency, investment in clean technologies, new alternative products, services and materials, and the ability to obtain value from the unavoidable waste (UNEP, 2012).

In this paper, with the theoretical and empirical approaches employed there is argued more on the need to acknowledge and better understand the concept and aim of the circular economy (a feature of the green economy) designed to close the loop in product life cycles by keeping as many resources in the economy as possible, thereby reducing waste and promoting sustainability (EC Panorama, 2016).

2.2. The circular economy as a feature of the green economy and a strategic development principle in the European Union

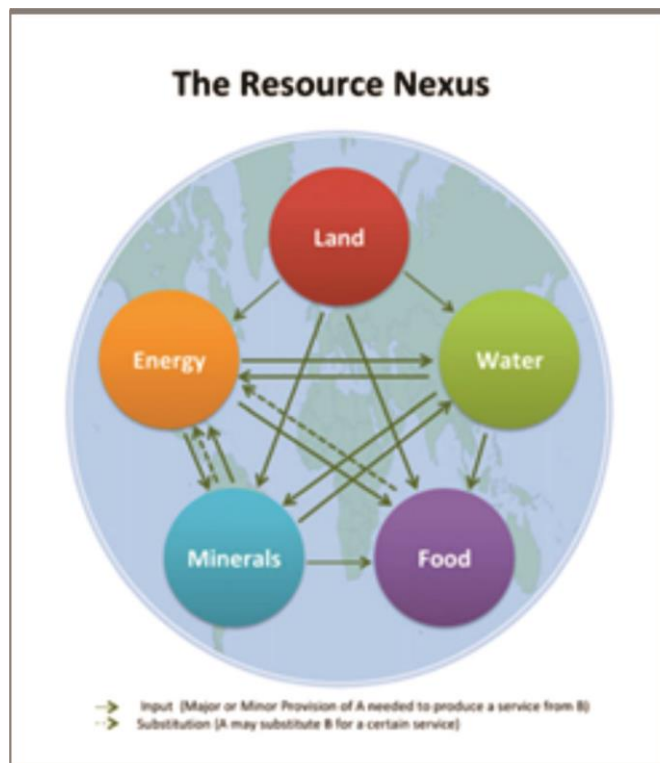
Green economy aims at sustainable management of environmental resources, based on the belief that our biosphere is a closed system with finite resources and a limited capacity of self-regulation and self-renewal.

As suggested in Frone D.F., Frone S., (2015) the global resource nexus model is very suggestive of a green (circular) economy model and especially of our topic, since the importance of the sustainable management of natural resources and of their increased resource-recovery and efficiency is better acknowledged.

To be followed and analysed carefully, the resource nexus (Blesichwitz R.*et al.*, 2014) is a conceptual model that illustrates the interconnections between and among different resources (Figure 1); in other words, it visually displays that one resource (or more) is used as an input to produce another resource.

This is well suggested in Figure 1 since the legend specifies: a black continuous arrow from resource A to resource B shows that an amount of A is needed to produce a service from B; a black discontinuous arrow from resource A to resource B shows that A may substitute B for a certain service.

Figure 1: The global resource nexus model



Source: Figure 1 in (Blesichwitz R.*et al.*, 2014).

By analysing the global resource nexus model (Figure 1) we notice some striking features and ideas:

- since all the environmental and natural resources of the planet are so interconnected and our economy relies on them, the sustainable development is required for the global survival and welfare, in the long run.
- there are some natural resources, such as water and land, which are really critical and may not be created and replaced by any others.
- only more efficient production processes and better environmental management systems may save water and other resources, and can significantly reduce pollution and waste.

The green economy is called to implement a more systemic and holistic socio-economic mechanism taking into consideration the sustainable management of the environmental and economic assets to preserve the ecosystem services and to ensure increased welfare of the planet.

According to an expert study (Szyja P., 2016), creating a green economy is aimed at achieving the following objectives: increase in energy and raw materials efficiency; reduction in greenhouse gases (especially carbon dioxide); reduction of pollution resulting from production processes; increase in energy security; mobilizing the innovative potential; acquiring new competitive advantages.

As a feature of the green economy, circular economy the re-use of resources in products whose shelf life has come to an end or which have lost their usefulness to construct new objects, the same quality or even better. The circular economy model may be the ideal solution for relaunching sustainably the European economy which has faced problems in recent years (2008-2012).

The principles of a circular economy support ideas and mechanisms for increased competitiveness and economic growth in the European Union, by: creating new business and job opportunities; transforming and revamping the processes of consumption for better efficiency; the correct management of resources.

Therefore, the European Commission launched in December 2015 the ambitious **Closing the loop – An EU action plan for the circular economy** (COM/2015/0614 final) as a package of measures to develop the circular economy. It is believed that by stimulating sustainable activity in key sectors and new business opportunities, the plan will help to unlock the growth and jobs potential of the circular economy. Nevertheless, although the action plan focuses on “action at EU level with high added value”, implementing the circular economy will still require “long-term involvement at all levels, from Member States, regions and cities, to businesses and citizens”. Member States

(including Romania) are invited to play their full part in EU action, integrating and complementing it with national action.

The circular economy requires an innovative approach to production and consumption that offers the savvy entrepreneur significant opportunities (EC Panorama, 2016). As we further argue in the paper, we consider that the Eco-Innovation Parks and the industrial symbiosis within provide such an innovative approach to production and consumption which really increases the business, innovation and development opportunities for all the green-aware enterprises and authorities in an area or a region.

The EC action plan for the circular economy (COM/2015/0614 final) actually states that it is important to promote innovative industrial processes. For example, industrial symbiosis allows waste or by-products of one industry to become inputs for another. In revised proposals on waste, the Commission proposes elements to facilitate this practice, and will engage along with Member States to help ensure a common understanding of the rules on by-products.”

Innovation will play a key part in the systemic change for the circular economy. In order to rethink our ways of producing and consuming, and transforming waste into high value-added products, we need new technologies, processes, services and business models shape the future of our economy and society.

The Horizon 2020 work programme 2016-2017 includes the initiative: "Industry 2020 in the circular economy", which will grant over €650 million for innovative demonstration projects that support the objectives of the circular economy and industrial competitiveness in the EU in a wide range of industrial and service activities, including process industries, manufacturing, and new business models.

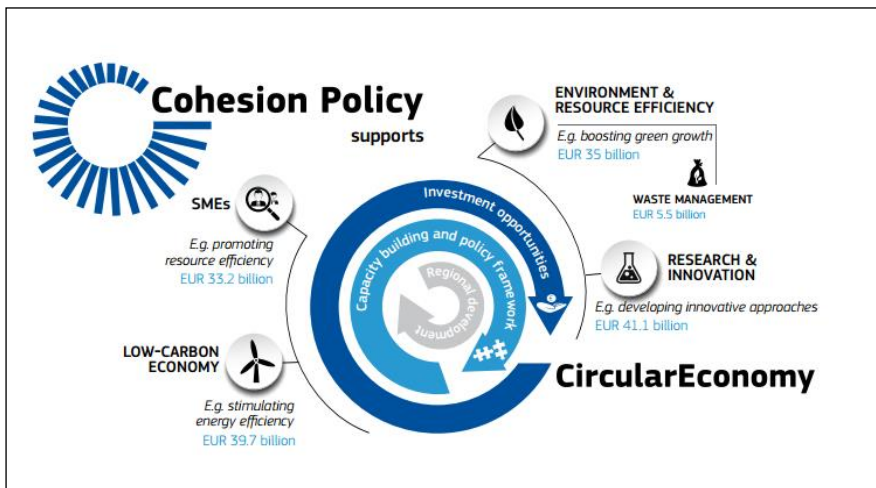
The EU Cohesion Policy funding can support its objectives, according to some important provisions of the Action Plan. The European Commission supports regions through, for example, the Smart Specialisation Platform which provides professional advice on the design and implementation of their research and innovation strategies for smart specialisation. The platform also helps facilitate interregional cooperation on issues related to innovation for the circular economy – and in specific areas like industrial modernisation (EC Panorama, 2016).

Cohesion Policy funds are directed towards a growing number of programmes supporting the circular economy, including support for reuse and repair, improved production processes, product design and SMEs (Figure 2):

- for Research and Innovation projects, the funding will be the most important, amounting to 41.1 billion Euro;

- for Environment and Resource efficiency programmes, the funding is up to 35 billion Euro;
- for the dedicated SME projects, the funding is up to 33.2 billion Euro;
- for developing the Low Carbon economy, the Cohesion funding is up to 39.7 billion Euro.

Figure 2. Mechanisms and policies of the EU Cohesion policy promoting the circular economy



Source: EC Panorama Autumn 2016/No.58, pg.18

The Commission will assist Member States, regions and local authorities in strengthening their circular economy approach in this context through targeted outreach (COM/2015/0614 final).

2.3. The role of eco-innovation for developing and implementing a green (circular) economy

In a green economy, all the economic organizations and stakeholders must develop the ways and vectors that will assure more efficient production processes and more performant environmental management systems. These developments are called to significantly reduce pollution and waste, to save water and other critical natural resources and ecosystem services.

In this respect, technological innovation could become the cornerstone of minimizing pollution and, at the same time, the key to global sustainable economic development [Constantinescu A., Frone S., 2014]. Moreover, when looking for a balance between aspirations towards sustainability and locally existing possibilities to implement it, other important concepts have resulted: eco-innovation, eco-innovation parks, industrial synergy.

Eco-innovation is a principle that combines economic growth, employment and sustainable development in an integrated manner as required by the Lisbon Strategy.

This economic growth can create green gains for society provided a long-term vision regarding issues of resource conservation and of the environment and strong support from both the public authorities and citizens.

Eco-innovation is indeed a pillar of the green economy, having a double valence, both for ecological and economic accounting: a way to improve the protection of the environment; a way to increase the efficiency of resource use, contributing indirectly to increasing economic competitiveness.

Also stated by Frone D.F., Frone S., (2015) resource-efficiency is a main paradigm behind the green and circular economy system that optimizes the flow of goods and services to get the most out of raw materials and cut waste to the absolute minimum.

In previous papers we focused on the theoretical and methodological features of eco-innovation as a driver of sustainable economic development (Constantinescu Andreea, Frone Simona, 2014), and also on eco-innovation parks (EInvP) as vectors of transition to a green economy.

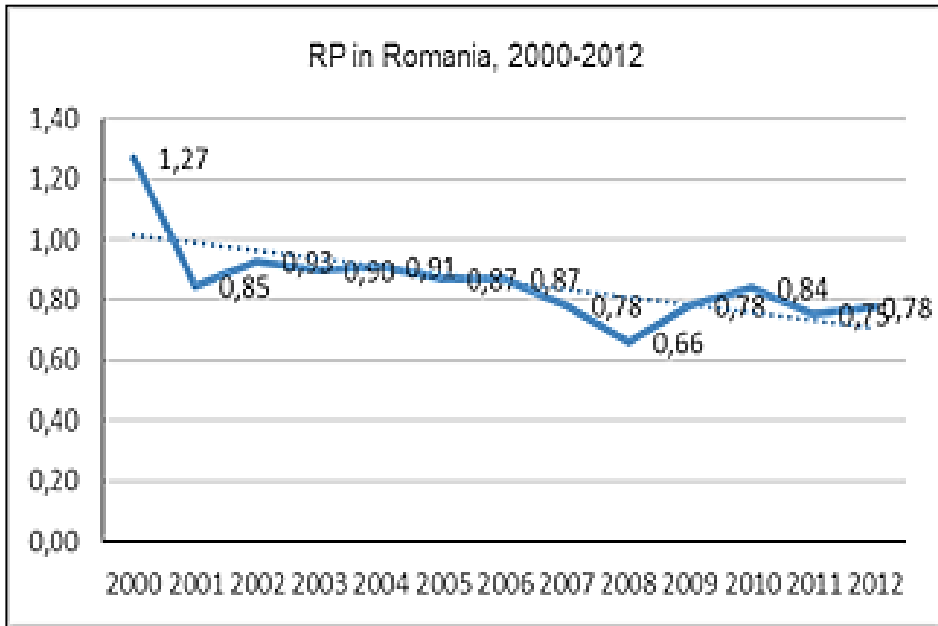
Here we would like to analyse the role of the eco-industrial and eco-innovation parks as regional metabolisms and industrial ecosystems, developed by grouping several SME-s in a certain area in order to let them share some technological eco-innovation facilities, as well as to put them in a relation of industrial synergy, leading to waste recovery and recycling as a resource, eventually improving the resource efficiency and productivity on the microeconomic as well as the sectoral and regional scale.

The concern for improved resource efficiency is crucial since the issue of low resource productivity (RP) in Romania is striking, as we showed in previous research papers. We notice (Figure 3) that over the period 2000-2012, the evolution in Romania of the resource productivity RP indicator development was quite significant and the overall trend is undoubtedly downward.

For the entire period considered (2000-2012), the overall resource productivity (RP) in Romania remained low, and even decreased more (with 38, 6% in 2012 as compared to 2002, see Figure 3). Since this downward RP trend in Romania was registered

simultaneously with an upward trend of the RP in the EU27, in 2000-2012, the resource productivity gap in Romania compared to the EU average has increased, missing the 2013 objective of the National Sustainable Development Strategy (Frone S., Frone D.F., 2015).

Figure 3 - Resource productivity (RP) evolution and trend in Romania, 2000-2012 (Thousand lei/t, 2005 prices)



Source: Own computations in Frone S., Frone D.F., (2015).

In the strategic efforts for a sustainable development, the motto "to achieve more quality goods and services with less consumption of natural and social resources" has become a common goal for many companies and the technological solutions adopted (Zaman G., 2014). Therefore, as a reaction to the latest economic as well as environmental challenges, some specific concepts have been developed and implemented in the last 20 years, especially in advanced economies such as the western EU.

Industrial areas are still underpinning economic development in many countries and can provide leadership in the area of environmental performance and resource efficiency by eco-innovation in the introduction of better environmental practices, because of their

provision of common infrastructure, their links with government institutions or by influencing the local suppliers due to their position in the global supply chain.

So it is important to acknowledge (see Table 2) the characteristics and the importance of the new concepts developed for the regional (spatial) dimension of the green economy.

Table 2 - Concepts of spatial eco-innovation and green (circular) economy

| Concept | Definition or characteristics |
|-----------------------------|---|
| Eco-innovation | Eco-innovation is any form of innovation aiming at significant and demonstrable progress towards the goal of sustainable development, through reducing impacts on the environment or achieving a more efficient and responsible use of natural resources, including energy. Collaboration among project partners (private and academia) for research and development is an important element for eco-innovation. |
| Eco-industrial park | An eco-industrial park is a community of manufacturing and service businesses seeking enhanced environmental and economic performance through collaboration in managing environmental and resource issues including energy, water, and materials. By working together, the community of businesses seeks a collective benefit that is greater than the sum of the individual benefits each company would realize if it optimized its individual performance only (Lowe, 1997). |
| Industrial symbiosis | Industrial symbiosis (IS), as part of the industrial ecology research field, focuses on the flow of materials and energy from local and regional economies. Industrial symbiosis traditionally engages separate industries in a collective approach to a competitive advantage involving physical exchange of materials, energy, water, and/or by-products as well as services and infrastructures shared at the industrial park scale to reduce environmental impact and overall production cost (Mansard, 2011). The factors for industrial symbiosis are collaboration among actors and the synergistic possibilities offered by geographic proximity (Chertow, 2000). |
| Eco-innovation park (EInvP) | The term eco-innovation park is used to define both, eco-industrial parks and eco-innovative areas combining residential and industrial activities. Eco-innovation parks are optimized from an environmental point of view (e.g., piloting installations and processes that incorporate environmental technologies and services) and are open for continuous improvement (e.g., collaboration with institutions of research and development). |
| Industrial ecosystem | The broadest application of industrial ecology's analogical approach is to describe manufacturing complexes as "industrial ecosystems". This idea suggests a web of interaction among companies such that the residuals of one facility become feedstock for another. Industrial ecosystems aim to minimize inefficiencies and the amount of waste created by mimicking natural ecosystems in industrial systems. |

| Concept | Definition or characteristics |
|---------------------|---|
| Regional metabolism | Within this concept, the assessment of ecosystem services can be integrated and based on the ecosystem approach and can form a unified framework of various insights dedicated to saving the environment. It opens the possibility of describing in detail the links between ecosystem services auditing and economic sectors they support. By binding the problem of the ecosystem services management to a regional metabolism functioning, we can choose the most appropriate strategy to adapt them to the conditions represented by a territory. |

Source: Own synthesis mainly based on references.

According to a comprehensive dedicated study (ERA-NET ECO-INNOVERA, 2014) all these concepts, methodologies and procedures may be considered as eco-innovation when applied to an industrial or combined (*i.e.* urban and industrial) area.

Another paper concerned with the academic entrepreneurship and scientific innovation in the context of bio-economy strategy (Pipirigeanu M. *et al.*, 2014) has stated that: “the current biodiversity loss is huge, increases every year, but many people are not aware of this at the moment. In general, structural changes to green business systems are not noticeable from one year to another (unless major environmental accidents and short term). Subsequently, eliminating disturbing factors, the natural environment can recover.”

Therefore, eco-innovation designed for an entire area or regional metabolism would enable a systemic response to the sustainable development and green economic premises. Thus one of the most important concepts for the new paradigm of green economic growth and resource efficiency improvements is the industrial symbiosis (industrial ecology, industrial ecosystem) approach.

A recent outstanding study dedicated to the regional endogenous development in the case of Romania (Zaman G., Georgescu G. *et al.*, 2015) outlined that an important part of the regional development programmes, in the post-crisis period should support the innovation and diversification of the local economies. This should be done especially by: boosting private investment in the fields of RDI, achievement of synergy among active RDI institutes at the regional level and the needs of local business communities, implementation of innovation activities in enterprises as well as stimulating the innovative activities and technology transfer from the universities or innovation centres towards the productive sector.

To link the premises for regional endogenous economic growth to the sustainable development and green economy trends and issues, we shall emphasize the role of

eco-innovation, as the particular type of innovation, in the regional green and circular economic development.

The collaborative patterns in industrial areas, also known as eco-industrial networks, industrial symbioses or industrial ecosystems, *are a type of eco-innovation applicable the scale of an eco-industrial park.*

Consequently, the eco-innovation parks (EInVP) are basically eco-industrial parks (EIP) which also embed research and development institutions pro-actively involved in technological innovation dedicated both to economic and environmental objectives, such as the increase in resource-efficiency (see the descriptions or definitions in Table 2).

In what follows we analyse more deeply the features of the EInVP as a regional metabolism and industrial ecosystem, implementing circular economy in a region.

3. Eco-innovation promoting the circular economy in Romania

3.1. Issues and trends of the eco-innovation in Romania

While the issue of poor or inefficient resource management was signalled in the previous edition, it is important to point out that the last EIO Country Profile report on Romania specifically raises the issues of barriers to and drivers of circular economy and eco-innovation in Romania.

According to the latest EIO Country Profile (EIO, 2015), Romania ranks 18th in the Eco-Innovation Scoreboard (Eco-IS), obtaining a score of 87.1. This indicates it is below the overall EU-28 average score 13%. However, it is encouraging that our country has advanced three positions since 2013, from of 21st to the current rank.

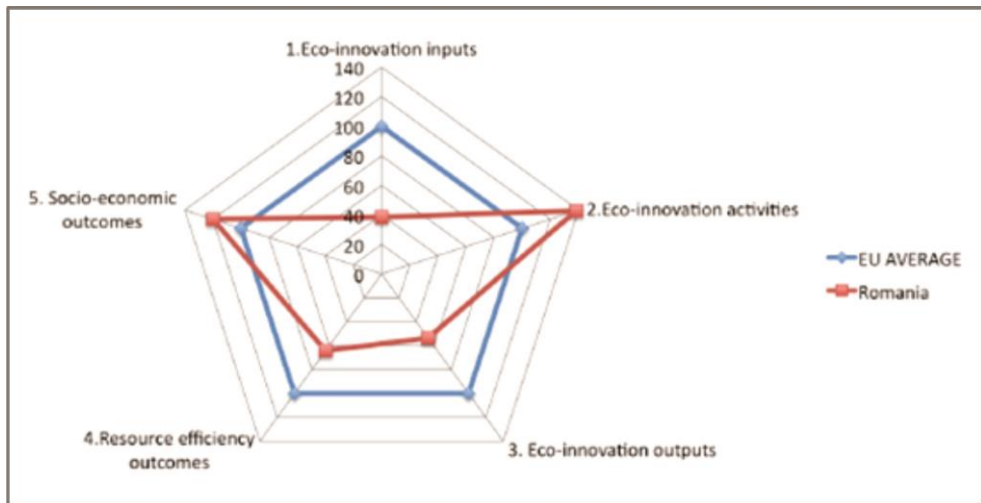
The best accomplishment is the fact that Romania ranks above the EU average in terms of eco-innovation activities, with an average score of 138 (38 points above the EU average score of 100). This is a positive improvement as against 2013, and the high score may be observed in Figure 4.

As reported in EIO 2015, in Romania, the positive results of eco-innovation activities are driven by a third indicator measuring the irms' interest in standardisation of their environmental management. According to the 466.3 companies per million inhabitants with an ISO 14001 certification in 2014, Romanian companies place a high importance on observing environmental management requirements.

Unfortunately, Romania's performance in achieving resource efficiency is stagnating, according to the latest data, as the economy remained on average 40% less resource efficient than the EU. As we notice f Figure 4, the highest contribution to the progress of

Romania's eco-innovation score is given only by some eco-innovation activities and the socio-economic outcomes.

Figure 4 - Components of the eco-innovation composite index for Romania, 2015



Source: Figure 2, page 4 in EIO 2015

Material (resource) productivity compares GDP generated relative to material consumption, measured in euros per kilogramme (EUR/kg), which amounted to 0.66 EUR/kg in 2013. The (EIO, 2015) report confirms some of our recent research outcomes (Frone S., Frone D.F., 2015) in showing that due to the increase in EU-level average material productivity, the gap is widening between the Romanian and the EU average (EU reached 1.93 EUR/kg average resource productivity in 2013).

There are also some other important features of the Romanian economy resource efficiency to be considered for eco-innovation in the transition to the green economy. According to the EIO 2015:

- the energy productivity, calculated as GDP relative to energy consumption and measured in euro per ton of oil equivalent (EUR/toe), is above EU average and has been rising, amounting to of 8.9 EUR/toe (108% of the EU average of 8.3 EUR/toe) in 2011. This evolution is due to the Romanian energy market, reaching a surplus production in 2014.

- the GHG emission intensity is somewhat higher in comparison to the EU average, amounting to 0.4 units of CO₂-equivalent emissions generated per unit of GDP. The EU has a level of 0.35 CO₂ - equivalent emissions per unit of GDP in 2013.

Due to more data available for Romania, the total score for socioeconomic outcome is now 20% above EU average performance (Figure 4). There are two indicators composing this sub-index which have improved due to the increased data availability and are not comparable to previous EIO reports: the employment in eco-industries is 4.26% of total employment in Romania in 2014, and this level places Romania at 68% above the EU average level of 2.53% of total employment in 2014; the eco-industries' revenue in Romania is also above EU average, at 2.99% of total revenue across sectors, as compared to the EU average turnover of eco-industries amounting to 2.2% of total turnover in 2012.

After reviewing these figures maybe more important are the identified trends in the selected circular economy and eco-innovation areas in Romania.

An important issue raised in EIO 2013 was that the Romanian SMEs were less likely to adopt measures to improve their resource efficiency in comparison to the EU average and had a low propensity to collaborate. These are important challenges for a systemic transformation agenda in the European Union such as the circular and green economy.

According to the most recent report EIO 2015 Romania's eco-innovation system can be broadly characterised in terms of push and pull factors acting in opposition. Indeed, there still is:

- a low level of investment in basic infrastructure and framework conditions for recycling, waste management and resource efficiency;
- low input into R&D from the public and private sectors.

The Green Business Index 2015, measuring the companies' environmental responsibility for 2014 (Green Revolution, 2015) provided a deeper analysis of the eco-innovative and environmental behaviour and approach of the Romanian enterprises. The main issues in the report include the following:

- Companies show weak environmental awareness and weak levels of transparency and communication on environmental issues. However, they increasingly make use of ecological product design, in spite of low uptake of environmental labelling.
- In terms of cost assessment, companies do not measure or do not want to declare the costs and benefits obtained through their environmental management practices.

- The surveyed companies do not monitor the resource use systematically, so they are not able to take measures to improve their environmental performance.
- A notable change is the increase in companies' use of renewable energy sources. Now 9.3% of the surveyed companies predominantly use renewable energy sources, while for 18.5% of the companies, less than 50% of their energy use comes from renewables.
- The majority of the surveyed companies (57%) do not use recycled resources as production materials at all, while for another 16.3%, recycled resources make up less than 2.5% of their production materials.
- A rising number of companies started implementing waste management policies: 83% in 2014, which is an increase of 15% compared to 2013. Although all of them also have a policy for minimising their waste production, but only 60% took actual measures. However, this trend is a promising one, towards more sustainable use of resources.

On the other hand, confirming the previous findings that eco-innovation activities are on the rise in Romania (EIO, 2013), there are islands of eco-innovation at the grass-root level that have gradually accumulated. They have the potential to reach the critical mass, and possibly have positive spill - over effects on further fields of economic activities in time.

While grass-root initiatives provide an indication of the economic potential and dynamism of the field, they generally need larger-scale investment and support to have a significant impact.

Nevertheless, after Romania's EU accession in 2007, the European Union Cohesion funding have been an important source of public investment in Romania, fostering some eco-innovation and green reforms. Some of the results of this funding are worth mentioning, according to the EIO 2015:

- The Competitiveness Sectoral OP 2007-2013 was an important funding source for eco-innovation and circular economy-related projects. For instance, the programme provided investments for 56 projects (either finalised or running in 2016) that use biomass, hydro-energy, solar, wind and biofuels as energy generating resources
- The Environment Sectoral OP 2007-2013 funded the majority of the environmental infrastructure investments. For example, by the end of 2015, it supported projects related to diminishing GHG emissions in the energy sector by investing €237 million in energy production from non-polluting sources; provided €2.2 billion to projects

related to modernising water and wastewater treatment facilities; and €500 million to projects in the waste management sector.

Indeed, as a conclusion to previous research, Romania's ability to provide efficient infrastructure and environmental services, both nationally and locally, is an important factor stimulating and supporting sustainable economic development. Therefore, besides providing water security for socio-economic development, the investments in environmental infrastructure funded and implemented within the Environment Sectoral OP 2007-2013 are much needed and expected in the national economy in view of complying with the EU Environmental Acquis.

However, a preliminary analysis shows, for instance, that due to significant challenges in analysing the correlation between water infrastructure and economic development and the peculiarities of the water supply and sanitation sector in Romania, the economic and environmental efficiency and sustainability of the Cohesion funded SOP Environment infrastructure investments has still to be further analysed and proved.

From the viewpoint of the green economy as a feature of sustainable development, we shall resume here the research on the importance of investment in environmental and business infrastructure, for fostering the regional scale eco-innovation able to provide for eco-innovation parks and industrial ecosystems eventually promoting a circular economy in Romania.

3.2. Industrial symbiosis in eco-innovation parks promoting a circular economy

Collaborative patterns in industrial areas, also known as eco-industrial networks, industrial symbioses or industrial ecosystems, are a type of eco-innovation applicable on the scale of an eco-industrial park, turning them into eco-innovation parks (EInvP).

The main conclusion of our approach in Frone Simona, (2015) was based on a regression model showing that in the 16 European countries of the analysed sample there is a positive correlation between the number of existing eco-innovation parks (EInvP) and the national level of resource productivity (as a macroeconomic indicator of the resource efficiency).

Based on the ERA-NET ECO-INNOVERA 2014 survey we have observed also the three main categories of benefits from eco-innovation parks, which are inter-connected, national, sectoral and local, public and private benefits:

- I. The reduction of natural resource consumption and pollution, consisting in: the reduction of energy and material inputs on the plant and the park scale; increased

material productivity for economic players; reduction of waste and emissions to the environment on the plant and the park scale.

- II. Significant economic benefits, resulting from synergic mechanisms: resource efficiency generating additive revenue for economic actors, providing cost savings and reducing the market dependence of non-renewable and imported resources; participation in eco-innovation projects gives businesses a competitive edge on the growing green market; adaptability and flexibility to regulatory changes.
- III. Sustainable regional development, since eco-innovation parks EInvP contribute to the strength of regional economies by fostering innovation and diversity on local and regional scales; eco-innovation strategies reduce the region dependence on non-renewable resources and thus increase its resilience to shortage in supply

In this section, the case-study analysis of the ECOREG (a pilot EInvP in the Suceava County) aims to provide evidence for the actual dimension and realization in these categories of green and complex environmental, economic and social benefits provided by the EInvP.

Also important from the view point of the current research is the key feature of the eco-innovation park in which material flow exchanges (or industrial symbioses) generally encompass other eco-criteria as well, in particular energy efficiency, waste and water management, so leading to an almost exponential growth in the local resource-efficiency, for all the clustered companies.

This inner mechanism of the EInvP closing-the-loop of resource use in a region deserves further attention due to the outstanding green economic growth impact and will be analysed and detailed. The role eco-industrial parks, namely eco-innovation parks EinvP, is not limited to their potential of increasing the resource efficiency but also to implementing and making the new modern synergic and circular business models work.

To foster eco-innovation in eco-industrial parks, several tools have been developed to store and analyse data on material and energy flows. Most focus on supporting the identification of potential networking and industrial symbiosis, few of them including functionalities for project management and technical assessment or integrating geographical information systems (Grant G.B. *et al.*, 2010).

An "Industrial symbiosis engages diverse organisations in a network to foster eco-innovation and long-term culture change. Creating and sharing knowledge through the network yields mutually profitable transactions for new sourcing of required inputs and value-added destinations for non-product outputs, as well as improved business and technical processes". (Lombardi D.R. & Laybourn P., 2012)

It is important for SMEs to be part of an EInvP (eco-innovation Park) and engage in such industrial symbiosis, since it provides a means to improve competitiveness and build resilient and sustainable economies. Eventually, industrial symbiosis helps businesses and organisations to operate in the same way as the natural eco-system where everything has a place and function, and nothing goes to waste. Whether working at company level, within a region or multiple regions, or at national level this eco-system based approach is considered.

Our research also recommends to study the EInvP as regional metabolisms, since as stated in Frone S., Constantinescu A., (2015) the ultimate purpose of the regional metabolism is eco-efficiency, which may indicate the quality of the entire process and on the other hand, represent a guarantee for the willingness of the business and community to restore the health of our habitats. Such regional metabolisms are inspired by of the new theory of Industrial Ecology (IE) designed to enable transformation of the traditional model of industrial activity into a more comprehensive model by which regional economies can be assembled in an industrial ecosystem composition, so the residues of some companies can be used as inputs for others. In addition, industrial ecosystems can be organized around product or material supply chains and/or in defined geographical areas.

A tendency toward planned and facilitated industrial symbioses is widely observed in industrialized and even in some emerging economies like India or China. Many private and government-led experiences are intending to facilitate inter-firm collaborations: in Switzerland, the strong political support fostered the establishment of a policy framework for material, water and energy exchanges within the city of Geneva; in the United Kingdom, the National Industrial Symbiosis Program (NISP) supports companies in diverting waste from landfills by facilitating of collaborations.

Since the National Industrial Symbiosis Programme (NISP) has become a world-known leader and consulting partner in creating and developing industrial eco-systems we should mention it first as European good practice of EU reference, serving as a model for other regional eco-innovation parks, such as the ECOREG in Romania (further analysed).

The NISP was developed in 2005 in the United Kingdom as an 'independent facilitator' to help businesses in various sectors and of various sizes come together to find uses for unwanted materials, aiming to divert significant waste loads from landfill and produce bottom line benefits for companies through reduced disposal costs and new commercial opportunities, by sharing assets, resources, logistics and expertise.

According to the (NISP_Factsheet, 2009), the National Industrial Symbiosis Programme is regionally based, facilitating material exchange over a given geographic area. The twelve UK regions have output targets and all results are externally verified.

Since the launch of NISP in 2005, the programme has: diverted more than 5.2 million tonnes of industrial waste from landfill; eliminated 357,000 tonnes of hazardous waste; prevented the use of 7.9 million tonnes of raw materials; prevented the use of 9.4 million tonnes of industrial water; delivered member cost savings of £131 million; generated £151 million in new sales for the members. This is actually a proof of the important dimension of the circular economy in the U.K. and it is probably still growing (NISP_Factsheet, 2009).

Hence, according to the expertise of the National Industrial Symbiosis Programme (nisp-ecoreg.ro), an efficient industrial metabolism cannot be achieved at the level of a single unit. By coupling two or more units, the material and energy flows become interconnected and various options for recycling matter and energy may emerge. Every surplus becomes a “resource” that the unit can recuse, sell or transfer to another production cycle, usually based on commercial agreements.

In practice using industrial symbiosis as an approach to commercial operations – using, recovering and redirecting resources for recuse – means resources remain in productive use in the economy for longer. This, in turn, creates business opportunities, reduces demands for the earth’s resources, and provides a stepping-stone towards creating a circular green economy.

In the following we shall refer to some successful and pioneering circular economy enterprises or industrial eco-systems already working in Romania, as good practices and pilot projects to serve as example and to raise awareness for eco-innovation and circular economy.

For instance, in the EIO 2015 report, the first circular economy workspace in Romania is considered QUIB, a project developed with the help of the European Social Fund, promoting cradle-to-cradle design and circular economy production principles. All of the products developed here are made of recused materials without generating waste. Since opening in 2015, the centre has supported 100 makers to develop 125 products out of 430 tonnes of reused materials.

The services offered by the QUIB centre include support for product design and prototyping, access to a full range of equipment for wood, metal and textiles processing, and several advanced technical tools such as a 3D printer, a CNC router and laser printer. It also offers various creativeness and technical design classes.

According to the EIO 2015, there are several issues to be learned by analysing the main drivers and barriers for opening the QUIB space in the Brasov county:

- the drivers were environmental, as well as the range of economic opportunities that the circular economy offers;

- the barriers to developing the business further include the scarcity of Romanian suppliers of organic raw materials, so that the company had to import the raw materials from Germany or Italy, because businesses are hard to convince to give up materials they do not use.
- the workers are not accustomed to using as little material as possible, while the Romanian consumers place less value on the sustainability of products, but more on the design.

These issues open new directions of research to identify the actual needs and policies for educating and training the Romanian people for greener and sustainable production and consumption behaviour.

Fortunately, in our research interests, there is also a recent successful large pilot project of an eco-innovation park development as industrial ecosystem and a regional metabolism in Romania. As a case study, we shall analyse here the main features, objectives and outcome of this pilot Romanian EInvP named Application of Industrial Ecosystems Principles to Regional Development (ECOREG) in the Suceava County, according to the official reporting (nisp-ecoreg.ro).

The main objective of the ECOREG Project was to test the application of industrial symbiosis (IS) principles in the area of the Suceava County (the focal area of the project), also allowing for regional symbiotic development with the neighbouring counties. This entails the reuse of resources and by-products used from one production cycle to another, thus creating mutually beneficial partnerships between companies in various sectors.

The environmental objectives were actually the most important: a reduction in raw material consumption, energy, utilities, by 2-5 % for all units through implementing innovative tools and instruments; reduction of waste generation and pollutant emissions by 5-20% for all units; the conversion of wastes/by-products into resources (secondary materials); significant reduction of environmental impact at the level of industrial units.

ECOREG is modelled on (the previously introduced) NISP, the world's only national industrial symbiosis programme (UK) which demonstrated that industrial symbiosis has the potential to significantly reduce industrial and commercial waste and comprehensively lessen the adverse environmental impacts of a business. The ECOREG project used actual business opportunity as a mechanism for encouraging resource efficiency and its holistic approach is actively dealing with all resources including water, energy, materials, logistics, assets and expertise.

ECOREG was implemented with financial support of the European Union through the LIFE+ Programme, in the period 1st February 2009 – 1st October 2011, in the area of the

Suceava County. The total project budget was of 880 700 Euro. ECOREG was funded by the European Commission through the LIFE+ programme as part of its package to help businesses to improve resource efficiency and reduce waste.

The most important feature of the ECOREG is **the industrial symbiosis as eco-innovation implemented on the regional scale**. It is supported by the numerous industrial synergies (more than 200) identified in the area, out of which 114 have been actually implemented (nisp-ecoreg.ro).

We analyse such an industrial synergy in the following case study, namely the one identified and implemented between:

- a) SC RITMIC SRL, a SME based in Ilisesti, 18 km E from Suceava, dealing, among others, with collecting wooden waste (sawdust, chops, branches, etc.), conditioning it and selling it as bio-fuel (wooden briquettes) and
- b) SC IASIMOLD SRL, another SME located near the Moldovita Commune, Suceava County, some 100 km W from Suceava, in a beautiful landscape. The company exploits wood and completes the first stages in processing timber, producing large quantities of sawdust and wooden waste, a heavily polluted material with no economic value.

The synergy created works like that: the sawdust and wooden debris produced by SC IASIMOLD SRL are collected by S.C. RITMIC SRL's trucks, transported and directed to the wooden debris processing unit of SC RITMIC SRL in Ilisesti. The sawdust and wooden debris are turned into briquettes and sold at a price of 400 RON/ton (95 Euros/ton) at the facility gate. It is worth noting that the same briquettes are sold in supermarkets at a price of 850 RON/ton (200 Euros/ton).

The ecological driver of the industrial symbiosis is the harmful environmental impact of the sawdust and wooden debris (Adding Value to Wooden Waste 1, 2009): "Disposed of on soil, saw dust modifies drastically the soil quality and composition, by changing the Carbon Nitrogen ration in soil. Bacteria that consume carbon from saw dust consumes also the Nitrogen (essential to plant metabolism) in soil, leaving less Nitrogen for plants. The impact upon water is similar, bacteria that consumes carbon in celluloses from sawdust, exhaust the oxygen in the water, suffocating fishes and other organisms."

The life cycle analysis of the final product should be done in order to certify the circular economy system created:

- Raw material for the briquettes comes from an insidious waste that currently pollutes the forests' outskirts and river valleys in the Suceava County as well as in other Romanian Counties. As wood is the main fuel for households in the Suceava area

(together with coal of rather low quality - lignite), the collateral benefit of using sawdust briquettes is sparing virgin resources (forests).

- The processing technology is environmentally friendly, uses biomass (wooden chips) as an energy source and the only waste produced is the (benign) carbon dioxide that comes from the biomass burnt. No additives (adhesives, binders) are used in the technology that could add some inorganic or organic load to the final product and increase its environmental impact;
- During their life time the briquettes do not cause any environmental hazard and their combustion produces benign carbon dioxide and small quantities of ash that can be used as fertilizer.

There are important economic, environmental and social benefits from this industrial synergy identified and exploited in the ECOREG EInvP of Suceava:

- i. The economic benefits are significant, since SC RITMIC SRL obtains the raw material it needs at a bargain price (cost of transportation and of manipulation – uploading and downloading trucks - constitutes the major share in cost breakdown); SC LIAMOLD SRL gets rid of the wooden debris that occupies the production space;
- ii. The environmental benefits from this industrial symbiosis are even more interesting, considering the saved virgin forests in the area, as well as the biomass energy potential and the avoided CO₂ emissions (Table 3):

Table 3 - Estimated environmental benefits from the industrial synergy SC IASIMOLD SRL - S.C. RITMIC SRL

| Characteristics | Value | U.M. |
|--|---------|----------------|
| Volume of biomass involved in synergy | 380 | m ³ |
| Virgin forest resources saved | 0.437 | ha |
| Methane gas saved by the biomass produced | 35625 | m ³ |
| Total harmful CO ₂ emissions avoided | 25.5892 | tons |
| Persistent Organic Pollutants (POPs) emissions avoided | 100.32 | micrograms |

Source: Own selection and computation from ***Adding Value to Wooden Waste (5), ECOREG Project Case Study No 5, 2010.

- iii. The social benefits are also notable since the synergy keeps the present jobs in both organizations and contributes to their social role. For customers, the synergy adds important quantities of renewable biomass fuel to the market, at a convenient price, saving households money.

- iv. Last but not least, the sustainability of this industrial synergy is high, since when the price of oil and gas increases, biomass becomes the alternative at hand. On the other hand, forest management in Romania does not fully comply with international and EU rules for sustainability, since large quantities of wood are cut illegally, jeopardizing the virgin forest natural heritage of Romania (Platon V. *et al.*, 2016). In the coming years, the cost of raw wood could raise, once sustainable forest management policies are implemented, adding also to the costs of processing wood.
- v. An important feature for our research is the replication potential of this industrial ecosystem synergy between these SMEs in the Suceava County, as well as in other regions of Romania. The project description mentions in (ECOREG Case Study #05 2010 that: “the synergy is a good and straightforward solution for improving the energy of small communities and limited geographic areas. It may be replicated in small communities across 28% area of Romania covered by forests.”

The synergy presented and analysed above - between the SC IASIMOLD SRL and S.C. RITMIC SRL - is only one of the many industrial synergies working in the ECOREG project. However, ECOREG may be considered an actual eco-innovation park, since it is a spatial, regional application of eco-innovation with rich environmental, economic and social benefits to all the companies and organisations involved, as well as for the people and natural environment in that area of Suceava County.

In an overall outlook, the ECOREG project has led to the following main quantitative outcomes (nisp-ecoreg.ro):

- 1) over 200 economic and social units from various fields and industrial sectors have been included in a regional symbiotic network;
- 2) 568 resources flows and 200 synergies were identified;
- 3) 114 synergies, involving 13 waste categories were completed;
- 4) The quantity of waste involved in the synergies was of over 530.000 to, out of which: 30,000 t of construction and demolition waste; over 500,000 t wood waste; 232 t of animal and food waste; 25 t plastic waste; 20 t waste electrical and electronic equipment.
- 5) A surface of over 2,500 ha of forest was preserved, following the replacement of wood raw materials with other types of wastes;
- 6) The reduction in GHG emissions by over 130,000 t of CO₂, following the replacement of virgin materials with alternative resources.

The economic impact of implementing the ECOREG industrial ecosystem in the Suceava region is given by: reducing production costs by processing waste (cheaper

than raw materials); reducing waste disposal costs by 20 to 30% on average per company (as shown in the synergy sheets for the finalised synergies); reducing the penalties for environmental non-compliance and other economic benefits through the sale of waste.

The social impact of implementing the ECOREG industrial ecosystem is featured mainly by the safeguarding of jobs in crisis conditions strongly felt in the pilot area. Some synergies also led to the creation of jobs, with direct positive impact on one of the poorest regions of Romania (N-E). There is also a redefining of the business strategy in order to develop a new organisational culture, suited to competitiveness in a European economy.

Despite numerous constraints and over a period of economic crisis (2009-2011), the implementation of the ECOREG project proved successful in setting up an Industrial Symbiosis network, in other words in implementing an eco-industrial park at the county level.

This pilot experiment must have led the ECOREG project coordinators (the European Commission, the Romanian Ministry of Environment, the Romanian Ministry of Economy) to „believe that the approach could be easily replicated in other regions of Romania before rolling out as a national programme, following the evolution of NISP in the UK” (LIFE07 ENV/RO/000690, 2011).

4. Conclusions and recommendations

For the circular economy, eco-innovation is based on centralizing knowledge about material and energy flows as an efficient tool to foster a transition from a linear industrial system to a closed-loop system mimicking biological ecosystems.

Although industrial ecology has emerged as a form of innovation required by the challenges posed by sustainable development, the principle of industrial symbiosis has been replicated and developed with much more dedication and interest during the recent global financial and economic crisis (2009-2012), its to the extraordinary potential to increase resource-efficiency and to many other related socio-economic benefits.

We strongly believe that the future implementation of industrial ecology models in eco-industrial parks will turn them into the EInvP needed for a resource-efficient, circular and green economy in the European Union and in Romania. In this respect, after having previously claimed that eco-innovation and eco-innovation parks are the vectors of transition to a green economy and their importance (Frone Simona, 2015), this paper there are analyses and highlights some of the objectives, features and principles of the

circular economy as they are implemented through industrial synergies in these very eco-innovation parks.

The eco-innovation and especially the regional eco-innovation of an industrial symbiosis will bring increased competitiveness and better management of resources over their life cycle, for all the economic entities and partnerships which are part of the industrial ecosystem.

However we have shown, by considering the recent reported trends and issues of the eco-innovation in Romania that there still is a lot to be done in order to catch-up in this field which is essential for sustainable development and systemic green economic restructuring.

It was only after Romania's accession to the European Union and with the Cohesion funding support, that adoption of the environmental acquis and of the know-how and good practice of the EU member states, as well as of the Strategy 2020 has enabled the implementation of ECOREG, a pilot project of industrial symbiosis in the Suceava County.

The objectives of the project correspond to the local, regional and national sustainable development requirements, since they are environmental, economic and social objectives. The pilot project ECOREG was drawn up for the assessment of the opportunity for a future industrial symbiosis programme on a national scale.

As the main case-study of circular economy, we have briefly analysed this Romanian project as a pilot eco-innovation park and a regional metabolism enabling the promotion of a circular economy system and a green growth in the N-E region. The official European web-site for the project description (<http://ec.europa.eu/environment/life/project/Projects>) has concluded that the ECOREG project „demonstrated major environmental benefits, as a result of developing a sustainable approach to waste and resource management. This will help Romania to recycle more of its waste, in line with EU policy. ECOREG recycled 530 000 t of waste, which would otherwise have gone to landfill, using less than €500 000 (€0.88/t)”.

A recommendation for replicating the ECOREG in other regions and for the objective of increasing resource efficiency by industrial symbiosis is applying material flow analysis to planned activities for the identification of solutions to foster resource efficiency prior to the settlement of the EInvPs' tenants.

One of the lessons learnt on promoting regional eco-innovation in Romania from the ECOREG implementation was that technical and financial evidence was required in order to encourage businesses to apply the principles of Industrial Symbiosis. However, once the synergy concept had been accepted, businesses became active promoters for

its introduction in the North-East Region of Romania and helped to remove any doubts that might have existed about the benefits of becoming a member of the programme”(LIFE07 ENV/RO/000690, 2011).

Nevertheless, there will always be quite important challenges in implementing the industrial ecosystem as a regional eco-innovation, for turning business clusters into eco-industrial or eco-innovation parks. As stressed by Deutz P. and Gibbs D., (2008), “the distinctive features of EIPs as clusters include the need for physical exchanges, which can involve complex negotiations/technical arrangements pertaining to items which for potential symbiosis partners are low priority items. For many firms these may simply be items they wish to dispose of without incurring excessive costs or uncertain liabilities. Such factors significantly add to the challenges involved”.

Since over 95% of the waste is landfilled in Romania, there still are high opportunities for developing the circular economy in Romania. As exemplified in the paper, some bottom-up civil society and private sector initiatives have indeed identified the existence of opportunities in this sector.

There are good trends in a survey of Romanian companies showing that many of them are improving their waste collection and resource efficiency policies. As based on our analysis, the wood sector of Romania has proved to be really suited for spatial industrial symbiosis, and a new direction of research is identifying other industrial sectors which may benefit from clustering in EInvP.

However, some research limitations of this paper mainly related to the methodology and the scope of research must be admitted:

- The eco-innovation composite score for Romania and the ECOREG case-study analysis are based on the official reporting, without own data collection and checking. Besides, due to the lack of other similar experiences of industrial ecosystems in other counties or regions of Romania, there was no possibility of national comparison or benchmarking.
- The scope of the research is quite limited since, for instance, the eco-innovation park and the industrial symbiosis are not grounded on detailed technical and financial evidence or on extended literature review.

Although limited to the case study and to only one industrial synergy analysis, the conclusions of this research paper reiterate our belief that planning, implementing and development of eco-industrial and eco-innovation parks are mostly needed in Romania, in view of a sustainable economic development and a path of green growth. But a proactive policy, a coordinated approach and a public management are strongly required to

sustainably develop circular economy in Romania and reap its significant advantages (including preservation of the virgin forests).

The prospects, policies and strategic approaches to implement the green economy by fostering eco-innovation in developing eco-industrial (eco-innovation) parks in Romania will be the topic of future research.

A new direction of research will be demonstrating the importance of EInvPs for increasing the economic and ecological performance of regional or county economies, through the creation and application of cross-regional (cross-county) regression models to Romania, like that applied to the EU member states.

Although seemingly very difficult to implement, such industrial ecology projects, involving a national program of industrial symbiosis in Romania are eligible for generous support from the Social and Cohesion Funds (through programmes and mechanisms supporting implementation of circular economy, as described in section 2.2) and would contribute to a balanced, endogenous and sustainable development of all the counties and regions.

References

- ***Adding Value to Wooden Waste (1), ECOREG Project Case Study No 1, 2009
- ***Adding Value to Wooden Waste (5), ECOREG Project Case Study No 5, 2010
- Bleischwitz Raimund, Johnson Correy M., Dozler Michael G., 2014, "Re-assessing resource dependency and criticality. Linking future food and water stress with global resource supply vulnerabilities for foresight analysis", in *European Journal of Futures Research*, Springer (2014) 27-40 doi: 10.1007/s40309-013-0034-1
- Chertow M. 2000: "Industrial Symbiosis: literature and taxonomy". *Annual Review of Energy and the Environment* 25, 313–337.
- Constantinescu Andreea, Frone Simona, 2014: "The role of technological innovation in sustainable economic development", Scientific Papers International Conference on Knowledge Society, in *Journal of Knowledge Management, Economics and Information Technology* 2014, Vol.4 Issue 1.1 <https://ideas.repec.org/a/spp/jkmeit/spicks14013.html>
- Deutz P. and Gibbs D., 2008: "Industrial ecology and regional development: eco-industrial development as cluster policy", in *Regional Studies*, December 2008
- EC COM(2011) 571 final, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, *Roadmap to a Resource Efficient Europe* {SEC(2011) 1067 final} {SEC(2011) 1068 final}; http://ec.europa.eu/environment/resource_efficiency/about/roadmap/index_en.htm
- EC COM(2015) 614 final: Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions Closing the loop - An EU action plan for the Circular Economy, European Commission, Brussels <http://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX%3A52015DC0614>

- EC *Panorama*, 2016: *Panorama*, No.58 Autumn 2016, European Commission http://ec.europa.eu/regional_policy/en/information/publications/panorama-magazine/2016/panorama-58-an-urban-agenda-for-the-eu
- EIO, 2013: "Country Profile Romania 2013", *Eco-Innovation Observatory*, Brussels, 2013 http://www.eco-innovation.eu/images/stories/Reports/EIO_Country_Brief_2013_Romania.pdf
- EIO, 2015: "Country Profile Romania 2014-2015", *Eco-Innovation Observatory*, Brussels, 2016 http://www.eco-innovation.eu/images/stories/2015_country_reports/romania_eco-innovation_2015.pdf
- ERA-NET ECO-INNOVERA, 2014: "International survey on Eco innovation parks. Learning from experiences on the spatial dimension of eco-innovation". Federal Office for the Environment and the ERANET ECO-INNOVERA, Bern. *Environmental studies* no. 1402
- Frone D.F, Frone S., 2015: "Resource efficiency objectives and issues for a green economy", in Scientific Papers Series, *Management, Economic Engineering in Agriculture and Rural Development* Vol. 15, Issue 3, 2015 E-ISSN 2285-3952, 133-138
- Frone S., Constantinescu A., 2015: "Ecosystem approach outcomes of a regional metabolism", *Quality – Access to Success*, 16 (S1) 56, March 2015
- Frone Simona, 2015: "The Eco-Innovation Parks: Vectors of Transition to A Green Economy", *Annals of the „Constantin Brâncuși” University of Târgu Jiu, Economy Series* Special Issue ECO-TREND 2015, 27-35
- Frone S., Frone D.F., 2015: "Importance and Trends of the Resource Productivity in Romania", in *Ovidius University Annals Economic Sciences Series*, Volume XV Issue 1 2015, 148-153
- Grant G.B., Seager T.P., Massard G. & Nies L. 2010: "Information and communication technology for Industrial Symbiosis". *Journal of Industrial Ecology* 14, 740–753.
- http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&n_proj_id=3254, ECOREG - Application of industrial ecosystems principles to regional development ECOREG LIFE07 ENV/RO/000690
- <http://www.international-synergies.com/our-approach/what-is-industrial-symbiosis/>
- LIFE07 ENV/RO/000690, 2011: LIFE+ PROJECT NAME or Acronym Application of Industrial Ecosystems Principles to Regional Development (ECOREG) FINAL Report 31/12/2011
- Lombardi, D. R. and Laybourn, P. (2012), "Redefining Industrial Symbiosis". *Journal of Industrial Ecology*, 16: 28–37. Doi: 10.1111/j.1530-9290.2011.00444.x
- Lowe E.A. 1997: "Creating by-product resource exchanges: Strategies for eco-industrial parks". *Journal of Cleaner Production* 5, 57–65.
- Massard, G., 2011. "Les symbioses industrielles: une nouvelle stratégie pour l'amélioration de l'utilisation des ressources matérielles et énergétiques par les activités économiques, Ph.D. thesis", Université de Lausanne.
- NISP_Factsheet, 2009: EU Waste prevention best Practice Factsheets http://ec.europa.eu/environment/waste/prevention/pdf/NISP_Factsheet.pdf
- Platon V., Frone S., Constantinescu A., 2016: "Challenges and innovations on the sustainable forest management in Romania; virgin forests as heritage", at the international project conference MIS ECT 2617 ALECTOR "Caring and Sharing. The Heritage Environment as an Agent for Change" 31st May-2nd of June 2016, Istanbul
- Szyja, P. (2016). „The Role of the State in Creating Green Economy". *Oeconomia Copernicana* 7(2), 207-222. DOI: <http://dx.doi.org/10.12775/OeC.2016.013>

- UNEP, 2011: "Decoupling natural resource use and environmental impacts from economic growth". A Report of the Working Group on Decoupling to the International Resource Panel. A United Nations Environment Programme
- UNEP, 2012: The Business Case for the Green Economy. Sustainable Return on Investment, United Nations Environment Programme, 2012
- Zaman G. Georgescu G. (Coordinators), Z. Goschin, D. Antonescu, F. Popa, 2015: "Dezvoltarea economică endogenă la nivel regional. Cazul României", GRIN Verlag, Open Publishing GmbH, 2015 ISBN: 978-3-668-04755-6
- Zaman G. (2014). *Repere teoretice generale ale științei sustenabilității*. Academia Română, Prelegere 3 sept. 2014