Martina Harc
Institute for Scientific and Artistic Work in Osijek
Croatian Academy of Sciences and Arts
Franje Kuhača 29/I,
31000 Osijek, Croatia
harcm@hazu.hr
Phone: +0038531214928

UDK: 628.477+502:338](497.5)
Review article

Received: October 9, 2018
Accepted for publishing: November 13, 2018

THE PATHWAY TOWARD A RESOURCE-EFFICIENT ECONOMY IN CROATIA

Abstract

Eco-innovation enables efforts to change dominant linear business models of production and consumption into a resource-efficient circular economy model by transforming the way consumers interact with products and services, developing the process of change that can underpin a future resource-efficient society and economy. The EU's Eco-Innovation Observatory defines eco-innovation as any new significantly improved product (goods or services), process, organisational change or marketing solution that reduces the use of natural and decreases the release of harmful substances across the product's full lifecycle. Although, the ultimate need for eco-innovation is widely recognized within the EU, eco-innovation performance indicates high variations across EU Member States. European Eco-Innovation scoreboard groups countries into eco-innovation leaders, average eco-innovation performers and countries catching up in eco-innovation. Countries catching up in eco-innovations are mostly new Member States, just like Croatia. Therefore, this paper highlights the economic, environmental and social dimensions of eco-innovation in Croatia according to the Eco-innovation index. Results of the overall eco-innovation performance measured through 16 indicators grouped into five thematic areas in the period 2013-2017 confirmed there is no long-term involvement in fostering transition toward a resource-efficient economy. Modest results indicate that eco-innovation development and transition into a new resource-efficient economy model in Croatia is at an early stage. Accelerating eco-innovation in the economy and society needs to be one of Croatia's priorities in order to boost a greener and more sustainable economy with potential to generate economic growth and new jobs.

Keywords: Eco-innovation, resource efficiency, circular economy, Eco-innovation Index

1. Introduction

Overuse of global resources, materials and energy, environmental problems and social inequalities have led to a demand for new technologies, solutions and products. Eco-innovation makes both, economic and environmental sense (Eco-Innovation Observatory, CfSD, 2016: 7)[1]. According to the European Commission, eco-innovation is a powerful instrument that combines reduced negative impact on the environment with a positive impact on the economy and society. Such eco-innovation or green innovation refers to new ways of addressing current and future environmental problems and decreasing energy and resource consumption, while promoting sustainable development. Many governments emphasize eco-innovation as part of their growth strategy. In light of the latest global challenges – the economic downturn, environmental degradation, and resource scarcity – eco-innovation fosters to unite economic and environmental priorities aiming to create a pathway for economic growth through green technologies and green industries (The Organisation for Economic Co-operation and Development (OECD), 2012: 3). Various models, such as the circular economy, zero waste, closed-cycle, resource efficiency, waste avoidance, reuse, and recycling foster the idea of responsible treatment of resources, materials, products and the environment (Wilts, 2016: 6). Eco-innovation, as one of key drivers, fuels the transition to a resource-efficient circular economy. The transition towards a circular economy refers to fundamental changes in production and consumption systems, going well beyond resource efficiency and recycling waste, although waste avoidance is prioritised (COM(2014) 398)[2]. Through minimising demand for materials and energy, and by minimising the generation of waste, the circular economy also contributes to a reduction in greenhouse gas emissions. One of EU's objectives includes reducing greenhouse gas emissions by 80-95 % by 2050. This target requires essential changes in many areas such as the energy, food and mobility system, the way raw materials and manufactured products are produced, traded, used, maintained and turned back into the economy at the end of the lifecycle (European Environment Agency, 2017: 7)[3]. The final goal is to close the cycle in the way to turn waste back into a resource (as a secondary raw material). In order to achieve such an ambitious plan, the European Commission[4] set clear targets in "closing the loop" of product lifecycles through greater recycling and re-use: a recycling rate of 65% for municipal waste by 2030, a recycling rate of 75% for packaging waste by 2030, a binding landfill target to reduce landfill to a maximum of 10% of municiple waste by 2030, a ban on landfilling of separately collected waste and promotion of economic instruments to discourage landfilling and inciniration (COM(2015) 596)[5].

Although, the ultimate need for eco-innovation within EU Member State countries is widely recognized, eco-innovation performance indicates high variations across EU Member States. According to results from the 2016 version of the Eco-Innovation Index and Scoreboard, countries catching up in eco-innovations are mostly new Member States just like Croatia. Top six performing countries, eco-innovation leaders led by Germany, are significantly above the EU average. Efficient regulatory framework (e.g. on landfill), technological innovations, producer responsibility for packaging waste, reduction in greenhouse gas emissions and consumer's awareness of responsibility for recycling have created an enviable technical level of waste management infrastructure in Germany. In respect with impressive recycling rates for almost all relevant waste flows, Germany has long been one of the absolute leaders in waste management. Regarding the numbers, 86.9% of household waste in Germany is recycled, while the European average in 2012 was just 37% (between 2008 and 2016, and EU recycling rates for municipal waste increased from 37% to 46% (COM(2018) 29: 7)[6]. Furthermore, Germany's overall recycling rate in 2013 was 79%. A rate of second-sourcing or proportion of waste returned into production as secondary raw materials was "just" 38% in 2013 in Germany (Wilts, 2016: 11,12). Opposite to such impressive numbers, Croatia had comparatively low rates. The landfilling rate of municipal waste in Croatia in 2013 was very high, 85%, followed by a poor recycling rate of 14.9%. In 2015, 80% of total municipal waste was landfilled and the recycling rate was 18% (Waste management plan of the Republic of Croatia for the period 2017-2022, Eurostat)[78]. In respect with European Commission concrete objectives in the area of waste management by 2030, with a focus on recycling and landfilling of waste, it will be very difficult to reach. Small and medium enterprises (SMEs), the backbone of the European Union, are also environmentally important. By increasing resource efficiency, providing circular economy solutions and participating in green markets, European SMEs can generate employment and growth as well as boost their productivity and competitiveness (Flash Eurobarometer)[9].

This paper discusses the eco-innovation performance and pathway toward a resource efficient economy in Croatia. After the introduction, Section 2 provides an overview of the definitions of eco-innovation and a review of different types of eco-innovation. Section 3 discusses the main features of the circular economy and stresses its importance. Section 4 outlines the eco-innovation performances in Croatia. Finally, the concluding remarks are given in Section 5.

2. Defining the concept of eco-innovation

In a changing globalised world, better use of resources is essential. The current model of production and consumption can be characterised as a traditional linear economy model. According to the traditional linear model, resources are extracted, processed, used and disposed as waste. At the end of a products' life cycle, wastes are usually burned or landfilled. In both cases, materials are withdrawn from or eliminated within the economic system. Such a linear economic model is able to persist as long as resources are sufficient within the needs of the entire population (Eco-Innovation Observatory, 2016: 10)[10]. Hence, the focus is on resources because the most notable environmental problems are overuse of materials and energy. Consequently, the global demand for resources is still increasing and non-renewables and renewables are limited in a resource-constrained world. In the long term, a linear economic model must reach its limits (Eco-Innovation Observatory, 2016: 10)[11]. Argued by the European Commission, since the industrial revolution, our economies have developed a "take-make-consume and dispose" pattern of growth—a linear model based on the assumption that resources are plentiful, available, easy to source and cheap to dispose of. Moving towards a more circular economy is essential to deliver the resource efficiency agenda established under the Europe 2020 Strategy for smart, sustainable and inclusive growth (COM(2014) 398)[12]. In order to reinforce the path of innovations for a sustainable future, in 2011 the European Commission adopted The Eco-innovation Action Plan (EcoAp (2011))[13]. Built under the Europe 2020 strategy for smart, sustainable and inclusive growth (2010)[14], EcoAp supports three mutually reinforced priorities and focuses on boosting resource productivity, efficiency and competitiveness in order to protect the environment, accelerating the path of innovative products toward markets. The Action Plan includes seven targeted actions supported by stakeholders, the private and public sector and the European Commission in order to achieve environmental goals through innovation. In order to evaluate the eco-innovation performance across all EU Member States, building on the experiences of the "Eco-Innovation Scoreboard", the Commission is monitoring and reviewing measures taken by EU Member States. The Eco-innovation Action Plan also complements other Europe 2020 Flagship Initiatives. An essential Initiative for the transition towards a green economy is the "Resource Efficient Europe" Flagship and its roadmap (COM(2011) 571)[15]. This flagship initiative aims at creating a framework for policies in order to achieve a resource-efficient and low-carbon economy which will boost economic performance while reducing resource use, identifying and creating new opportunities for economic growth and innovations boosting EU competitiveness, ensuring security of supply of essential resources and fighting against climate change, and limiting environmental impacts of resource use. The Eco-innovation Action Plan is therefore an important element of the European policy framework for sustainable consumption and production.

The Eco-Innovation Observatory's Methodological report (Eco-Innovation Observatory, 2010)[16] developed a framework for analysing eco-innovation. According to the report, eco-innovation is defined as any new significantly improved products (goods or services), 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 life-cycle (Eco-Innovation Observatory, 2010: 10)[17]. Furthermore, environmental challenges and resource constraints have led to a demand for new technologies, solutions and products. According to the European Commission, eco-innovation refers to all forms of innovation – technological and non-technological, new products and services and new business practices – that create business opportunities and benefit the environment by preventing or reducing their impact, or by optimising the use of resources.

Eco-innovation takes the full life-cycle of products (goods or services) into account, focusing on inventing new products and delivering new services, but also on minimising the use of the natural resources, reducing environmental impacts in the way products are designed, produced, used, reused and recycled (Eco-Innovation Observatory, CfSD, 2016: 7)[18]. New concepts such as sharing, leasing and remanufacturing also contribute to eco-innovation efforts. Moreover, the European Commission aims to deploy eco-innovation towards a resource-efficient circular economy applying all those concepts at those levels where they contribute best (Eco-Innovation Observatory, 2016: 5,6)[19]. In order to boost competitiveness and environmental protection, it encourages approaches that minimise material and energy flows by changing products and production methods. All of these eco-innovation performances are incorporated into a new product's full lifecycle supported by six pillars of the circular economy model. Different types of eco-innovation that refer to products, processes, systems, organisational, marketing, and social issues support transformation from the traditional linear model of production and consumption into a new circular model characterised by circular resource management.

Product design eco-innovation refers to new approaches in the design of a product minimising overall impact of the environment and use of resources during its whole life-cycle (Eco-Innovation Observatory 2016: 15)[20] allowing product reparability, recyclability, proportion of recycled and renewable material in the product, and its suitability for refurbishment or remanufacture (European Environment Agency, 2017: 10,11)[21]. Product design therefore determines the circularity potential of a product. Furthermore, according to the European Commission, better product design can make products more durable or easier to repair, upgrade or remanufacture, allowing recyclers to disassemble products in order to recover valuable materials and components (European Commission, 2015)[22].

Process eco-innovations minimises or reduces effects of emissions and hazardous substances of production and consumption, reduces risks and saves money by reducing costs of material and energy in production processes due to efficiency gains (Eco-Innovation Observatory, 2016: 12)[23]. This type of eco-innovation is grounded in initiatives like "cleaner and leaner" production (Eco-Innovation Observatory, CfSD, 2016: 9)[24]. Production processes involve models such as advancing remanufacturing, respectively, refurbishment, including the update of products, disassembly and recovery on material and substance level, upcycling, functional recycling and downcycling in order to gain zero waste production, zero emissions and cleaner production (Eco-Innovation Observatory, 2016: 12)[25].

Organisational eco-innovation refers to methods and management system reorganization pushing for closing the loops and increasing resource efficiency (Eco-Innovation Observatory, 2016: 12)[26]. This includes new business models such as Industrial symbiosis, Extended producer responsibility (EPR) and Individual producer responsibility (IPR). There are two concepts of industrial symbiosis, a classic concept of material resource exchange based on collaboration between companies whereby the wastes or by-products of one are used as a resource for another company and a concept of digital-age interpretation of industrial symbiosis based on knowledge exchange in order to foster eco-innovation through network of actors (companies, public-private partnership, policy makers, research institutions etc.) (Taranic et al., 2016: 4). Focus on offering a product-service system rather than product ownership is another form increasing resource efficiency (European Environment Agency, 2016: 11)[27]. In the product-service system the ownership of the product remains with the producer who provides design, usage, maintenance, repair and recycling across the product's life-cycle, while consumers pay a rent for the time of its usage (Kalmykova et al., 2017: 7). Extended producer responsibility (EPR) and Individual producer responsibility (IPR) are other environmental policies in which a producer's responsibility for a product is extended to the post-consumer stage of a product's life-cycle (EPR) implying that producers take responsibility for collecting or taking back used goods and for sorting and treating them for eventual recycling (European Environment Agency, 2017: 23)[28]. Individual producer responsibility (IPR) refers to effective individual responsibility by each producer for their individual brands (Wilts, 2016: 17).

Marketing eco-innovation involves changes in product and service design, packaging, placement, promotion, pricing and marketing techniques to drive people to buy, use or implement eco-innovation (Eco-Innovation Observatory, 2010: 27)[29]. In order to boost marketing strategy and provide consumers and businesses with economic, resource and energy savings, the EU introduced EU Ecolabel[30], a voluntary eco-label of environmental excellence that is awarded to products and services with high environmental standards throughout their life-cycle: from raw material extraction, to production, distribution and disposal.

Social eco-innovation refers to the human element in sustainable resource consumption and sustainable consumer's behaviour. It includes market-based dimensions of behavioural and lifestyle changes (Eco-Innovation Observatory, 2010: 28)[31]. Social innovations associated with waste avoidance, reuse, recycling, eco-design, a sharing economy and other developments create opportunities to establish more sustainable patterns of consumer behaviour, while contributing to human health and consumer safety (Wilts, 2016: 8). Collaborative consumption, known as sharing economy, assume shared use of products by consumers, or by a company. Shared use of assets leads to the more efficient use of existing products and consequently to a lower demand for new products (European Environment Agency, 2017: 22)[32].

System eco-innovation can be defined as a series of connected changes improving or creating entirely new organizational and functional systems reducing the overall environmental impact (Eco-Innovation Observatory, 2016: 12)[33]. A key feature of system eco-innovation is to lead to system changes in both social (societal values and attitudes, regulations) and technical level (infrastructure, technology, tools, production processes) increasing sustainable competitiveness and economic development by developing radical eco-innovations and creating new markets (Eco-Innovation Observatory 2013: 9)[34]. Eco-cities, eco-industrial parks and new mobility concepts are examples of system eco-innovation induced by a series of connected system changes with interaction between many actors (policy makers, architects, engineers, business representatives).

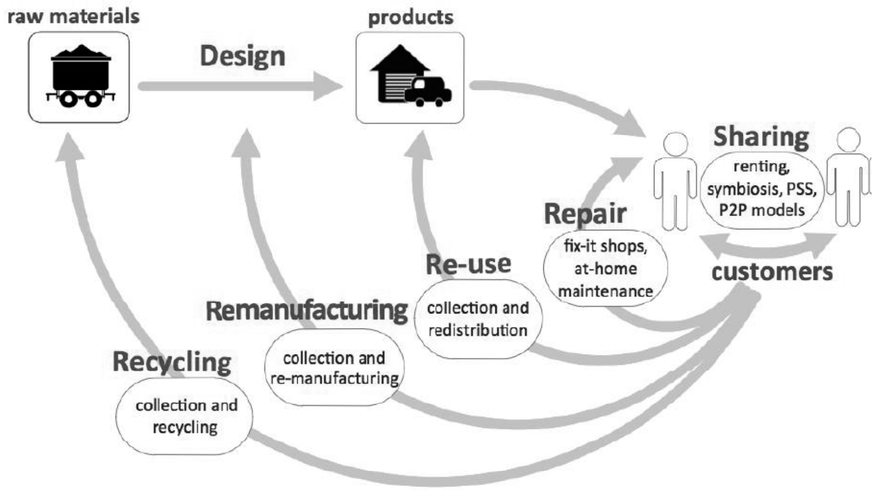
The impact of eco-innovations can range from incremental to disruptive system changes. Incremental innovations are most commonly associated with small step improvements of modifying and improving existing products, services and processes, without fundamentally changing and do not lead to a substantial change in a short time. Although, small step improvements applied on a large scale may lead to development of radical innovations (Sarkar, 2013: 8). Radical innovations involve substantial improvements of processes, products and services, but do not necessarily lead to system changes. Completely new processes, products and services bringing new approaches to technology, market and consumers, lead to the development of disruptive eco-innovations resulting in changes in the functioning of an entire system. Beside system changes, eco-innovation involves “hardware” and “software” perspectives. The “hardware” involves technologies and technical infrastructures relying on the conventional innovation support instruments while development of “software” requires new innovative approaches in developing skills, expertise and new business models based on sharing, remanufacturing, reuse and repair (Eco-Innovation Observatory, 2016: 13, 75)[35].

3. *Toward a resource-efficient circular economy*

In order to stimulate Europe’s transition towards a circular economy, boost global competitiveness, foster sustainable economic growth and generate new jobs, the European Commission adopted an ambitious Action Plan for the Circular Economy and a set of measures within the Circular Economy Package in 2015. All these measures, according to the Action Plan, aim at the transition to a more circular economy, where the value of products, materials and resources are maintained in the economy for as long as possible to minimize the generation of waste. They are an essential contribution to the EU’s efforts to develop a sustainable, low carbon, resource efficient and competitive economy. The European Commission acknowledges the key role of eco-innovation in the context of job creation, growth and competitiveness, as well as environmental protection. Further, according to the European Commission, eco-innovation is key to delivering many aspects of the circular economy: industrial symbiosis or ecologies, cradle-to-cradle design and new, innovative business models. Thereby, the main concept of circular economy is to keep the value and function of materials and products at the highest level for as long as possible. This helps to minimise the need for the input of new materials and energy, reducing environmental pressure linked to the life-cycle of products, from resource extraction, through production and use to end-of-life (European Environment Agency, 2017: 7)[36].

The Eco-innovation Observatory (EIO)[37] defines the new product’s full lifecycle supported by six functional pillars of circular economy, including recycling, remanufacturing, re-use, repair, sharing and design. The proposed actions are an integral part of the eco-innovation process in enabling the transition from a linear to a circular economy.

Figure 1 Illustration of functional pillars of the circular economy model



Source: EIO, 2016: 11

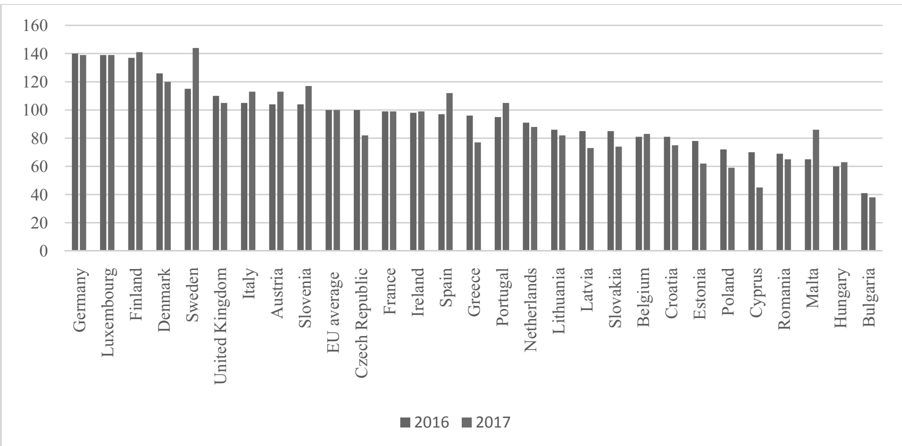
According to previous literature, the main emphasis is put on design. In order to enable the product to be recycled as fully as possible, and the raw materials to be recovered at the end of its life cycle, the circular economy must begin with intelligent design (Wilts, 2016: 5). Design is crucial in a circular economy because it can predefine if the product can be repairable, durable recyclable, re-usable, or suitable for shared use, or remanufactured at the end of its life cycle (Eco-Innovation Observatory, CfSD, 2016: 8)[38]. By designing products in a "smarter way", without any losses in quality, they potentially offer significant environmental and economic benefits (European Environment Agency, 2017: 6)[39]. According to the European Commission "it is estimated that 80% of all product-related environmental impacts are determined during the design phase of a product". The benefits of such "smart design", beside energy and material savings, allow products to be part of more than one life-cycle or to spend more time within one cycle. The enhanced durability of smart design products (by design, reselling, repairing, remanufacturing or upgrading) leads to the next step of the circular economy known as sharing platform, respectively, consuming services rather than (owning) products (product as a service options) (Eco-Innovation Observatory, 2016: 24, 25)[40]. Collaborative consumption models known as renting business models (tools, equipment, furniture), sharing-based business models (bike-sharing system, car sharing), "Pay-per-service" business models, product leasing and industrial symbiosis are important aspects of sharing infrastructure enabling increased utilization rate of products by shared use (Eco-Innovation Observatory, CfSD, 2016: 10)[41]. Repair and maintenance play a key role in service-based business models offering life-time product guarantees or repair integrated in after-sales services, as well as maintenance services (for cars, devices, equipment, machines) prolonging the lifetime of products and enabling the reuse of products (Eco-Innovation Observatory, 2014: 4)[42]. Products designed to last longer in a way they can be easily repaired or upgraded retain their value as long as they can be reused. Reusing products and their components, as well as remanufacturing include traditional second-hand product use as well as using the components from products that are no longer in use (spare parts, fibres from fabric) in new products. Reuse conserves the physical assets of raw materials as well as the energy embedded in products or components (European Environment Agency, 2016a: 18)[43]. Remanufacturing refers to a series of manufacturing steps undertaken at the end of the life part or life cycle of the product in order to remanufacture it into a like-new or with better performances product, with corresponding warranty (COM(2015) 614: 5)[44]. Remanufacturing can save 85% of the energy that went into manufacturing the original product (Eco-Innovation Observatory, CfSD, 2016: 10)[45]. Finally, recycling as one of the priorities of EU resource efficiency policies lies at the heart of circular economy. A strategy to make the EU a 'circular economy' is based on a recycling society with the aim of reducing waste generation and using waste as a resource (COM(2011) 21: 6)[46] generating new streams of secondary resources and new economic opportunities (Eco-Innovation Observatory, CfSD, 2016: 8)[47]. Recycling reduces the demand for extraction of new raw materials, helps to reuse valuable materials which would otherwise be wasted, and reduces energy consumption and greenhouse gas emissions avoiding landfilling, processing or incineration of waste (COM(2011) 21: 4)[48]. The proposed actions contribute in 'closing the loop' of product life-cycles through smarter design, greater forms of recycling and reuse, bringing opportunities in creating new quality jobs, contributing to more sustainable economic growth and bringing significant environmental improvements.

Small and medium enterprises (SMEs), as generators of employment (67% of total employment) and value added (57% of value added in non-financial business sector) in EU28, have a significant cumulative impact on the environment. According to the survey provided by the Flash Eurobarometer, minimising waste and saving energy are the most common resource efficiency actions taken by SMEs and have become more widespread since 2015. More than half of all SMEs confirmed that they are minimising waste (65%), saving energy (63%) and saving materials (57%) in order to be resource efficient. More than four in ten SMEs are saving water (47%), or recycling by reusing material or waste within their company (42%). Further, 25% of SMEs are designing products that are easier to maintain, repair or reuse, while 21 % are selling their scrap material to another company. More than one in ten are using predominantly renewable energy (14%). The survey revealed that the larger the SME, the more actions it undertakes: recycling by reusing material or waste within the company; designing products that are easier to maintain, repair or reuse; selling their scrap material to another company; or using predominantly renewable energy.

4. Eco-innovation performance in Croatia

In order to compare the relative performance of Member States in key areas related to eco-innovation, the Eco-Innovation Observatory (EIO) has developed the Eco-Innovation Scoreboard (Eco-IS)[49]. Therefore, in order to evaluate the different aspects of eco-innovations, 16 indicators are interpreted by five sub-indices (eco-innovation inputs, eco-innovation activities, eco-innovation outputs, resource efficiency and socio-economic outcomes) in the Eco-innovation Scoreboard forming the aggregated Eco-innovation index. In order to do that, the Eco-Innovation Scoreboard shows how well individual Member States perform in economic, environmental and social dimensions of eco-innovation compared to the EU average.

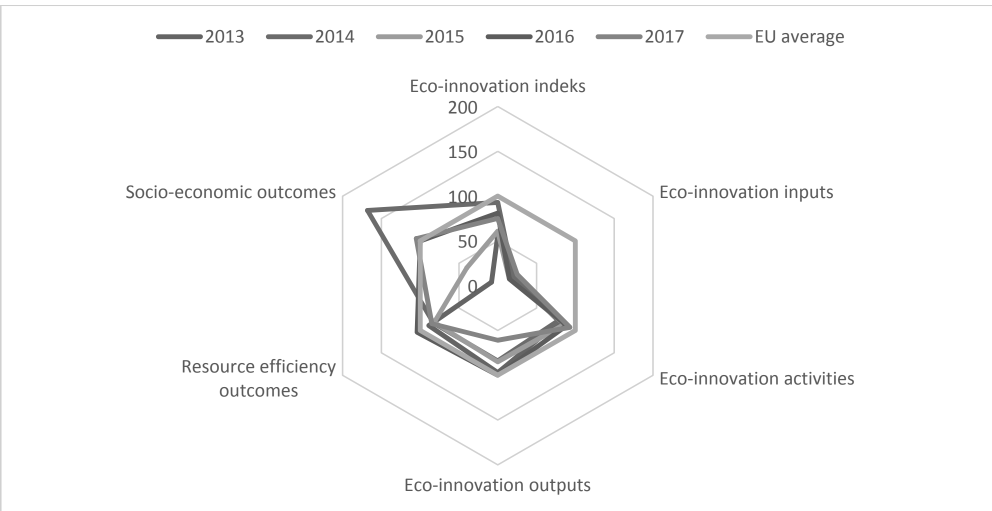
Figure 2 EU 28 Eco-Innovation Index[50] 2016-2017



Source: Eco-Innovation Observatory

Figure 2 illustrates the results from the aggregated eco-innovation index in 2016[51] and 2017[52] providing an overview of the overall Eco-innovation performance across the EU. According to the figure, countries were clustered into three groups: Eco-innovation (EI) leaders, scoring significantly higher than the EU average; average Eco-innovation (EI) performers with scores around the EU average; and countries catching up in Eco-innovation (EI), with around 85% or less performance compared to the EU average. Top six performing countries in 2016 were highly above the EU average, led by Germany with an aggregated score of 140. Luxembourg (with a score of 139) and Finland (with a score of 137) are catching up with Germany. Following three top-performing countries, Denmark, Sweden and the United Kingdom also have been grouped into the "eco-innovation leading" countries. The countries with an aggregated eco-innovation score range from 105 to 91 were grouped into average Eco-innovation performers, scoring around the EU average of 100 in 2016. The last performing group labelled as countries catching up in Eco-innovation, in 2016 were defined by aggregated scores ranging from 86 for Lithuania to 41 for Bulgaria (EIO Brief 2017: 2). In the 2017 version of the Eco-Innovation index, small changes occurred. Compared to the 2016 version of the Eco-Innovation index, most countries have remained in the default group. In 2017, Sweden took the leading position with an aggregated score of 144. Germany dropped to third position with a score of 139, followed by the "eco-innovation leading" group except for the United Kingdom, that was replaced by Slovenia. The highest rise was accomplished by Sweden, which moved from fifth position in 2016 to the leading position in 2017. Regarding other eco-innovation performers, Malta moved from catching up countries into the group of average eco-innovation performers. The group in which aggregated eco-innovation scores ranged from 113 (Italy and Austria) to 86 (Malta) included nine Member States that were labelled as "average eco-innovation performers". As in 2016, with the exception of Belgium, in 2017 all the countries found in the group of "countries catching up in eco-innovation" were Member States that joined the European Union in or after 2005. With an aggregated score of 81 in 2016, and 75 in 2017, Croatia stayed among the catching up countries. Compared with the leading countries, Croatia had a comparatively low score. Furthermore, compared with 2015 (with a score of 61), 2014 (with a score of 93) and 2013 (with a score of 56), Croatia shows a very modest improvement with an increased score by 19 points compared to 2013.

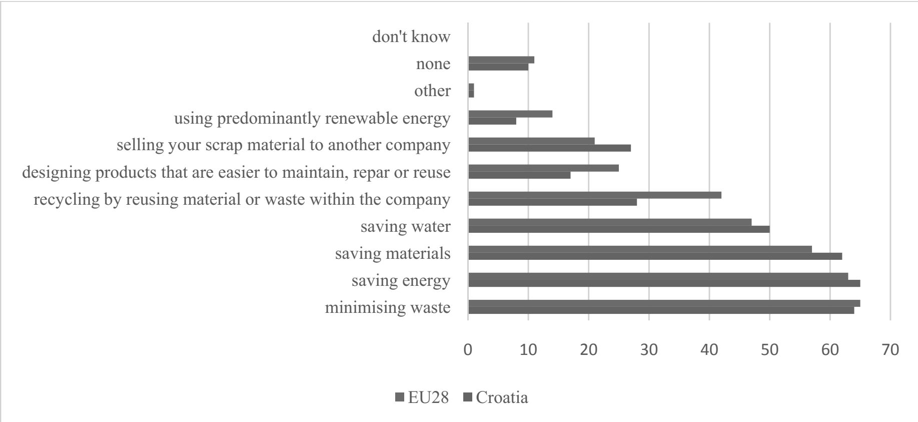
Figure 3 Components of the Eco-Innovation composite Index for Croatia 2013-2017



Source: Eco-Innovation Observatory

Therefore, Figure 3 illustrates the scores of the Eco-innovation index and its five sub-indices in the period 2013 – 2017.With a score of 15 in 2016, and 25 in 2017, high bellow the EU average, Croatia shows very poor performance in the area of eco-innovation inputs. In the previous years, the lowest scores were also achieved in all three indicators of this component. In 2015 Croatia had the same score as in 2016, a 5% decrease compared to 2014. Particularly low scores are in the area of the government's investments in the environmental and energy R&D with 0.1 Euro per inhabitant in 2016 (Eurostat) [53] and total value of green early stage investments in eco-industries with only 15%, 10% and 8% of the EU average in 2016, 2015 and 2014, respectively. In 2017, the lowest indicator was in total value of green early stage investment with only 30 USD per capita (Denmark had 318 USD per capita). Countries with higher investments in environmental and energy R&D (as Finland, Germany Denmark or France) had results with better patenting performances (eco-innovation outputs) and vice versa. In the second thematic area of eco-innovation activities, Croatia showed better performance with a score of 89 in 2016, right behind Lithuania and Slovakia in the group of catching up countries and a slight improvement with a score of 93 in 2017. Compared with top-performing countries, this is still an unsatisfactory score. The score in 2016 slightly increased compared to 2013(80), mainly due to a high share of companies with ISO 1400 certificates (97 per one million inhabitants in 2016 and 112 per one million inhabitants in 2017) and an increase of companies which implemented innovation activities aiming at a reduction of energy compared to previous years. The area in which Croatia performed relatively better in 2016 (right behind Latvia and Cyprus) compared to other catching up countries is eco-innovation outputs with a score of 100, mainly determined by a very high performance regarding eco-innovation related media coverage with a score 146% that is above the EU average. The lowest performance is in the area of eco-innovation related patents with only 11 patents per one million inhabitants in 2016 and 8 patents per one million inhabitants in 2017. Compared to the leading countries with 235 and 228 patents per one million inhabitants (Germany, Sweden and Finland), Croatia showed extremely poor eco-innovation performance. With regard to environmental (resource efficiency) outcomes, Croatia had the best performing score, 4% above the EU average in 2016. Its score has increased by 22 points compared to 2015. Among the indicators for resource efficiency, the highest scores are achieved in water productivity with 64% above EU average in 2016 and 33% above EU average in 2017, mainly due to Croatia's large freshwater reserves. Material productivity amounts around 1.09 € per kilogram of material consumption in 2016 (Domestic Material Consumption, DMC) which is bellow the EU average of 2.04 Eur/kg (Eurostat)[54]. Although, the gross inland consumption of each EU Member State depends, mainly, on the structure of its energy system, the availability of natural resources for primary energy production, and the structure and development of each economy, Croatia's energy productivity is 14% bellow the EU average (in 2016 and 2017) with a value of 5.4 Eur/oe (Euro per kilogram of oil equivalent) in 2016 (5.2 Eur/oe in 2015, 5.3 Eur/oe in 2014, 5.1 Eur/oe in 2013)(Eurostat)[55]. Despite its rich water and biodiversity, Croatia is still lagging behind the more developed EU Member States in most environmental sectors. Within the area of socio-economic outcomes, the data for Croatia showed that higher employment in eco-innovation and circular economy industries correlates with the higher revenues in this sector. The employment in eco-industries and circular economy was 40% above the EU average in 2016 and 41% in 2017, while turnover in the same sector was 53% above the EU average in 2016 and 42% in 2017. Exports of products from eco-industries showed low values, only 48% of the EU average performance in 2016 and 55% in 2017. These results position Croatia at the EU average performance level regarding socio-economic outcomes.

Figure 4 Relevance of different types of resource efficiency for SMEs in the EU28 vs Croatia in 2017



Note: Q1. What actions is your company undertaking to be more resource efficient? (multiple answers possible)
Source: Flash Eurobarometer 456, 2018

According to the survey provided by the Flash Eurobarometer, in order to be more resource efficient, 64% of the SMEs in Croatia minimise waste, 65% of the SMEs save energy, 62% of the SMEs save materials and 50% of the SMEs save water. Not even three in ten of the SMEs in Croatia (28%) are recycling by using material or waste within the company. Less than two in ten of the SMEs in Croatia (17%) are designing products that are easier to maintain, repair or reuse. Almost three of ten SMEs in Croatia (27%) are most likely to be selling their scrap material to another company, while only 8% are using predominantly renewable energy.

5. *Conclusion*

The European Commission is strengthening efforts to deploy eco-innovation towards a resource-efficient circular economy applying relevant policies at those levels where they contribute best. Hence, eco-innovation needs to be accelerated in the economy and society in order to catalyse systemic changes, by supporting new processes, technologies and services, changing production and consumption patterns, and increasing sustainable competitiveness and economic development.

Therefore, it is important to raise awareness of eco-innovation in Croatia among local and regional authorities, industry and local society. The Eco-innovation index places Croatia among the ten least eco-innovative countries in the EU. Modest results in all the aspects of economic, environmental and social performance of eco-innovation indicate that Croatia is only at the beginning of the process toward a resource-efficient circular economy. The transition should imply the development of new materials and products with smart design, as well as innovative business models. Furthermore, it should foster eco-innovation related patents and raise awareness about eco-innovation among the consumers, in the business sector and the government. The biggest challenge lies in waste management. Improvements need to be done in decreasing the landfilling rate of municipal waste, in establishing a system based on waste prevention and separate collection of waste which is adequately recycled or recovered. Small and medium-sized enterprises in Croatia are trying to be environmentally conscious by taking actions in all areas of resource efficiency.

References:

1. Kalmykova, Y., Sadagopan, M., Rosado, L. (2017), "Circular economy – From review of theories and practices to development of implementation tools", Resources, Conservation and Recycling, Vol. 135, pp. 190-201.
2. OECD (2012), "The Future of Eco-Innovation: The Role of Business Models in Green Transformation", OECD Background Paper, available at https://www.oecd.org/innovation/inno/49537036.pdf (Accessed on: February 5, 2018)
3. Sarkar, A. N. (2013), "Promoting Eco-innovations to Leverage Sustainable Development of Eco-industry and Green Growth", European Journal of Sustainable Development, Vol. 2, No. 1, pp. 171-224.
4. Taranic, I., Behrens, A., Topi, C. (2016), "Understanding the Circular Economy in Europe, from Resource Efficiency to Sharing Platforms: The CEPS Framework", CEPS Special Report No. 143, Brussels.
5. Wilts, H. (2016), "Germany on the road to the circular economy?", WISO Diskurs 10/2016, Friedrich-Ebert-Stiftung, Bonn.

(Endnotes)

1 Eco-Innovation Observatory, Centre for Sustainable Design (2016), "Eco-innovate! A guide to eco-innovation for SMEs and business coaches", 2nd edition, Brussels.

2 European Commission (2014), "Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. Towards a Circular Economy: A Zero Waste Programme for Europe", COM(2014) 398, Brussels.

3 European Environment Agency (2017), "Circular by design – Products in the circular economy", EEA Report No 6/2017, Luxembourg.

4 European Commission (2018), "Circular Economy: Implementation of the Circular Economy Action Plan", available at: http://ec.europa.eu/environment/circular-economy/index_en.htm (Accessed on: July 30, 2018)

5 European Commission (2015), ", Directive of the European Parliament and of the Council amending Directive 94/62/EC on packaging and packaging waste", COM(2015) 596 final, Brussels.

6 European Commission (2018), "Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on a monitoring framework for the circular economy", COM(2018) 29, Strasbourg.

7 Eurostat (2018), "Circular economy", available at http://ec.europa.eu/eurostat/web/circular-economy (Accessed on: February, 8, 2018)

8 Government of the Republic of Croatia (2017), "Waste management plan of the Republic of Croatia for the period 2017-2022".

9 European Commission (2018), "Flash Eurobarometer 456: SMEs, resource efficiency and green markets".

10 Eco-Innovation Observatory (2016), "Policies and Practices for Eco-Innovation Up-take and Circular Economy Transition", EIO Bi-annual report.

11 Eco-Innovation Observatory (2016), "Policies and Practices for Eco-Innovation Up-take and Circular Economy Transition", EIO Bi-annual report.

12 European Commission (2014), "Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. Towards a Circular Economy: A Zero Waste Programme for Europe", COM(2014) 398, Brussels.

13 European Commission (2011b), "Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: Innovation for a sustainable Future - The Eco-innovation Action Plan (Eco-AP)", COM(2011) 899, Brussels.

14 European Commission (2011), "Communication from the Commission, Europe 2020: A strategy for smart, sustainable and inclusive growth", COM(2010) 2020, Brussels.

15 European Commission (2011), "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", COM(2011) 571, Brussels.

16 Eco-Innovation Observatory (2010), "Methodological Report", Brussels.

17 Eco-Innovation Observatory (2010), "Methodological Report", Brussels.

18 Eco-Innovation Observatory, Centre for Sustainable Design (2016), "Eco-innovate! A guide to eco-innovation for SMEs and business coaches", 2nd edition, Brussels.

19 Eco-Innovation Observatory (2016), "Policies and Practices for Eco-Innovation Up-take and Circular Economy Transition", EIO Bi-annual report.

20 Eco-Innovation Observatory (2016), "Policies and Practices for Eco-Innovation Up-take and Circular Economy Transition", EIO Bi-annual report.

21 European Environment Agency (2017), "Circular by design – Products in the circular economy", EEA Report No 6/2017, Luxembourg.

22 European Commission (2015), "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", COM(2015) 614/2, Brussels.

23 Eco-Innovation Observatory (2016), "Policies and Practices for Eco-Innovation Up-take and Circular Economy Transition", EIO Bi-annual report.

24 Eco-Innovation Observatory, Centre for Sustainable Design (2016), "Eco-innovate! A guide to eco-innovation for SMEs and business coaches", 2nd edition, Brussels.

25 Eco-Innovation Observatory (2016), "Policies and Practices for Eco-Innovation Up-take and Circular Economy Transition", EIO Bi-annual report.

26 Eco-Innovation Observatory (2016), "Policies and Practices for Eco-Innovation Up-take and Circular Economy Transition", EIO Bi-annual report.

27 European Environment Agency (2016), "Circular economy in Europe: Developing the knowledge base", EEA Report No 2/2016, Luxembourg.

28 European Environment Agency (2017), "Circular by design – Products in the circular economy", EEA Report No 6/2017, Luxembourg.

29 Eco-Innovation Observatory (2010), "Methodological Report", Brussels.

30 European Commission (2018), "EU Ecolabel", available at: http://ec.europa.eu/environment/ecolabel/facts-and-figures.html (Accessed on: July, 2018)

31 Eco-Innovation Observatory (2010), "Methodological Report", Brussels.

32 European Environment Agency (2017), "Circular by design – Products in the circular economy", EEA Report No 6/2017, Luxembourg.

33 Eco-Innovation Observatory (2016), "Policies and Practices for Eco-Innovation Up-take and Circular Economy Transition", EIO Bi-annual report.

34 Eco-Innovation Observatory (2013), "A systemic perspective on eco-innovation", EIO Thematic Report, Brussels.

35 Eco-Innovation Observatory (2016), "Policies and Practices for Eco-Innovation Up-take and Circular Economy Transition", EIO Bi-annual report.

36 European Environment Agency (2017), "Circular by design – Products in the circular economy", EEA Report No 6/2017, Luxembourg.

37 Eco-Innovation (2018), "The Eco-Innovation Scoreboard and the Eco-Innovation Index", available at: https://ec.europa.eu/environment/ecoap/indicators/index_en (Accessed on: June, 2018)

38 Eco-Innovation Observatory, Centre for Sustainable Design (2016), "Eco-innovate! A guide to eco-innovation for SMEs and business coaches", 2nd edition, Brussels.

39 European Environment Agency (2017), "Circular by design – Products in the circular economy", EEA Report No 6/2017, Luxembourg.

40 Eco-Innovation Observatory (2016), "Policies and Practices for Eco-Innovation Up-take and Circular Economy Transition", EIO Bi-annual report.

41 Eco-Innovation Observatory, Centre for Sustainable Design (2016), "Eco-innovate! A guide to eco-innovation for SMEs and business coaches", 2nd edition, Brussels.

42 Eco-Innovation Observatory (2014), "Eco-innovation and Competitiveness: Enabling the transition to a resource-efficient circular economy", Annual Report 2013, Luxembourg.

43 European Environment Agency (2016), "Circular economy in Europe: Developing the knowledge base", EEA Report No 2/2016, Luxembourg.

44 European Commission (2015), "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", COM(2015) 614/2, Brussels.

45 Eco-Innovation Observatory, Centre for Sustainable Design (2016), "Eco-innovate! A guide to eco-innovation for SMEs and business coaches", 2nd edition, Brussels.

46 European Commission (2011a), "Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: A resource-efficient Europe – Flagship initiative under the Europe 2020 Strategy", COM(2011) 21, Brussels.

47 Eco-Innovation Observatory, Centre for Sustainable Design (2016), "Eco-innovate! A guide to eco-innovation for SMEs and business coaches", 2nd edition, Brussels.

48 European Commission (2011a), “Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: A resource-efficient Europe – Flagship initiative under the Europe 2020 Strategy”, COM(2011) 21, Brussels.

49 Eco-Innovation (2018), “The Eco-Innovation Scoreboard and the Eco-Innovation Index”, available at: https://ec.europa.eu/environment/ecoap/indicators/index_en (Accessed on: June, 2018)

50 It is important to note that the Eco-Innovation Index is not a static tool, but continuously adapted and improved, as more recent data becomes available and new data sources are being tested. If evaluated as better-suited, new data sources replace the ones used in previous index versions. EU Eco-Innovation Index: 2017 version Technical note. April, 2018. (https://ec.europa.eu/environment/ecoap/sites/ecoap_stayconnected/files/eco-innovation_index_eu_2017_technical_note.pdf).

51 Eco-Innovation Observatory (2017), “EU Eco-Innovation Index: 2016 version”, Technical Note.

52 Eco-Innovation Observatory (2018), “EU Eco-Innovation Index: 2017 version”, Technical Note.

53 Eurostat (2018), “Government Budget Appropriations or Outlays on Research and Development (GBAORD)”, available at: http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=gba_nabsfin07&lang=en (Accessed on: February 18, 2018)

54 Eurostat (2018), “Resource productivity and domestic material consumption (DMC)”, available at: http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=sdg_12_20&plugin=1 (Accessed on: June, 2018)

55 Eurostat (2018), “Energy productivity”, available at: http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=t2020_rd310&plugin=1 (Accessed on: February 18, 2018)

Martina Harc

PUT PREMA RESURSNO UČINKOVITOM GOSPODARSTVU U HRVATSKOJ

Sažetak

Eko-inovacije omogućavaju promjenu dominantnog linearnog poslovnog modela proizvodnje i potrošnje u resursno učinkovit kružni model gospodarstva transformirajući način na koji korisnici (potrošači) stupaju u interakciju s proizvodima i uslugama, razvijajući proces promjena koji može podržati buduće resursno učinkovito društvo i gospodarstvo. Eco-Innovation Observatory definira eko-inovacije kao potpuno nove, znatno poboljšane procesne proizvode (robe ili usluge), organizacijske promjene ili marketinška rješenja koja smanjuju korištenje prirodnih resursa (uključujući materijale, energiju, vodu i zemlju) te smanjuju otpuštanje štetnih tvari tijekom čitavog životnog ciklusa proizvoda. Iako je potreba za ekološkim inovacijama široko prepoznata unutar EU-a, ekološko inovacijski rezultati ukazuju na velike razlike među državama članicama EU-a. Europski Eco-Innovation Scoreboard grupira zemlje članice EU-a u vodeće ekološki inovativne zemlje, prosječne ekološki inovativne zemlje i zemlje koje zaostaju u ekološkim inovacijama. Zemlje koje zaostaju ili kaskaju u ekološkim inovacijama uglavnom su nove države članice EU-a, kao što je i Republika Hrvatska. Stoga, u ovom radu, koristeći Eco-innovation index, naglašavaju se ekonomske, ekološke i socijalne dimenzije ekoloških inovacija u Republici Hrvatskoj. Rezultati učinkovitosti ekoloških inovacija mjerenih kroz 16 pokazatelja grupiranih u pet tematskih područja u razdoblju od 2013. do 2017. godine, potvrđuju kako ne postoji dugoročno uključivanje u poticanje tranzicije prema resursno učinkovitom gospodarstvu. Skromni rezultati ukazuju da je razvoj ekoloških inovacija i prijelaz u novi resursno učinkovit model gospodarstva u Republici Hrvatskoj još u početnoj fazi. Poticanje ekoloških inovacija u gospodarstvo i u društvo moraju biti jedan od prioriteta Republike Hrvatske kako bi se potaknulo zeleno i održivo gospodarstvo s ciljem stvaranja gospodarskog rasta i novih radnih mjesta.

Ključne riječi: ekološke inovacije, resursna učinkovitost, kružna ekonomija, Eco-innovation Index