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CIRCULAR ECONOMY: AN ANALYSIS FOR TURKEY

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ABSTRACT

Circular Economy has emerged in need of an alternative economic model to reduce the environmental hazard and improve sustainability. This study analyzed four different indicators of Circular Economy, namely: resource productivity, renewable energy consumption, domestic material consumption and the generation of municipal waste based on secondary data to depict the volume of circular practices in Turkey in a frame of Circular Economy and environmental performance. Main findings of the paper show that Turkey is lagging behind the EU average regarding circular economy practices and environmental performance. On the other hand, increased levels of Renewable Energy Consumption may help to reduce CO_2 emissions.
Keywords: Circular Economy, Turkey, sustainability, resource productivity, decoupling, environment

INTRODUCTION

Nature is moving circularly in an infinite cycle of materials, whereas humans and their current way of living keep flowing linearly. Especially after the Second World War, both production and consumption processes caused the rise of environmental problems. The idea of sustainability started to emerge after realizing how the current system had been damaging our natural environment and a need for an alternative model was essential. Hence green economy, blue economy and circular economy have emerged as the most popular concepts (*Onder*, 2018). The simplest definition of circular economy stands as; "The economy in which products, materials, and resources last as long as possible and waste is kept at the possible lowest level" (*European Commission*, 2015). This concept necessitates a restorative industrial system, conversion into renewable energy, reduction of toxic chemicals and prevention of waste, which is being summarized as 3R: reduce-reuse-recycle *(Kalmykova et al*., 2018). "Reducing" however, is the essential part of the system in order to minimize the harm in the first place. Recycling per se does not lead the way towards circularity and an efficient implementation of sustainability requires a change in consumption and production patterns (*Sapmaz Veral*, 2019).

Turkey, being among the developing economies in the world and in the EU harmonization process, needs a better policy and understanding of environmental concepts especially within its economic development frame. OECD states that "Turkey is the eighth largest OECD economy and the fastest growing. The country's

rapid economic development and population increase are likely to aggravate environmental pressures" (*OECD*, 2019, p. 4).

In Turkey the Circular Economy concept has not been properly developed nor it is understood accurately. The policies and strategies are not being implemented thoroughly yet. However, primarily with the collaboration and guidance of EU institutions and regulations, the country has made a progress in this context. Environmental policies have become an essential part of national development plans where The Ministry of Environment and Urbanization is the main actor of the policy making and implementation process.

The main objective of the present paper is to make a review on Turkey from a Circular Economy approach. In the theoretical background the concept of Circular Economy and various indicators together with a country overview have been explained briefly. Specific indicators have been chosen for an assessment depending on data availability and their prevalence in the field. In the analysis part firstly, decoupling trends between resource efficiency, domestic material consumption and GDP (Gross Domestic Product) have been analyzed. A second analysis demonstrates the relationship between renewable energy consumption and CO_2 emissions. As a final analysis, the graphs depicting the data for 2016 municipal waste generation, resource productivity and domestic material consumption have been given in a comparison to some of the EU countries. In the conclusion section recommend-dations are- given towards a better understanding, system and implementation.

THEORETICAL BACKGROUND

The Concept of Circular Economy and Indicators

China and the European Union have presented the Circular Economy (CE) concept as a solution to live in balance with the natural environment and close the loop of the product life cycle (*Prieto-Sandoval et al.*: 2016). This concept originates from the idea of integrating economic activity and environmental well-being in a sustainable way. "… aims at reducing both input of virgin materials and output of wastes by closing economic and ecological loops of resource flows" (*Haas et al.*, 2018, p. 765). One of the main targets of CE is to increase the harmony between economy, environment and society by focusing on resource efficiency and waste (*Valavanidis*, 2018).

Along with the circular economy concept, the development of more recent theories such as regenerative design, performance economy, cradle to cradle, biomimicry and the blue economy may be regarded as an important step towards the further elaboration and improvement of this concept (*Ghisellini et al.*, 2016).

EASAC (the European Academies' Science Advisory Council) grouped several indicators related to circular economy such as: sustainable development, environment, material flow analysis, societal behavior, organizational behavior and economic performance. They also evaluated that non-material measure indicators should also be taken into account for monitoring progress towards a CE. In their circular economy indicators report they state that indicators by industrial sector on critical raw materials, of social change, infrastructure, human resources and changes in business models, an indicator showing the extent to which waste was being

transformed to secondary raw materials, water indicators may also be desirable to be included in the indicator sets for the circular economy (*EASAC*, 2016).

Decoupling of resource use and environmental impact from economic activities are the important priorities in Circular Economy. Therefore, resource efficiency, waste reduction and tracking material flows are all important concepts, however, those do not show the real environmental impact of resources extraction and use (*EASAC*, 2016).

Progress towards a circular economy should ultimately lead to a measurable reduction of the total amount of primary raw materials that are extracted from the environment, as well as the total amount of landfilled or incinerated waste. Hence, most of the abovementioned indicators focus on material inputs, waste outputs and recycling rates. On the other hand, the share of secondary materials in total material consumption is also crucial to measure the degree of "circularity" of a specific economy (*ESPON*, 2019).

Environmental Performance and Circular Economy Approach in Turkey

Turkey, with a population slightly over 82 million and approximately 9.000 US dollars per capita GDP (*World Bank*, 2020), is a developing country facing severe environmental issues. Among the root causes of environmental problems faced by Turkey, factors such as inter-regional differences of development levels, inequalities in income distribution, high rate of population growth, lack of cohesion between environmental and economic development objectives, lack of legal and institutional regulation, inadequate public awareness and inclusion in terms of environmental protection play a substantial role (*Kizilboga & Batal*, 2012).

Candidacy for EU membership has brought a new perspective and targets in Turkey's environmental action agenda where the need for harmonization to and implementation of EU legislation is mandatory as a candidate country.

OECD's environmental performance review for Turkey 2019 states that Turkey has partially decoupled its economic growth from resource use and environmental hazard, however still more effort is needed in the transition process towards a low carbon circular economy (*OECD*, 2019).

Turkey must adopt a comprehensive material resource policy and promote a separate collection of municipal solid waste, reducing biodegradables going into landfills and incineration of hazardous waste. The European Commission states that "The preparation of waste management plans at the local level, in line with the Waste Framework Directive, is ongoing" (*European Commission*, 2018). According to OECD Report 2019, "Material productivity is below the OECD average but did however start to grow in the recent years" (*OECD*, 2019, p. 5).

Currently, recycling rate in Turkey is still lagging behind the EU and developed countries as per "Municipal waste recycled and composted in Europe chart" provided by European Environment Agency (*EEA*, 2020).

According to the data regarding environmental spending and employment obtained from the Turkish Statistical Institute for 2016, overall environmental spending was realized as 1.2% of GDP. Among all environmental spending, waste management services constituted 40.4%. Income generated by environmental

activities belonged to the public sector with 58.9% share and 41.1% to business. The most substantial spending on environmental activities is realized by the public sector, whereas the environmental employment is realized rather high in the private sector (*Turkish Statistical Institute*, 2017).

When we consider environmental management in two levels as central and local, local governments' responsibilities become substantial for providing services for public benefit considering environmental problems. An important feature of environmental problems is that they are specific to the place where the hazard originates and hence, local authorities in the origin of the problems play a primary role in preventing and resolving them. When local administrations are financially dependent on the central government, they cannot use initiatives in a broad sense to solve the local issues, which generate problems in policy making and functioning. Local authorities should be able to set local environmental taxes and use these tax revenues to prevent and eliminate environmental problems (*Kizilboga & Batal*, 2012).

Fundamental drawbacks regarding the waste management in Turkey can be summarized as follows: Inadequate coordination and cooperation among various organizations in power, need for a better taxation policy for environmental services provided, lack of awareness and education, political concerns averting local needs and local authorities, "save the day" policies which result in inefficient use of financial sources, and lack of resource, staff, and equipment due to low amount of investments. (*Gulec & Pekkucuksen*, 2018) Proper data collection, research and analysis are essential factors to reflect the status quo and for developing efficient environmental and circular strategies and policies which Turkey is in need.

Turkey, with vast farmlands and a large population should use the advantages of energy production based on renewables and wastes, and develop policies in this direction.

The choices in the stages starting from the definition of environmental problems to the setting the priorities, policies for the solution, and the reflection of these to the implementation can lead to different environmental policies. In this case, in addition to the consistency of environmental policies within, it is necessary to ensure compliance with economic and social policies. In this context, it might be concluded that environmental policies are not only related to the protection of the environment, but also indirectly with other fields such as law, finance, urbanism and industrial policies.

MATERIALS AND METHODS

Although the primary goal of this paper is to show the degree of circularity with a comparative analysis, some restrictions have been encountered due to the data availability to make an accurate assessment regarding the main circular economy indicators. Finally, an analysis has been made to reflect the decoupling trends between economic growth, resource productivity and domestic material consumption. Another analysis has been made to demonstrate the relationship between Renewable Energy Consumption and CO_2 emission in Turkey. Comparison for Resource Productivity, Domestic Material Consumption, and Waste Generation data have also been analyzed on graphs.

Decoupling refers to breaking the link between environmental hazards and economic advantages, which means decoupling indicators measure the decoupling of

environmental pressure from economic growth over a given period. A lot of the variables that feature in decoupling indicators also appear in the concepts of resource efficiency, resource intensity and resource productivity. Decoupling is usually conceived as an elasticity focusing on changes in volumes, whereas efficiency and intensity are more concerned with the actual values of these ratios. "The decoupling concept has however no automatic link to the environment's capacity to sustain, absorb or resist pressures of various kinds … . A meaningful interpretation of the relationship … will require additional information." (*OECD*, 2003, p.13)

Resource productivity is an indicator for the effectiveness with which an economy or a production process is using natural resources and it reflects the output or added value generated per unit of used resources. It is calculated as the ratio between GDP and Domestic Material Consumption (DMC) - a variable used in material flow accounting. DMC measures the weight of the materials that are physically used in the consumption activities of the domestic economic system. As per its circularity measurement character, one can expect that the lower the per capita value of the DMC is, the less primary material input is expected to flow into the system (*OECD*, 2008).

The data for Resource Productivity, Domestic Material Consumption and Municipal Waste Generation have been obtained from Eurostat Environment Database for the year 2016 due to the availability of data for all the chosen countries of this year. Data used in the analysis of decoupling of resource productivity, economic growth and domestic material consumption have also been obtained from Eurostat for the period 2009-2016. Decoupling trends for Turkey has been illustrated on a graph that has been reproduced based on another graph that was previously provided by Eurostat for EU countries. (*Eurostat*, 2019)

Time series data for CO_2 emissions and Renewable Energy Consumption (REC) have been obtained from the World Bank's World Development Indicators database. CO2 emissions data as a representative of Greenhouse Gas Emissions (metric tons per capita- Carbon dioxide emissions are those stemming from the burning of fossil fuels and cement manufacture. They include carbon dioxide produced during the consumption of solid, liquid and gas fuels and gas flaring) range the period 1990-2014. REC (% of total final energy consumption - Renewable energy consumption is the share of renewable energy in total final energy consumption.) data covers the period 1990-2014 (*World Bank*, 2019)

For testing the correlation between REC-CO2 emissions, the analysis has been made in Minitab and EViews programs. Raw data have been converted with a calculation of annual change for each year. The data for the indicators of the decoupling trend (namely DMC, RP and GDP) have been indexed to the base year.

RESULTS AND DISCUSSIONS

Decoupling Trends between Resource Productivity, Domestic Material Consumption and GDP in Turkey

Resource productivity in the EU increased by 38.8 % between 2000 and 2016 and despite the decline in domestic material consumption since 2007, GDP has nevertheless continued to grow. This suggests that the EU has partly decoupled

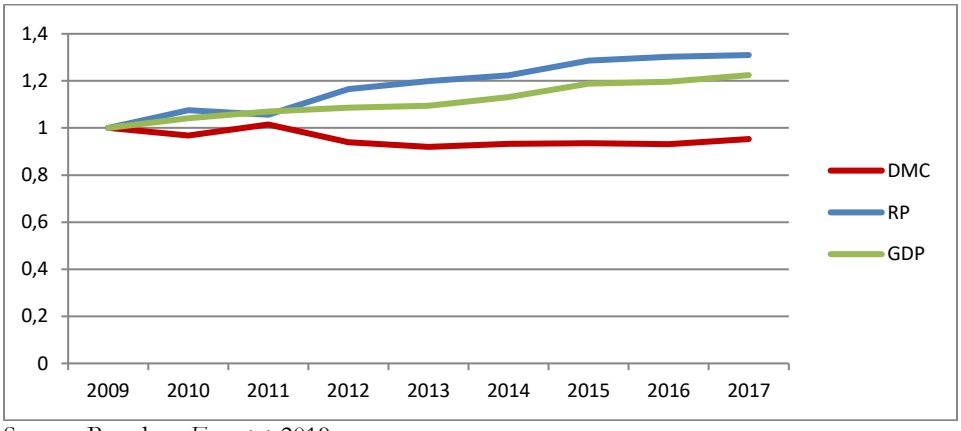
economic growth from resource use. Like material consumption, resource productivity also significantly varies between Member States, although it has been improving in nearly all of them. (*European Parliament*, 2017)

Observation of a potential decoupling of an economy from resource consumption is mainly based on an analysis of the relationship between GDP and DMC per capita. "The idea behind decoupling is that economic growth is possible without harming the environment or with lowering the negative environmental effects of growth (i.e. when resource consumption decreases and at the same time economic production increases). The opposite of decoupling is recoupling (or relinking). In this case both indicators have the same sign, but the change rate of resource use is higher than that of the economic production" (*ESPON*, 2019, p. 22).

"Relative decoupling is achieved when economic growth is exceeding growth in material use. In contrast, achieving economic growth at the same time decreasing overall material use is called absolute decoupling. While both cases entail an increase in efficiency in raw material use, only the latter can be seen as a means towards lowering the pressures on the environment." (*Materialflows.Net*, 2020)

Figure 1 and *Figure 2* show the decoupling trends for EU 28 and Turkey respectively.

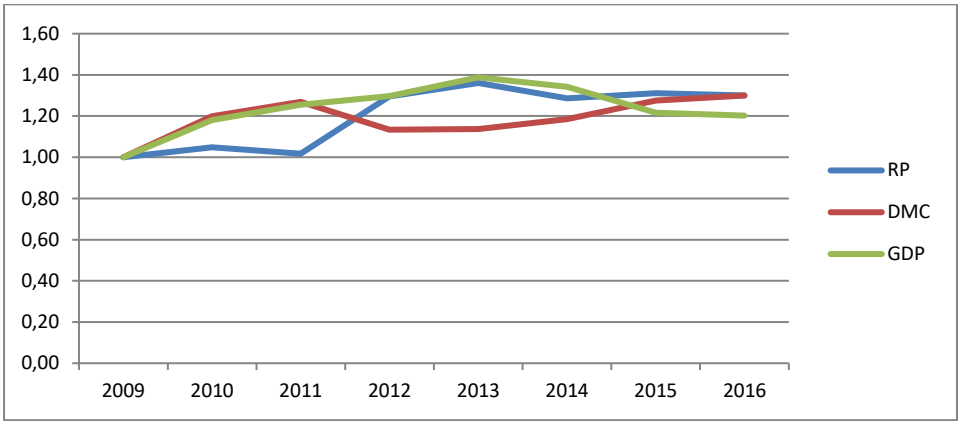
Figure 1: Resource productivity (Euro per kg DMC) in comparison to GDP (Euro per capita) and DMC (tonnes per capita) in EU-28



Source: Based on *Eurostat*, 2019

Figure 1 shows that despite the decline in domestic material consumption in EU 28, GDP has nevertheless continued to grow, which suggests that the EU has partly decoupled economic growth from resource use. On the other hand, when we look at *Figure 2* (as reproduced based on the Eurostat's previous graph), which depicts fluctuations in different periods, however considering the recent trends, it can be argued that DMC has been increasing together with a decrease in GDP, which means we cannot talk about a DMC independent economic growth. One might expect a decrease in Resource Productivity shortly, where an absolute recoupling may be observed in Turkey. In this case one cannot talk about a clear decoupling trend in Turkey.

Figure 2: Decoupling Trends of GDP (euro per capita), Resource Productivity (Euro per kg DMC) and DMC (tonnes per capita) in Turkey



Source: Based on *Eurostat*, 2019

Increasing resource productivity through improved efficiency and reducing resource waste through circular economy with recycle and remanufacture can at a great sense lower both resource consumption and GHG emissions. Such measures can also result in highly desirable social benefits such as more equitable access to resources and reduced pollution. In order to reduce both GHG emissions and other pressures on environment and resources, economic growth should not cause the environmental and resource degradation and a circular economy targeting reduce, reuse and recycle must be a key strategy (*UNEP*, 2015).

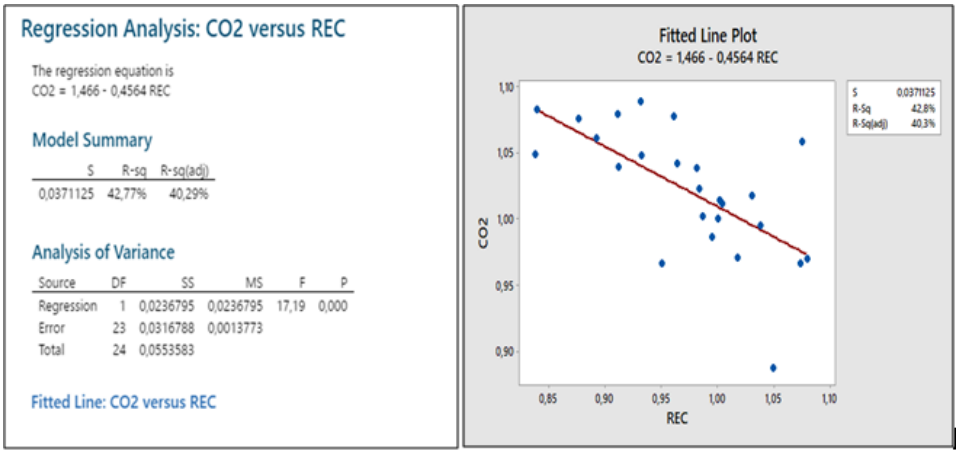
Renewable Energy Consumption and CO_2 Emissions

Climate change is one of the biggest challenges the world is facing today, therefore renewable energy sources provide an excellent opportunity to mitigate the greenhouse gas emissions. Optimal use of renewable energy sources can help to tackle the environmental challenges (*Keleş & Bilgen*, 2012). The use of renewable energy sources instead of traditional energy sources is seen as the most effective method against the threat of climate change and global warming. However, neither the policy practices nor empirical researches on this issue are sufficient yet *(Özbuğday & Erbas*, 2015). One of the main principles of Circular Economy includes "renewability" where renewable energy is the main source to reduce fossil energy dependence therefore enhancing the resilience of the economic system (*Ghisellini et al.*, 2016). Reducing CO_2 emissions and conversion to renewable energy consumption therefore constitutes an important part of circularity.

Since air pollution is a critical environmental problem in Turkey, renewable energy sources are vital for ensuring the safety of Turkey's future energy supply in terms of both being a sustainable source of energy and environment friendly. In addition, Turkey's geographical location and climate conditions provide important advantages in terms of renewable energy sources (*Keleş & Bilgen*, 2012).

Despite the drastic increases in energy prices, the strong appetite for the growth in the world increases energy demand and thus this increase is satisfied by fossil fuels. However, this increase in prices could help to accelerate the trend towards the utilization of renewable and sustainable energy sources that are thought to be costly (*Soytas & Sari*, 2009).

Figure 3: Results of correlation test between REC and CO_2 emissions



Source: *World Bank*, 2019

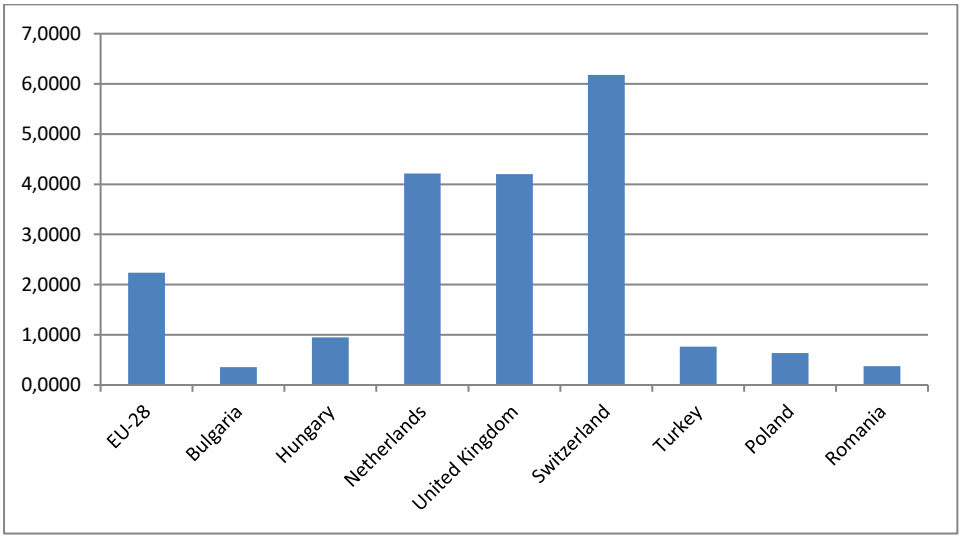
In *Figure 3* the first results of the analysis show a negative correlation between REC and CO_2 emissions, meaning that one unit increase in REC results in 0,05 unit decrease in CO_2 emissions. Similarly, the empirical results of the study made by *Seker & Cetin* (2015) on the relationship between renewable energy consumption and carbon emissions by incorporating economic growth, population density and trade openness as potential determinants of environmental pollution function in case of Turkey over the period 1960 to 2010 shows that renewable energy consumption has a negative effect on carbon emissions in the long run. This negative correlation can lead us to a middle ground of two different approaches in environmental studies: climate change and circular economy, which in fact goes hand in hand, however having different focus points and indicators. Increased levels of REC (as a part of circular economic approach) can result in decreased levels of CO_2 emissions being in the core of climate change debates.

Comparison of Resource Productivity, Domestic Material Consumption and Municipal Waste Generation

For this analysis, certain EU countries have been selected regarding their resource productivity (the lowest- Bulgaria and Romania-, the highest- UK, Switzerland and the Netherlands and the ones performing similar to Turkey- Hungary and Poland) as of 2016 (due to the restrictions of data availability) and three graphs for Resource Productivity, Domestic Material Consumption and Municipal Waste Generation

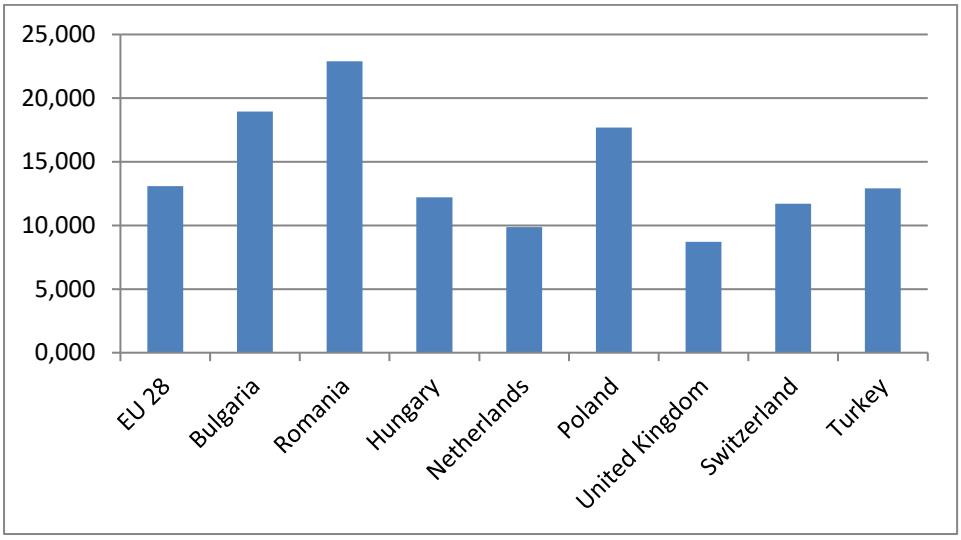
have been elaborated based on the statistics from *Eurostat* (2019) to show a comparison between Turkey and other selected countries which can be seen in figures 4,5 and 6 respectively.

Figure 4: Resource Productivity, Euro per kg, 2016



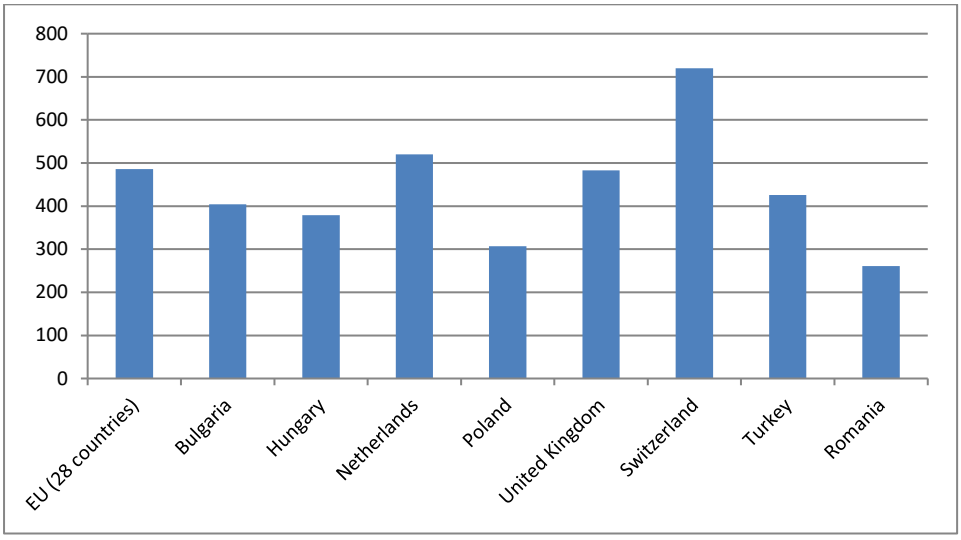
Source: *Eurostat*, 2019

Figure 5: Domestic Material Consumption, tons per capita, 2016



Source: *Eurostat*, 2019

Figure 6: Generation of Municipal Waste, kg per capita, 2016.



Source: *Eurostat*, 2019

The graphs summarize that for the year 2016 Turkey performs close to the lowest group in terms of resource productivity, whereas its domestic material consumption remains above the ones which are the highest performers of RP. The generation of municipal waste amount is above the lowest performers of RP as well as its counterparts, but still below the countries with high resource productivity. It performed weakly regarding resource productivity. Domestic Material Consumption and Municipal Waste Generation have been observed close to the higher group of EU countries and EU-28. As Resource Productivity shows us the rational trend between GDP and Domestic Material Consumption (RP= GDP/DMC), one can conclude that low resource productivity would stem from either low levels of GDP or high levels of domestic material consumption. In this case both are valid for Turkey and to some extent this explains its low resource productivity (Turkey's GDP USD per capita for 2016 was the third lowest in this group depending on OECD data).

CONCLUSIONS AND RECOMMENDATIONS

Circular economy is a remarkable sustainable development strategy that has great potential to reduce environmental harm, increase material and energy efficiency and create new opportunities for businesses and communities as well as is relevant for all types of territories, yet it will be implied diversely in accordance with local conditions.

The main difference between sustainable development and circular economy is their macro and micro-level characteristics respectively. "If the application of circular initiatives brings better results towards sustainability, then the circular economy becomes a tool for sustainable development" (*Valavanidis*, 2018, pp.5).

This study has analyzed four different indicators of Circular Economy, namely: resource productivity, renewable energy consumption, domestic material consumption and the generation of municipal waste to demonstrate the volume of circular practices in Turkey in a frame of Circular Economy and environmental performance. The paper's main findings show that Turkey is lagging behind the EU average regarding circular economy and environmental performance. On the other hand, the analysis also shows that increased levels of Renewable Energy Consumption may help to reduce CO_2 emissions in Turkey. In terms of decoupling economic growth from material use and resource productivity, a clear decoupling trend could not be observed in the case of Turkey. This reveals the fact that Turkey has not seemed to be quite successful to sustain its economic growth without putting a pressure on the environment (or creating environmental hazard in other words) or being independent from resource consumption so far.

For further studies it may be recommended to include more variables to test the impacts on environmental degradation and the degree of circularity with more effective results. So far, it can be concluded from the given literature that there is no consensus on a common framework regarding the CE (the reason can be attributed to the fact that it is place specific, the implementation and policies vary in different places in regards to differences in development and growth, technology and education levels, available resources, structure of the population and the economy, geographical conditions etc.). Improving a common understanding and policy of the concept may lead to better practice all around the world.

Turkey has a significant potential in terms of combustible renewables and waste energy sources. The findings of the study have shown that the use of these kinds of renewable energy sources may contribute to the reduction of carbon dioxide emissions. Therefore, policy makers should conduct new incentive policies and investments for combustible renewables (biogas and biomass), municipal waste and industrial waste, as well as measures to encourage renewable energy sources. In particular, the use of agricultural areas in this way with the technological developments and evaluation of the waste can be estimated to be much more effective. It is necessary to give importance to training that ensures environmental awareness in every sector and to ensure active participation of local governments, public and non-governmental organizations in the management process. It is also important to prioritize environmental planning, ensure balanced and healthy urban development, eliminate conflicts in the management level and ensure cooperation between local governments as they are the drivers for the implementation of circular economy. Local governments can play the key role to bring private and public stakeholders together, define the needs of the society and certain places as being the first level governance, urban planning, waste regulations, policies and roadmaps. To tackle the systematic problems, collaborative governance may be helpful by sharing the visions, expertise and experiences (for instance multi-topic governmental networks such as EUROCITIES, ICLEI, and the Covenant of Mayors including circular economy focus areas). The city of Milan for example has had the opportunity to share the experiences of Tokyo, Seoul and San Francisco regarding food waste collection and exceeded the EU food waste recycling target through an A C40 waste

and resource network event. Local city networks are also valuable, like in Scotland and Portugal, creating a regional network and knowledge exchange. The CircE Interreg project brings together European regions and cities to share and learn from each other for a transition to CE. Other networks focusing on specific circular economy elements also exist, such as the Sharing Cities Alliance that brings together cities working on sharing economy policies (*Ellen MacArthur Foundation*, 2019)

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