

# Circular Economy in Croatian Society

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**Abstract** – The circular economy appears as a kind of opposite perspective to the ubiquitous „paradox of resources“, one of the foundations of the traditional industrial society. It represents the establishment of sustainable development and Industry 4.0. It is based on smart production, an increased supply of services, and improved management of production resources, all of which make it one of the basic elements of global state competitiveness. Although often neglected in the past, the need for conscientious exploitation of resources and environmentalism are gradually becoming the direction of policy development at the highest level, as both governments and international organizations have recognized the risks of late response to imminent challenges to economic and social growth. The European Union acknowledged the problem by presenting the legislative package as well as strategic documents Europe 2030 and the European Green Deal, which also oblige the Republic of Croatia to act as one of the member states. Based on a comparison of available statistical data, the paper focuses the presence of the circular economy as one of the indicators of the Fourth Industrial Revolution in Croatia. Finally, the paper points to difficulties regarding transformation from a linear to a circular model of the economy.

**Keywords** - *Industry 4.0, circular economy, Croatia, indicators*

## I. INTRODUCTION

New technologies of Industry 4.0. (or 4IR) have great potential for application in reducing the ecological footprint, mainly through the interconnection of cities, transport and energy networks, the introduction of new ways of production and consumption, as well as the creation of added value in the industrial sector.

In addition to changes in the field of ICT application, 4IR emphasizes the need for changing the way of thinking, policy-making and institution-building, which seems to be a necessary precondition for the establishment of a sustainable and inclusive future system [1]. Optimal enhancement of 4IR opportunities towards environmental improvement is ensured through the cooperation between the government, scientists, civil society and ICT experts, encouraging innovative business models that can accelerate eco-innovation, and finally, enable the development of joint strategies to address environmental challenges. As "time is of the essence", due to raising climate changes and environmental pollution, the need to take timely action in parallel with the further development of technology is imperative that requires a certain level of flexibility of governing structures, more precisely the ability to act

according to current needs, reducing institutional barriers to the lowest possible level [2].

A sustainable Europe by 2030, as one of 6 priorities of European Union's Strategic Agenda 2019-2024, resides on The European Green Deal [3], an action plan to boost the efficient use of resources by moving to a clean, circular economy and restore biodiversity, while cutting pollution. The EU aims to be climate neutral in 2050, proposing a European Climate Law to turn this political commitment into a legal obligation.

Republic of Croatia, being one of the member countries, is also obliged to tackle this environmental challenge. 2030 National Development Strategy, as one of development directions, states green and digital transition as intertwined goals, as is suggested in subject research.

## II. CIRCULAR ECONOMY AND SUSTAINABILITY

Economic planning is shaped under the influence of a linear economy, at the centre of which lies the consumer as the buyer of the product. The linear economy is based on the "resource paradox", or the careless consumption of natural resources with complete neglect for their reduction, as well as, in some instances, rarity. Additionally, the scarcity of some resources reflects negatively on the overall international economy, and this realization, along with deliberation on a gross domestic product (GDP) and population growth on a global level, led to a shift in focus towards a circular economy (hereafter CE), at the centre of which lies the user of a service. The CE relies on natural resource circulation cycles, reducing expenses and the ecological footprint. In the past few years, ecology has become one of the critical issues in all levels of politics as a result of the irrevocable understanding of the challenges that climate change poses for the entirety of humankind [4]. The issue is also discussed by citizens, who are becoming more aware of the immediate influence of ecological policies on their everyday lives, which is why it comes as no surprise that, according to a research project recently undertaken by Eurobarometer, as many as 94% of people surveyed in all EU member states find the issue of environmental protection a significant one, while 78% of those surveyed gave an affirmative response to a question about the possible effects of environmental challenges on their everyday lives and health. Therefore, the CE represents the grounds for the establishment of sustainable development and Industry 4.0, and the construction of a new digital society shaped by intelligent manufacturing

methods, increases in service offering, and optimal resource management.

The term sustainability itself originates from forestry and its principle that the amount of wood harvested should not exceed the volume that grows again. Later, it was transferred to the context of ecology, as “the quality of causing little or no damage to the environment and therefore able to continue for a long time” [5].

The concept's capturing can be linked to the increasing evidence on global environmental risks, such as ozone depletion, climate changes, biodiversity loss or the alteration of the nitrogen cycle, as the current and traditional linear extract-produce-use-dump material and energy flow model of the modern economic system is unsustainable [6].

The idea of CE has been around since the dawn of industrialization with the argument that it reduces negative environmental impacts and stimulates new business opportunities [7], but the linear flow model has dominated. Unlike traditional recycling, the practical policy and business orientated CE approach emphasize product, component and material reuse, remanufacturing, refurbishment, repair, cascading and upgrading as well as solar, wind, biomass and waste-derived energy utilization throughout the product value chain and cradle-to-cradle life cycle [8][9][10].

The concept of the CE has been gaining momentum since the late 1970s [11], but the contemporary understanding of its practical applications to economic systems and industrial processes has evolved to a variety of concepts that share the idea of closed loops. Some of the most relevant theoretical influences are cradle-to-cradle [12], laws of ecology [13], looped and performance economy [14], regenerative design [15], industrial ecology [16], biomimicry [17] and the blue economy [18].

### III. METHODOLOGY

Guided with the main hypothesis that the presence of a circular economy is an indicator of the 4IR occurrence, research is conducted on data for the 2010–2020 period cited in the Croatia Country Report 2020, which was delivered to the European Commission for assessment at the beginning of 2020, as well as the Eurostat statistical evaluations for the 1990–2019 period based on the data given by member states to the European Commission every year. Likewise, to corroborate the arguments about the representation of deliberations on ecological matters among the EU citizens, the results of Eurobarometer's [19] data, gathered in December 2019 via a direct survey of 27,498 EU citizens, are used.

The observed indicators are:

- the annual reduction rate of greenhouse gas emissions in comparison to data from 1990,
- the share of renewable energy in total energy expenditure,
- the total number of electric vehicles in the Republic of Croatia in 2020,
- the percentage of total recycled waste,
- the percentage of communal waste transported to proper waste disposal sites,
- the circular material use rate,
- the leakage rate of the Croatia's water supply system for 2018.

Furthermore, to provide a more detailed insight into the context, the following documents were also used:

- the EU's circular economy legislative package,
- the European Green Deal,
- the Croatian National Waste Management Plan for the Period 2017-2022,
- the Strategy of Upgrading and Development of the Environmental Protection Information System and Improvement of the Environmental Monitoring and Reporting System in the Republic of Croatia,
- Europe 2020,
- the Integrated National Energy and Climate Plan of the Republic of Croatia for the period 2021-2030.

### IV. RESULTS AND DISCUSSION

#### A. Context for change

As an EU member state, the Republic of Croatia is consistent in its enactment of laws and strategies of the circular economy's advancement on a European level. Some examples of this are the legislative package enacted in 2015, which encourages strengthening competitiveness, the creation of new job opportunities, and sustainable development, along with the associated EU Circular Economy Action Plan, which secured over 6 billion euros for the funding of the transformation [20], as well as waste management directives and the recently enacted European Green Deal. The European Green Deal expressed the EU's ambitions for achieving climate neutrality for the entire continent by 2050, which is projected to be accomplished through a complete transition to the circular economy, reducing the ecological footprint, and the encouragement of biodiversity of the continent's flora and fauna [3].

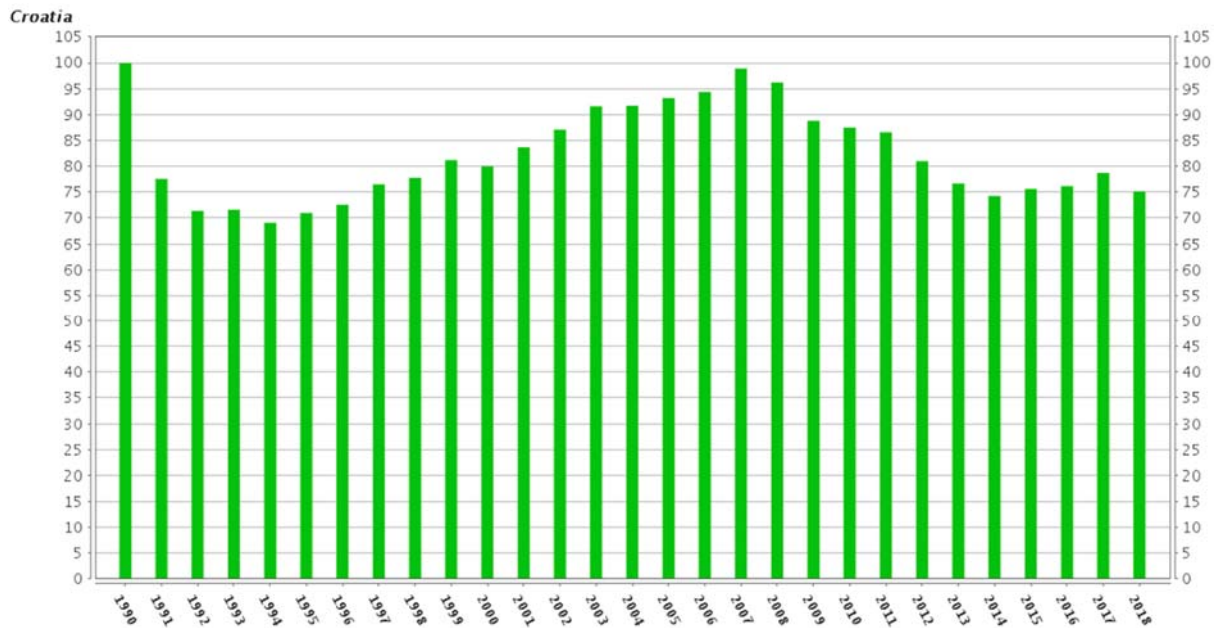


Fig. 1 The percentage of greenhouse gas emissions in the Republic of Croatia compared to 1990 data

Along with assuming the responsibilities defined in the aforementioned documents, the Republic of Croatia has, on a national level, also undertaken activities that support the realization of its goal of digital transformation through sustainable development, which is why it is important to mention the implementation of the National Waste Management Plan for the Period 2017-2022 [21], the Strategy of Upgrading and Development of the Environmental Protection Information System and Improvement of the Environmental Monitoring and Reporting System, which is being carried out as part of the Environmental Protection and Energy Efficiency Fund, as well as the implementation of the Environmental Protection Information System (ISZO) as part of the activities of the Croatian Agency for the Environment and Nature [22], and the activities relating to the LIFE

Programme enacted by the Ministry of Environmental Protection and Energy with EU funding. The LIFE Programme secure the funding for projects from the field of the circular economy [23].

Finally, strategy Europe 2020, which got a 10-year extension under the name Europe 2030, stands out as the EU's most important strategic document in the field of sustainable development. As its primary goals to achieve by the end of 2020, the strategy highlights employment, research and development, climate change and energy, education and social inclusion, and poverty alleviation. Among the objectives on the advancement of the circular economy, it highlights the need for sustainable resource use, reducing carbon emissions, and the protection of the environment and biodiversity [24].

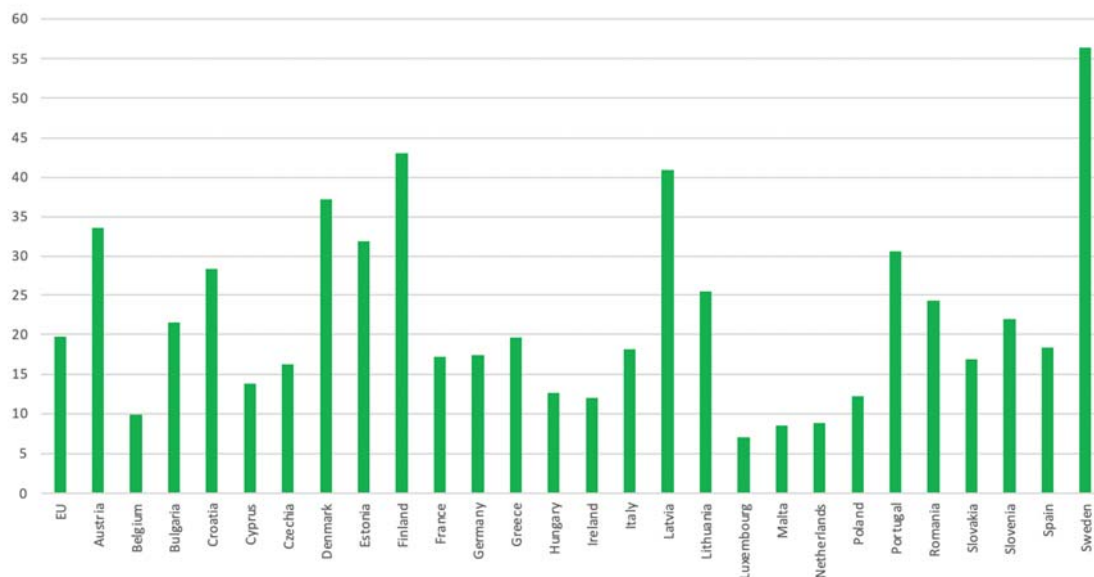


Fig. 2 The share of renewable energy in total energy expenditure in the EU in 2019

The strategy's concrete goals on the EU level are a 20% reduction of greenhouse gasses compared to 1990, meeting 20% of energy needs with renewable energy sources, and a 20% increase in energy efficiency [24]. The greenhouse gas reduction goal has already been met, considering that the 2018 results showed a reduction of 24.2% compared to 1990 data. Even though national measures are not the same in all countries, it is possible to point out the positive direction in which the Republic of Croatia has progressed [25], which is also shown in Fig. 1

### B. Present indicators

Furthermore, according to the data for 2019 the EU has advanced towards reaching its goal in the share of renewable energy sources in the total energy mix, whereupon Croatia became one of the European Union's leading countries in the field of renewable energy source usage [26] as shown in Fig. 2. The Integrated National Energy and Climate Plan for the Period 2021-2030 has presented an additional increase in this upward trend by setting the ambitions for 36.4% of total energy consumption from renewable sources by 2030 [27].

Despite the positive results relating to greenhouse gas emissions and renewable energy sources in total energy consumption, use in certain sectors is falling significantly behind the expected results, mostly due to the scarce and inadequate state incentives. This problem is made most apparent by the usage of renewable energy sources in traffic. According to data from the Croatian Centre for Vehicles, too few electric vehicles are used in Croatia – only 1343 in 2020 [28].

Since the usage of alternative fuel types in vehicles is a relatively new phenomenon related to the implementation of Industry 4.0, a used vehicle market has not been

developed yet, urging all interested customers to buy new vehicles that are significantly more expensive than vehicles that use traditional fuel types. Therefore, it would be desirable to encourage buyers to purchase these vehicles through financial aids provided by the state, which is still not an established continuous practice in Croatia, since the aids rely greatly on economic events and the current capacity of the state budget [29].

The Republic of Croatia is considerably lagging behind EU averages in many areas, and the lack of concrete political initiatives for change can be highlighted as the main reason for the sluggishness of its progress. For example, Croatia recycles only a small percentage of its total waste, a total of 25% in 2018, as opposed to the EU average of 47%. Furthermore, the percentage of communal waste dumped in landfills instead of being incinerated or recycled is 66%, which is three times higher than the European average. Moreover, Croatia has a low circular material use rate - 4,9% of 2019's total material use [30], as shown in Fig. 3. Even though certain positive steps have been made, Croatia requires more significant investment into its development and reaching the European goal of eliminating its ecological footprint by 2050 [3]. In doing so, the key is a focus on recycling and the prevention of waste generation itself, and this is something that, along with the Croatian Government, the business sector, and the citizens, should be directed towards.

Along with more efficient waste management, it is also necessary to focus on optimizing the water supply network, considering that a significant share of Croatia's population still does not have access to drainage and water supply systems.

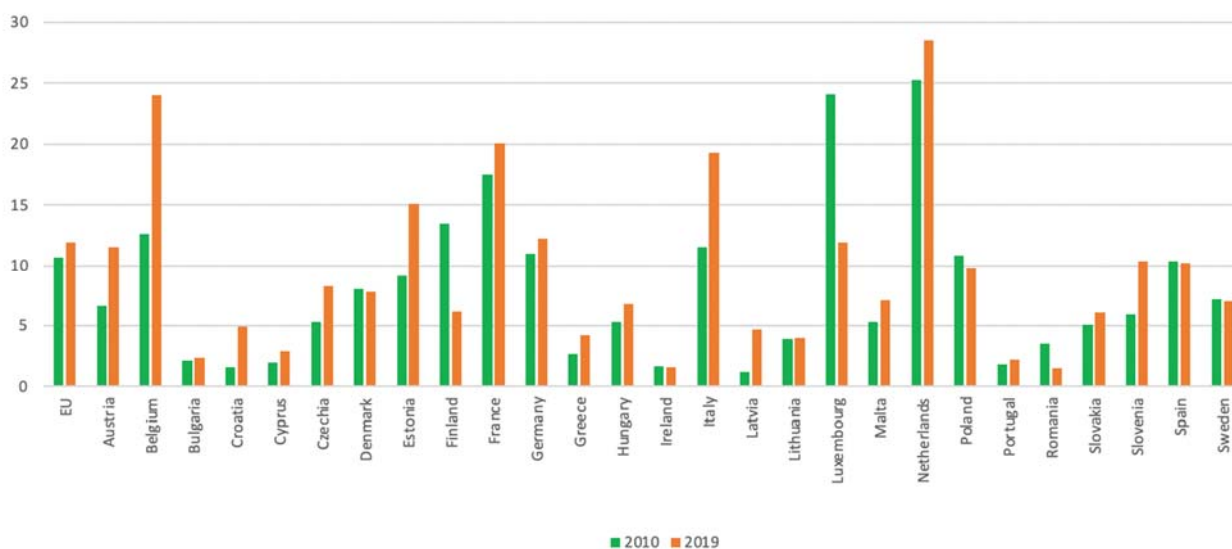


Fig. 3 The circular material use rate in EU member states in 2010 and 2019

In addition to the construction of new parts of the network, significant investments need to be made into the modernization of the existing infrastructure, which would reduce the unnecessary usage of natural resources caused by technical inadequacies such as, for example, the leakage rate of the water supply system, which is the cause for the loss of 44% of its total received water supply. Furthermore, Croatia is missing an ecologically acceptable wastewater management system, considering that they are currently mostly being released into the environment without previous processing and purification. That could prove to be extremely dangerous for the health of the population, but also for the protection of its biodiversity and natural beauties, which Croatia highlights as one of its advantages over its competition and uses as the basis for the promotion of its tourism sector as an important source of income [29].

## V. CONCLUSION

The CE represents the grounds for the further development of society and the economy. Adequate resource quantities, the reliability of future energy supply, and environmental care, which were the grounds for establishing the Fourth Industrial Revolution, present the conditions for further industrial development on a global level. In the case of inadequate investment and political unwillingness to change, technological accomplishments soon may become limited, considering that the commercialization of ICT will not be able to keep up with their further development, which is why the encouragement of circular economy makes for one of the essential elements of current and future state competitiveness. The European Union has recognized these challenges by setting ambitious goals in this area with a legislative package and strategic documents. The Republic of Croatia has, as an EU member state, accepted the designated goals and activities for their fulfillment, but they have shown themselves to be more challenging to achieve in practice. Despite several examples of good practices, a large number of indicators are well below the EU average, while certain activities, such as adequate waste incineration and wastewater treatment, are not being conducted at all. All of this affects the sluggishness of the Croatian economy's transformation from a linear to a circular model and, thereby, its competitiveness, which partially confirms the hypothesis established above, as it proves its connection to the presence of a Fourth Industrial Revolution in some areas, but not its implementation in the Republic of Croatia. To achieve better results in the period encompassed by the Europe 2030 strategy, the Croatian Government needs to establish national strategies in all areas of activity of the circular economy, set more ambitious goals, and secure the backing of EU funds for their implementation.

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