



# ANALYZING SOME ECONOMIC AND ENVIRONMENTAL RETURNS OF CIRCULAR ECONOMY IN ITALY

**Dr. Zeinab Ali Dashoor**

Department of Economics, college of Administration and  
Economics, Wasit University, Iraq

\* [zdashoor@uowasit.edu.iq](mailto:zdashoor@uowasit.edu.iq)

**Abstract.** *The present study targets carrying out an analysis of economic and environmental returns as an effect of the adoption of a circular economy in Italy. Some of the key concepts it focuses on are promotion of private circular investment, export of recyclable material, use of circular material, eco-innovation, material footprint, and contribution of renewable energy to the total energy. The present study is supported by the systematic analysis of international data related to the role of circular economy in increasing economic efficiency and reducing environmental costs. The results highlight that private circular investment is highly relevant for the creation of new opportunities for economic development and supporting new, innovative sectors, such as recycling technologies. The results also underlined that eco-innovation plays a crucial role in improving resource efficiency, material footprint reduction, and renewable energy. The study confirms that the circular economy can be a strategic opportunity for Italy to further contribute to renewable energy and to reduce its imported natural resources dependence in a way that is both sustainable and economically competitive. The present study provides valuable insights for decision-makers and policymakers to promote circular economy strategies at national and international levels.*

**Keywords:** *Social Welfare, Environmental Law, Financial Incentives, Material Footprint, Ronchi Decree, Industrial Symbiosis.*

## 1. INTRODUCTION

Linear economy, with the plenty of resources, is based on the extraction of raw materials at low costs and on designing short-lived products, with waste landing in landfills. The negative impacts of human lifestyles on various aspects of life and environment have become more evident. Globalization, industrialization, increasing consumption, and mass production have given way to serious consequences on the planet, such as the increase of waste in energy and resources, accumulation of huge amounts of waste as a consequence of a global environmental crisis (Milanović and Erić 2024). The circular economy model is one of the key solutions for achieving a sustainable human future. In this respect, it allows reduction in natural resource extraction, given that the raw materials will be obtained from recycling linked to production. The main approach

of this economy is to create long-life, environmentally friendly products. It is more economical in the long run to repair and reuse well-designed products, instead of the negative impacts brought about by resource extraction and disposal. The transition from a linear to a circular economy has been theoretically and practically documented (De Oliveira, Dantas, and Soares 2021). Circular Economy can be portrayed as a disruptive transformation that aims at the conservation of resources through the closing of circles related to energy and material consumption, with the aim of reducing their depletion(O'Connor 2021).

Applying the notion of a circular economy leads to a rise in the level of environmental protection and social prosperity (Jawahir and Bradley 2016). It is believed that, besides the addition of more new value creation, circular economy could reduce negative environmental impacts on the system as a whole. The European Commission estimates that the transition to a circular economy could add as much as 600 billion euros in additional economic benefits annually to the manufacturing sector in the European Union (Korhonen, Honkasalo, and Seppälä 2018). Economic sustainability is achieved by following the principle of balance among the economic, social, and environmental dimensions(Friant, Vermeulen, and Salomone 2021).

The transition to a circular economy requires radical changes in behaviors, organizational culture, business models, as well as priorities and policies. In addition, it is necessary to bear in mind that this transformation requires efforts at several levels, including the macro level, such as a city, province, or country, the mid-level, such as industrial cooperatives and industrial eco-parks, and the micro level, such as organizations, products, consumers, and citizens. At the macro level, it requires policy adjustments at the national, regional, and local levels(Pauliuk 2018; Vanhamäki et al. 2020).

The research gap identified in the present study is that most studies focus on the environmental benefits of circular economy, but the aim of the present study is to provide a comprehensive analysis that integrates economic and environmental benefits to provide a clearer image for decision makers about the expected benefits for the economy. The present study aims to fill this gap by analyzing some economic and environmental returns of circular economy in Italy. The study is structured as follows

Section 1 presents the context, research gap, and main objective. Section 2 presents previous studies supporting the study. Section 3 presents the analysis of economic returns of circular economy. Section 4 presents an analysis of the environmental returns of circular economy. Section 5 presents the results and concluding remarks.

## 2. PREVIOUS STUDIES

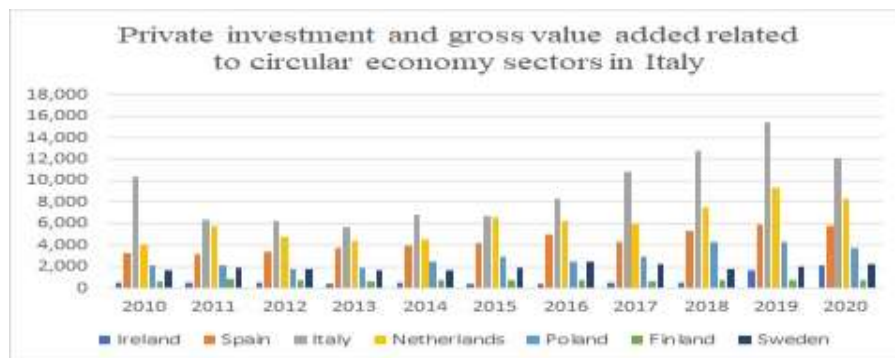
The application of circular economy has become a major topic in economic and environmental studies in recent years. It seeks to address the challenges resulting from resource scarcity and climate change. Previous literature shows that circular economy can lead to achieving significant economic benefits by reducing costs and increasing job opportunities, while also contributing to environmental protection by reducing carbon emissions and waste. Several studies have reviewed the influence of circular economy on the economies of European countries. In (Trica, Banacu, and Busu 2019), the presentation of the economic factors for the sustainable development of circular economy is addressed. In (Sulich and Sołoducho-Pelc 2022), it is indicated that factors of circular economy have a strong and positive influence on economic growth at the European Union level by presenting a proposed model for green jobs in the pursuit of implementing the idea of circular economy. While (Hysa et al. 2020; Vuță et al. 2018) confirm the positive relationship between circular economy measures in the European Union countries (28) and resource productivity, as well as the positive influence on economic growth. In (Hailemariam and Erdiaw-Kwasie 2023), the influence of circular economy on reducing carbon dioxide emissions is examined, based on indicators such as recycling rates of municipal waste, biological waste, and packaging waste. Based on data from 29 European countries for the period from 2000 to 2020, (Pao and Chen 2022) investigate the relationship between circular economy and CO<sub>2</sub> emissions in the European Union (EU) in 2021. They found that for every 1% increase in the recycling rate of municipal solid waste (RMW), CO<sub>2</sub> emissions decrease by 0.5%. While (Schwarz et al. 2021) examined the environmental influence of recycling processes and the best practices for recycling specific plastic polymers. According to their study model, recycling the 15 most demanded polymers in Europe could contribute to reducing plastic-related CO<sub>2</sub> emissions by up to 73%.

### 3. ANALYZING ECONOMIC RETURNS OF CIRCULAR ECONOMY IN ITALY

As a technologically advanced country, Italy has a long history of global competitiveness based on innovation and sustainability. Circular economy offers multiple economic and environmental advantages. From an economic point of view, the transition to a circular economy represents a stimulus for creativity within the Italian entrepreneurial ecosystem, where the exploitation of reused materials becomes a fundamental pillar of the economic process. In this context, materials are transformed from waste into sustainable economic resources. Environmentally, circular economy contributes to the preservation of natural capital and the ecosystem services associated with it. Below is a look at some of the main economic returns of this model:

#### Promoting Private Circular Investment

Environmental sustainability and circular economy in Italy have become profitable assets worth investing in. These investments focus mainly on the purchase of recycled materials (64%) and the recycling of production waste (61%), with 14% of investments allocated to industrial symbiosis projects (Sani et al. 2021). This reflects the growing awareness of the importance of circularity as a fundamental element in the Italian industrial structure. The increasing volume of investments in this area also indicates that companies are beginning to realize the true value of circular economy. However, the benefits of circularity are not limited to the economic aspect only. It also helps companies improve their reputation as a result of adopting these principles as shown in Figure (1).



**Figure 1. Private Investment and Gross Added Value Related to Circular Economy Sectors in Italy**

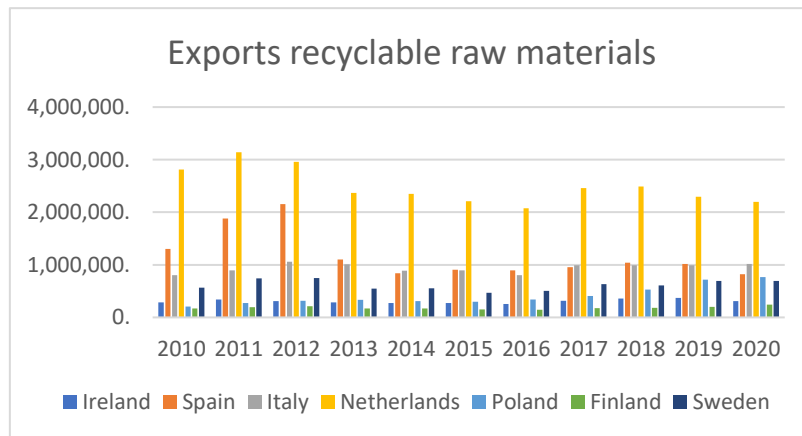
It is clear from Figure (1) that Italy possesses a relatively high level of investment and added value in comparison to other countries, indicating a greater focus on circular economy sectors. There is a clear upward trend in investment and added value between 2010 and 2020, indicating increased awareness and policies supporting circular economy. Italy shows a leading performance, which may be attributed to strong government support, environmental laws, and increased awareness within the private sector about the importance of sustainability.

Italy has launched several measures to enhance incentives and encourage investments in the fields of research and development (R&D) and green innovation, with the aim of directing production and consumption towards sustainable growth and digitalization. The National Recovery and Resilience Plan (NRRP) allocated around €2.1 billion to investments in waste management infrastructure (€1.5 billion) and investments in pilot projects linked to circular economy (€0.6 billion). National spending on R&D in the renewable energy sector amounted to 10% during the period 2011-2020. It is estimated that around 20-40% of total R&D funding for renewable energy technologies comes from the private sector in Italy (Gasser et al. 2022). The Transformation 4.0 industrial plan also launched a set of financial measures to support digital and green innovation, which directly contribute to promoting the transition towards a circular economy. These measures include (Lombardia 2022):

1. Tax credits for investments in capital goods; The aim is to encourage companies to invest in new capital goods that support the technological and digital transformation of production processes in Italian manufacturing sites.
2. Tax credits for research, development, and innovation; The aim is to encourage spending in the areas of research, development, and technological innovation in order to enhance the competitiveness of companies and support the digital transformation towards a circular and environmentally sustainable economy.
3. Training 4.0 tax credits; The aim is to motivate companies to train their employees on how to implement technologies and skills related to technological and digital transformation in the business field.

## Exports of Recyclable Raw Materials

The import and export of recyclable raw materials plays an important role for countries with limited domestic supply, including Italy, which seeks to reduce waste, recycle resources, and improve the efficiency of material use. Exports of recyclable materials have become an integral part of this strategy, contributing to increasing the country's revenues and achieving sustainable development goals as shown in Figure (2).



**Figure 2. Italy's Exports of Recyclable Raw Materials Outside the European Union.**

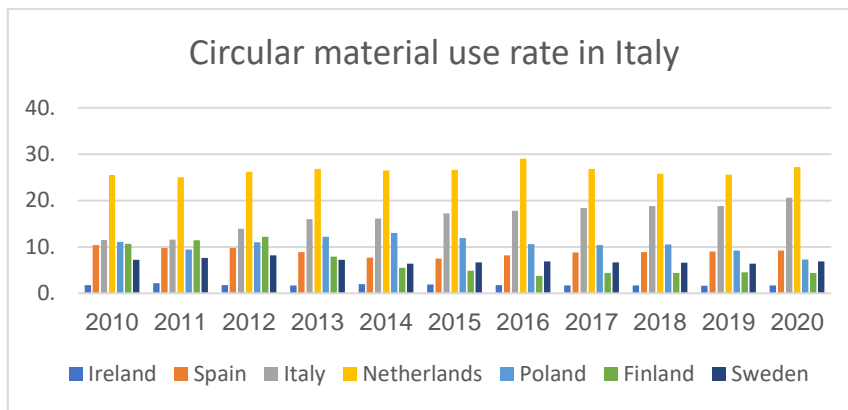
Italy shows a stable and strong performance in exporting recycled materials outside the European Union. With a continued focus on sustainable policies and innovation, it can increase its share in the global market and strengthen its position as one of the leading countries in this field. Italy's privileged position makes it a strategic hub for exports to markets outside the EU. Italy's data show a relatively stable and consistent trend in comparison to other countries, which may indicate the development of the local recycling industry and its gradual expansion into global markets.

The index measures the quantities of specific categories of waste and by-products shipped across the borders of the European Union (outside the EU). Five categories, including plastics, paper and cardboard, precious metals, iron, steel, and copper, aluminum, and nickel represent the selected categories. Before 2018, China received a large share of Italian plastic waste, with about half of the plastic waste exported from Italy destined for Chinese factories. China's import restrictions in 2017 led to a 92% decrease in the country's imports of plastic waste and a 56% decrease in used paper (Tran, Goto,

and Matsuda 2021). Meanwhile, new countries have emerged as export destinations for Italian waste, such as Malaysia, Turkey, Vietnam, Thailand, and Yemen, especially in the Southeast Asian region. Italy is one of the world's largest exporters of plastic waste, ranking 11th globally in 2018, with total exports of 197,000 tons, representing 2.25% of the total plastic waste exported globally.

### **Uses of Circular Materials**

In Italy, urban or municipal solid waste was collected in an undifferentiated manner until the 1970s. Waste was dumped in unorganized landfills. It was not until the 1990s that recycling and material recovery practices through separate collection began to spread. The Ronchi Decree, Law 22/1997, defines the basic principles of waste management, which had previously been fragmented. The decree aims to reduce waste generation and encourage material recovery and recycling, in addition to raising environmental awareness among citizens and promoting cooperation between companies and municipalities (Agovino et al. 2024). The main innovation of the Ronchi Decree is the introduction of a more equitable tax system for waste generation, based on the principle of the more pollution, the higher the cost. Legislative Decree 152/2006, amended by Decree 205/2010 implementing the European Waste Framework Directive of 2008, defines waste management responsibilities at national level. Italian laws contribute to the implementation of the waste management strategy by distributing roles between regions, provinces, and municipalities. Regional authorities plan, provinces control collection, and municipalities implement operational strategies. Italy is also committed to European legislation and recycling targets for 2025 and 2030 (Bertossi, Kaulard, and Massarutto 2000). Increasing the proportion of recycled waste, whether by increasing the amount of recycled waste or reducing the amount of materials used, would reduce the amount of raw materials extracted for production and the related negative impacts on the climate and environment (Geissdoerfer et al. 2017; Kirchherr, Reike, and Hekkert 2017) as shown in Figure (3).



**Figure 3. Circular Materials Use Rate.**

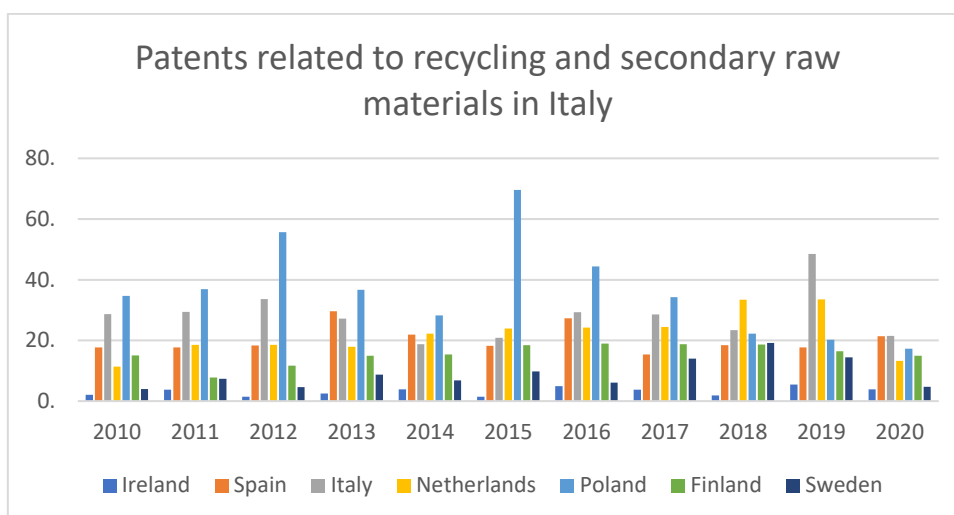
Circular materials use rate indicator is the share of materials recovered and reintroduced into the economy - thus saving the extraction of primary raw materials. Italy aims to raise circular materials use rate to 30% by 2030, which is a very ambitious goal, especially since the current rate in Italy (19%) is already double the EU average. Achieving this goal will contribute significantly to reducing the consumption of raw materials, whether extracted locally or imported.

#### **4. ANALYZING ENVIRONMENTAL RETURNS OF CIRCULAR ECONOMY IN ITALY**

##### **Environmental Innovation**

During the implementation of circular economy model and its principles, environmental innovations gain special importance, as they affect products, services and producers alike. The close relationship between environmental innovation, patent development, and circular economy activities has been identified. These innovations in the fields of patents and environmental innovation are among the most prominent mechanisms that contribute to the transition from a linear economy to a circular economy in production processes (Maldonado-Guzmán, Garza-Reyes, and Pinzón-Castro 2021). On the other hand, the number of patents depends on several factors, including the size of the population. Theoretically, a country with a larger population also has greater potential for innovation and the production of more patents in comparison to countries with a smaller population (Constantinescu et al. 2022; Vence and Pereira 2018) as shown in Figure (4).





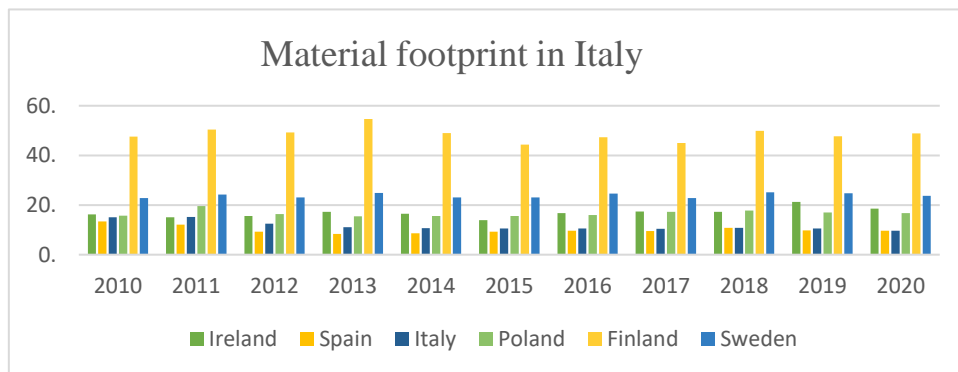
**Figure 4. The Number of Patents in Italy Related to Recycling and Secondary Raw Materials.**

In 2019, Italy ranked third with 48.51 patents related to recycling and secondary raw materials (Milanović and Erić 2024), due to several factors, including significant investment in research and development, and supportive government policies such as financial incentives. The growing awareness of sustainability issues in society also drives companies towards innovation. In addition, the Italian industrial sector is diverse, providing wide opportunities for the application of new technologies. Thanks to its significant investments in the development of plastic recycling technologies (Milanović & Erić, 2024). In 2020, Italy could recycle 73% of the packaging materials in circulation on the market, exceeding the 2025 target of 65% by 8 percentage points, and the 2030 target by 3 percentage points (Cdp 2023).

### Material Footprint

The material footprint is a measure of the material impact, i.e. the local and global demand for the extraction of materials, such as biomass, mineral ores, non-metallic minerals, and fossil energy resulting from the consumption and investment of households, governments, and companies in the world. Italy is one of the most important economies within the European Union and globally, despite the scarcity of its natural resources and its heavy dependence on imports, especially fossil energy and minerals. Natural resources play a vital role in the domestic economy, especially in the manufacture of goods that

Italy exports to various parts of the world (Ghisellini and Ulgiati 2020). The transition to a circular economy would enhance the sustainability of the national economy and increase its competitiveness and security, thus reducing its exposure to the negative impacts resulting from its excessive dependence on natural resources. Italy has been able to reduce its material footprint as shown in Figure (5) due to the strategies for circular economy represented by Legislative Decree 152/2006, known as the (Environmental Law), which constituted an important turning point in Italian waste legislation, as it set ambitious goals that preceded and exceeded the standards set by European regulations (Arcuri, Tienhaara, and Pellegrini 2024). The law defined a tariff structure for waste, and introduced a system of penalties and incentives to enhance compliance, in addition to setting specific goals for the collection of separated waste (SWC) with clear timelines, including achieving 35% by 2006, 45% by 2008, and 65% by 2012 (Agovino et al. 2023, 2024).



**Figure 5. The Material Footprint in Italy.**

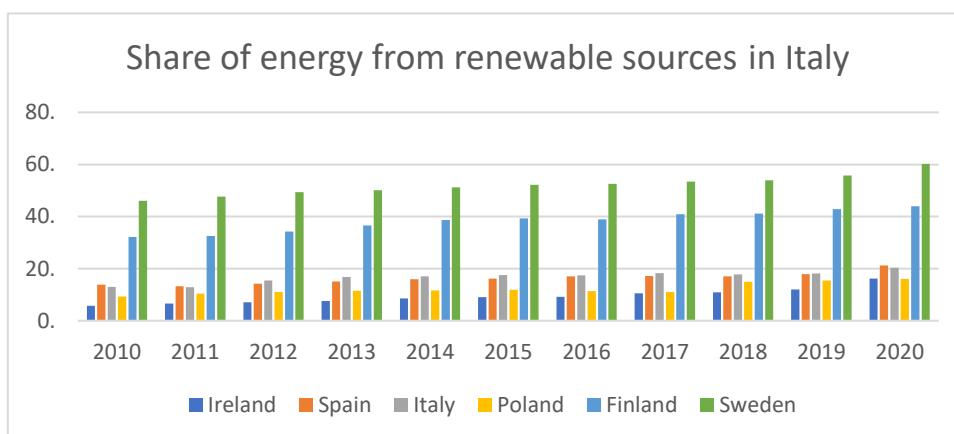
Figure (5) shows the decrease in the material footprint in Italy. The strategy of supporting innovations in production and operations, in the field of resource efficiency, waste treatment and transformation has contributed to placing Italy among the best countries in terms of the number of environmental process certificates and promoting the environmental footprint of products (OECD 2024).

### **Contribution of Renewable Energy to Total Energy**

Italy has put considerable emphasis on renewable sources of energy in recent years as a key priority that contributes to a reduction in the use of fossil fuels and external energy while decreasing the emission of greenhouse gases. The Italian government has

proposed to produce 30% of its electricity by 2030 through RES. Hydroelectricity plays an important role in the Italian energy plans (Quadroni et al. 2022). Geographical features of Italy accommodate a great number of rivers and mountainous areas where hydroelectric plants could be constructed. Large hydroelectric plants prevail in the northern part of the country, but small installations in mountainous areas contribute much to the total capacity (Kishore et al. 2021).

Italian wind energy has also grown significantly, mainly driven by funding programs of the European Union, including Horizon 2020 (D’Adamo et al. 2024). Such programs have covered a wide range of research projects that try to work on increasing the efficiency of wind farms, advanced technology in wind turbines, and deliver analyses of environmental, social, and economic results related to the generation of wind energy (Esposito and Romagnoli 2023) as shown in Figure (6).



**Figure 6. The Contribution of Renewable Energy to the Total Energy in Italy**

Figure (6) shows a gradual growth in the use of renewable energy in Italy. Its share has increased steadily over the decade, indicating the strengthening of national policies supporting renewable energy, such as the incentive system for solar and wind energy. Solar and hydropower are likely to be key drivers of growth, given Italy’s natural conditions. The share of Italy’s contribution is less pronounced in comparison to countries such as Sweden and Finland, which have much higher shares. This variance is due to the fact that the political system in Italy is dedicated to promoting and guaranteeing a go-ahead development of renewable energy through a green certification system and approaches of compensation for renewable energy resources.

## **5. DISCUSSION**

Among the most powerful economies both within the European Union and around the world, Italy faces its challenges, connected with natural resources scarcity and the following very high dependence on import, first of all, fossil energy, and minerals. High dependency might become one of the certain risks for the national economy's sustainability. The transition to the model of a circular economy thus represents an opportunity for strategies that make the Italian economy greener and, at the same time, more competitive on the world market. A better resource efficiency will cut down on waste, making Italy less vulnerable to the volatility in world natural resources markets thanks to economic and regulating incentives supporting business in the creation of production models with less need for imported resources and capable of fostering environmental innovation. Natural resources are also fundamental to local production processes, making great contributions to the manufacturing industry, which is the most relevant sector for Italian exports to foreign markets. In this sense, the transition to a circular economy not only reduces dependence on imported resources but also strengthens the competitiveness of Italian industries in international markets. This study evaluates the economic and environmental performances developed in the transition toward the Italian circular economy model. This work, in practice, will contribute to being a useful reference for scholars and practitioners working on circular economy issues since the research work developed will help the enhancement of further research and the creation of practical practices. This study also gives scientific support to policymakers and researchers in both the public and private sectors, but especially those interested in the development of transition strategies towards a circular economy at the macro level. In fact, by analyzing the achieved benefits, strategic guidance is provided that enhances the understanding of challenges and opportunities linked to the transition towards a more sustainable and competitive economic model.

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