ISSUES AND TRENDS OF ECO-INNOVATION FOR RESOURCE EFFICIENCY IMPROVEMENTS IN ROMANIAN SMEs

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Abstract
As analysed in our previous publications, eco-innovation and resource efficiency are important concepts that represent strong pillars and opportunities for implementing the green and circular economy in the European Union and in Romania, as practical steps in the Sustainable Development Strategies. However, there were conclusions signalling some issues and challenges to be still tackled demanding coordinated efforts and policies at all scales.

The main objective of the research is the analysis of the SMEs eco-innovation efforts to raise resource efficiency, by implementing specific actions and investment able to play a decisive role in the transition to a green economy in Romania. Methodology is based on previous research outcomes of conceptual and empirical analysis in the areas of resource efficiency, green economy, and eco-innovation parks as well as on comparative analysis based on recent reporting. In this view, we emphasize again the positive direct correlation between eco-innovation and resource productivity revealed by recent national and international surveys as well as by own research. The conclusions and policy recommendations are that lately Romanian SMEs have become interested to adopt measures to improve their resource efficiency and have made some progress but are still lagging behind in comparison to the EU average. A chance for catching-up would be the development of more industrial ecosystems in Romania, in view of a sustainable development and a green economy.

Keywords: green economy; SME; resource efficiency; eco-innovation; industrial eco-system

Clasificare JEL: O44, O47, Q32

1. Introduction and context of the study
Eco-innovation and implementing a green development becomes a must for sustainable economic growth, based on increased resource efficiency and a circular economy. The green economic growth is no longer confined to reducing pollution, but requires, among other principles and paradigms, structural changes in the processes and in manufactured products, as well as in the type and amount of resources used.

This has determined the urge for deeper analysis and understanding of the eco-innovation and eco-innovation parks, as some important concepts related to the complex changes of paradigm required by the green economy [11].

The main objective of the research is the analysis of the SMEs eco-innovation efforts to raise resource efficiency, by implementing specific actions and investment able to play a decisive role in the transition to a green economy in Romania. The context of the research is given by the higher and higher importance given to Small and Medium Enterprises (SMEs) in the European Union as potential individual or collective vectors for implementing a green economy, through eco-innovation involving also increased resource-efficiency.

It is analysed and concluded how by increasing resource efficiency, providing circular economy solutions and participating in green markets, the Romanian SMEs involved in industrial symbiosis or other types of spatial eco-innovation can generate employment and growth as well as boost their productivity and competitiveness [10].

There is explained again the meaning and the features of eco-innovation for the circular economy and of the industrial symbiosis, focusing on the main resource-efficiency increasing actions taken by Romanian and EU SMEs. In this context, the paper presents a short analysis of the
eco-innovations and applications of industrial ecosystems principles in the European and Romanian SMSs, in order to put into evidence the fact that these actions are promoting, sooner or later, the green and circular economy in the European Union and in Romania.

Using previous significant research outcomes [12] there will be an analysis emphasizing how the Romanian SMEs part of an eco-innovation park (EInvP) may take benefit of the synergic features for re-cycling and re-using the resources, thus increasing dramatically their resource efficiency and closing-the-loop as required in the green and circular economy.

The methodology is based and develops on conceptual and empirical analysis in the areas of sustainable development, resource efficiency, green economy, industrial symbiosis, eco-innovation parks, small and medium enterprises, and eco-innovation.

2. Theoretical and methodological background

The resource-efficiency must be acknowledged as a main concept for all the ideal concepts of economy and development: sustainable development, the green economy and the circular economy, as well as the strategies dedicated to their objectives [9].

Hence, as stated in [7] the resource-efficient economy is very close to advanced concepts such as the 'green economy' or the 'circular economy'; both promote great resource-efficiency gains through a systemic transformation in the way resources flow through the economy and society, arguing that there are business and job opportunities to be had by revolutionising recycling and re-use.

The principles of a green economy support ideas and mechanisms for increased competitiveness and economic growth in the European Union, by taking into consideration the potential of the increased environmental awareness and resource efficiency for creating new business and jobs opportunities as well as a sustainable management of resources.

The "green economy" is a model that "secures growth and development, safeguards human health and well-being, provides decent jobs, reduces inequalities and invests in, and preserves biodiversity, including the ecosystem services it provides (natural capital), for its intrinsic value and for its essential contribution to human well-being and economic prosperity". [2]

In this conceptual framework, the European Commission has launched the Green Action Plan aiming to contribute to the re-industrialisation of Europe as advocated by the European Industrial Renaissance Communication (COM (2014) 14) and supported by the European Council, by enhancing SMEs competitiveness and supporting green business developments across all European regions, since significant differences in resource efficiency exist between sectors and Member States [3].

Indeed, as shown in [11], there are quite important differences between the EU member states as concerning the national level of resource-productivity, but our regression analysis based on the data-base of the eco-innovation parks in Europe, as well as on a Romanian regional case-study [8; 12] have shown indubitable evidence on the role of these most advanced EIP, namely the eco-innovation parks (EInvP) in promoting local, regional and national sustainable economic development and transition to a green economy.

The eco-innovation has the ability to maintain a balance between ecosystem services and the intrinsic economic circuits, adjusting also, by geared technical means, both the renewing of resources according to the assimilative capacity of the environment and the transactions that include ecosystem services into the economic cycle. An eco-innovation is any form of innovation aiming at reducing impacts on the environment or achieving a more efficient and responsible use of natural resources, including energy [5].

A significant concept for green development is also the spatial eco-innovation with an industrial symbiosis implemented in the industrial eco-system, while alignment of ecology to industry can foster its reorientation towards a sustainable use of resources [13].

The most interesting application of industrial ecology’s analogical approach is to describe manufacturing complexes as “industrial ecosystems”. This concept suggests a web of interaction
among industrial companies or SMEs in a region or district, such that the residuals of one facility are recycled such as to become feedstock for another.

The main green and circular economy goals of recycling are, as analysed in [8]:

- to prevent wasting potentially useful materials;
- to reduce consumption of fresh raw materials;
- to reduce energy usage;
- to reduce air pollution and water pollution;
- To lower greenhouse gas emissions as compared to virgin production.

The industrial ecosystems can minimize inefficiencies and the amount of waste created, by mimicking natural ecosystems in industrial parks.

In this paper the focus is more on the role and potential of the SMEs in finding the best ways for their green development, meaning a sustainable economic growth of their business while considering the entire regional and national economic prospects and environmental resources.

### 3. Issues and trends of eco-innovation for resource-efficiency improvements in EU and Romanian SMEs

Preventing and correcting environmental damage and moving towards a low carbon economy is a societal challenge which also offers new business opportunities for enterprises. Since technological innovation could become the cornerstone of minimizing pollution and at the same time, the key to global sustainable economic development [1], but the eco-innovation is a concept embedding more than technology.

Eco-innovation is also the introduction of any new or significantly improved product (good or service), process, organisational change or marketing solution that reduces the use of natural resources (including materials, energy, water and land) and decreases the release of harmful substances across the whole life-cycle.[12]

Yet, 'eco-innovation', just like any other types of innovation, needs a fertile ecosystem to flourish and green innovators depend on support to develop their ideas and on access to finance to implement them. The development of green entrepreneurship benefits from the proximity to knowledge institutions as well as from the availability of skilled labour and industrial relationships that facilitate cross-sectoral cooperation, conditions which enable the emergence of eco-innovative clusters that we referred as eco-innovation parks (EInvP).

Within the European Union, where Romania is a member state, the Green Action Plan for the EU builds on the Eco-Innovation Action Plan (EcoAP), which provides directions for eco-innovation policy and funding under the umbrella of the Europe 2020 strategy. A number of actions and instruments of the EcoAP are highly relevant for SMEs.

Examples are the European Innovation Scoreboard Eco-IS, the Eco-innovation Observatory, the European Forum on Eco-innovation, European Innovation Partnerships and financing instruments for eco-innovation under Horizon 2020. The actions featured in the Green Action Plan and the EcoAP are, therefore, complementary and generate important synergies.

The Eco-Innovation Index shows how well individual Member States perform in different dimensions of eco-innovation compared to the EU average and presents their strengths and weaknesses. The Eco-IS and the Eco-Innovation Index complements other measurement approaches of innovativeness of EU countries and aim to promote a holistic view on economic, environmental and social performance.

For instance, as presented in [8] according to the EIO Country Profile, Romania ranks 18th in the Eco-Innovation Scoreboard (Eco-IS), obtaining a score of 87.1[6]. This indicates it is still below the overall EU-28 average score by 13%.

Why is eco-innovation for resource efficiency improvements also important for SMEs? Eco-innovation can have a twofold positive impact on resource efficiency:

- a) it can increase the generated economic value, while at the same time
- b) it will decrease pressures on the natural environment.
An important aspect related to eco-innovation activities meant for the resource-efficiency enhancing signalled previously 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. Also in this respect, Romania’s eco-innovation system can be broadly characterised in terms of push and pull factors acting in opposition. It may be stated that there is still:

- 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.

In the Green Action Plan for SMEs (SWD(2014) 213 final) it was stressed that European SMEs are generally aware that being resource efficient is important given that 75% of SMEs in the EU have seen an increase in their costs of materials in the past five years. At least 93% of SMEs in the EU are taking at least one action to be more resource efficient which, in most cases, is a low-cost action. [3]

It is therefore important to underline that the specific resource efficiency actions taken by companies and counting also as eco-innovations are mainly the following:

1. Minimising waste;
2. Recycle by reusing waste within the company;
3. Design products that are easier to maintain, repair and reuse;
4. Sell scrap material to other companies.

Although significant shares of the SMEs in the European Union are undertaking these actions in order to become resource efficient, they are still less likely to do so than large companies (Fig.nr.1).

![Image](image-url)

**Fig. nr.1 Share of companies taking actions to become more resource efficient**

*Source: SMEs and the Circular economy. Facts from the Eurobarometer, 2017*

However, only 41% of SMEs that implement measures to improve resource efficiency have seen a reduction of their production costs, as compared to 53% of the large companies. Besides, quite many SMEs (18%) have observed slightly or significantly increased production costs. (Fig.nr.2).

This indicates the necessity to provide more guidance and consulting to SMEs on the cost-effectiveness and environmental opportunity of resource efficiency investments.
Fig. nr. 2 Impact of the undertaken resource efficiency actions on the production costs over the past two years (% - EU)

Source: SMEs and the Circular economy. Facts from the Eurobarometer, 2017

Also, as observable in Fig. nr. 2, according to a recent report [4], in the European Union the SMEs are more likely to say there has been no change (27% vs. 10%) in the production costs, as compared to the large companies, so there is not enough awareness on the importance and effectiveness of the eco-innovations for increased resource-efficiency.

There should be stressed that SMEs are quite important at the scale of the European Union, both from the economic viewpoint (representing about 99% of the European Businesses) but also environmentally. Although their individual environmental impact may be low, the cumulated impact of the SME is more than significant and should be considered for a green development.

As mentioned above, the Green Action Plan for SMEs (2014), aims to help SMEs take advantage of the opportunities provided by the green economy, and details how the European Commission works in partnership with Member States and regions to help SMEs turn environmental challenges into opportunities.

Thus a partial conclusion is that SMEs from the European Union need a favourable business environment, in which green ideas can be easily developed, financed and brought to the market, as well as more cooperation and clustering for efficient spatial eco-innovation and facilitated resource recycling and recovery.

However, another partial conclusion was that European SMEs are generally aware that being resource efficient is important: 75% of SMEs in the EU have seen an increase in their costs of materials in the previous five years. [3]

To analyse on the trends and issues of the Romanian SMEs, it is therefore important to know which the types of resource-efficiency eco-innovation actions taken by companies are:

a. minimising waste;

b. saving energy, materials and water;

c. recycle by reusing waste within the company;

d. design products that are easier to maintain, repair and reuse;

e. sell scrap material to other companies.

Although significant shares of the Romanian SMEs are undertaking these actions in order to become resource efficient, they are still less likely to do so than other EU SME companies (Fig.nr.3).
It may be noticed from the figure (Fig.nr.3) that, as for the data of this recent survey, the percent of Romanian SMEs minimising waste is only 31% as compared with the 65% percent of the total number of SMEs in the European Union, so it is less than a half of the indicator at the EU scale.

The same lag of the Romanian SMEs is observable also for the other resource efficiency increasing eco-innovation actions undertaken at present by the Small and Medium Enterprises in the European Union. Unfortunately, there is also still a high percent of the Romanian SMEs (36%) reporting they have taken none eco-innovation in order to increase their resource efficiency.

There are also other issues and trends of resource-efficiency actions which may be considered as such eco-innovations by the Romanian SMEs. For instance, the investment efforts made by the Romanian SMEs to become more resource-efficient are on average lower than those of the EU SMEs, but with some interesting differences on several categories (Fig. nr. 4)

As may be observed in Fig.nr. 4, there is quite a similar trend in the Romanian and in the EU SMEs as regarding the share of turnover invested to become more resource-efficient. About 25% of
the SMEs in Romania and in the EU, have invested about 1-5% of their annual turnover in this respect.

On the other hand, there is a high percent of the Romanian SMEs (38%) who have invested less than 1% of annual turnover for resource-efficiency, as compared to only 25% of the SMEs at the scale of the EU. But, to remark the best trends, there are 5% of Romanian SMEs (but only 1% of the total EU SMEs) who have invested (on average, over the past two years) more than 30% of annual turnover for resource-efficiency actions and eco-innovations.

However, the most efficient way to increase resource-efficiency and implement eco-innovation in SMEs is, in our opinion, to increase cooperation between companies across sectors so that new processes to re-use waste by-products can be developed.

As shown in [10] the ECOREG industrial-ecosystem of Suceava in which material flow exchanges (or industrial symbioses) significantly increase the efficiency and saving of energy, waste and water management, is providing for an impressive growth in the local resource-efficiency, for all the clustered Romanian SMEs.

4. Eco-Innovation Parks for Industrial Symbioses between Small and Medium Sized Enterprises

There was evidence on the role of eco-innovation parks (EInvP) as vectors of transition to a green economy [11], but here we aim to analyse only the role of the eco-innovation parks as industrial ecosystems, 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 of resources, eventually improving the resource efficiency and productivity at the microeconomic, sectoral and regional scale.

Some negative issues but also positive findings about the green economy prospects of the Romanian companies analysed in [12] included the following: companies show weak environmental awareness and weak levels of transparency and communication on environmental issues; in terms of cost assessment, companies do not measure or do not want to declare the costs and benefits obtained through their environmental investments.

Industrial symbiosis (IS), as part of the industrial ecology research field, focuses on the flow of materials and energy from local and regional economies. An “Industrial symbiosis engages diverse organizations in a network to foster eco-innovation and long-term culture change. Creating and sharing knowledge through the network yields mutually profitable transactions for novel sourcing of required inputs and value-added destinations for non-product outputs, as well as improved business and technical processes”.[14]

Therefore, in a previously analysed case-study, we have identified and emphasized the necessity and opportunity for the small and medium size enterprises to group or cluster in some kind of Eco-Innovation Park, taking advantage of all the environmental and economic benefits involved, especially those of an industrial ecosystem aimed for promoting a circular economy.

While the main conclusion of [11] was based on a regression model showing that in the 16 European countries of the analyzed sample there is a positive correlation between the number of existing eco-innovation parks (EInvP) and the national level of resource productivity (as macroeconomic indicator of the resource-efficiency).

In other research papers [8; 10; 12] there was presented and analysed the case study of a pilot Romanian EInvP implemented as an Application of Industrial Ecosystems Principles to Regional Development (ECOREG) which has become a real model of circular economy and good practice of waste management in a region, namely the Suceava county in Romania.

Resuming some of the most interesting and useful insights from that previous research, it may be stated that:

- The ECOREG project used actual business opportunity as the mechanism for encouraging resource efficiency dealing with all resources including water, energy, materials, logistics, assets and expertise.
The ECOREG is an example of a sustainable business model, since reducing primary resource inputs; closing material loops; applying an integrated resource management; promoting regional self-sufficiency and proximity; minimising the environmental impacts.

The most important feature of the ECOREG is the industrial symbiosis as eco-innovation implemented at a regional scale, supported by the numerous industrial synergies identified and actually implemented. [15]

In the paper [10] it is shortly described such an industrial synergy identified and implemented between several SMEs from the wood sector:

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.

c) SC DIVIP PRODCOM SRL which is a SME located near the village of Braesti, Suceava County, some 40 km SW from Suceava, in the hills of the Sweet Bucovina Province. The organization exploits wood and completes the first stages in processing timber, producing large quantities of sawdust and wooden waste with no economic value.

With several prerequisites, the industrial synergy created is based on the fact that the sawdust and wooden debris produced by SC IASIMOLD SRL and by SC DIVIP PRODCOM 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 analysed industrial synergy had important economic and environmental drivers and managed to dramatically increase the resource-efficiency of most materials and resources employed by those SMEs, especially of the wood. Before entering in the industrial symbiosis, it was considered that the wooden waste had no economic value as a resource, being a heavily polluted material available at no cost in many locations, across the Suceava county of Romania.

After a more detailed analysis in [10] there were identified important economic, environmental and social benefits of this double (wood sector) industrial synergy exploited in the ECOREG EInvP of Suceava, for all the SMEs involved but also for the entire eco-innovation park and the entire county.

Besides, the double synergy presented and analysed above, between S.C. RITMIC SRL and the SC IASIMOLD SRL, as well as between S.C. RITMIC SRL and SC DIVIP PRODCOM SRL was only one example of the many wood sector industrial synergies working in the ECOREG project, other examples being analysed in [12] and [13].

Most important for the current research is the key feature of the eco-innovation park in which there is a good cooperation between some SMEs involving material flow exchanges (or industrial symbioses) which significantly increase the efficiency of energy, waste and water management, so leading to an outstanding growth in the local resource-efficiency, for all the clustered companies.

5. Conclusions

The ‘circular’ or ‘symbiotic’ economy enhances resource and cost savings by maximising the time that resources, products and components are used. Making better and more efficient use of resources by reducing waste and converting waste into new goods and services requires eco-innovation, new intermediaries and brokerage services.

SMEs and entrepreneurs need a supportive environment to engage in new industrial relationships enabling them to move towards a circular economy that would enable increased resource-efficiency and several general economic, social and environmental benefits.
The concerns for increased resource efficiency in the EU SMEs and the prospects for a greener and circular economy in the European Union have been inquired by several recent own research papers as well as by some official surveys such as [4].

Some interesting conclusions and prospects of this study [4] refer to the fact that saving energy and minimising waste are the most commonly planned resource-efficiency actions, but most actions are increasingly being planned in 2017 (as compared to 2015).

- More than half of all SMEs plan to implement energy saving (59%), waste minimisation (57%), or materials saving actions (51%) in the next two years.
- More than four in ten are planning to implement actions to save water (45%), while 38% plan to recycle by reusing material or waste within the company, 25% plan to design products that are easier to maintain, repair or reuse (25%), 22% plan to use predominantly renewable energy and 21% plan to sell their scrap material to other companies.
- Many European SMEs are also more likely to be planning additional actions over the next two years. In particular, SMEs are more likely to be planning additional actions to minimise waste (+10 pp), save energy (+9 pp), save materials (+8 pp), save water (+7 pp), or use predominantly renewable energy (+6 pp).

The Romanian SMEs are now, more or less, on the track with these trends of actions dedicated to increased resource efficiency but they often need more support or consultancy on how to achieve this (23% of SMEs in the EU and in Romania declare this need in thereport [4]).

From the viewpoint of the Romanian SMEs, in order to increase their resource efficiency and business opportunities, we recommend they should be encouraged and helped to enter in industrial symbiosis relations on a regional and/or cluster system.

In a green market economy, the interest of economic operators to establish a synergy is still firstly financial, each industrial manager aiming to increase resource efficiency of its business and find a market for its wastes and/or by-products. However, to provide advice and help for the Romanian SMEs and start-ups, this paper highlighted again some of the features, principles and trends of eco-innovation and eco-innovation parks for a greener development in SMEs.

After Romania’s accession to the European Union and with the Cohesion funding support, the 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 conclusions of our previous dedicated papers have reinforced the strategic development of eco-innovation parks in Romania, as industrial ecosystems for the manufacturing and service enterprises or the local authorities seeking enhanced environmental and economic performance through closer collaboration in managing environmental and resource issues.

As highlighted, the regional eco-innovation park of ECOREG can help Romania to recycle more of its waste, in line with EU policy and thus save precious and rare natural resources, such as wood, water, energy.

A pro-active European and national policy, with a coordinated approach and smart public-private partnerships may be still required to sustainably develop circular economy in Romania and reap its economic and environmental advantages for all the SMEs and other actors involved.

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