The European Union Cohesion Policy impact on Circular Economy and Renewable Energy: a comparison between Portugal and Slovenia*

O impacto da Política de Coesão da União Europeia na Economia Circular e nas Energias Renováveis: uma comparação entre Portugal e a Eslovênia

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RESUMO: A Política de Coesão da União Europeia (UE) promove transições sustentáveis. Ela enfatiza o estabelecimento de um plano sólido de Economia Circular (EC) e um esforço de transição para Energia Renovável (ER) para um ambiente que corresponda aos objetivos de desenvolvimento sustentável das Nações Unidas. Este artigo compara o impacto da Política de Coesão Europeia nas práticas de EC e ER em Portugal e Eslovênia durante o último programa de financiamento de 2014 a 2020. Alinhada com os objetivos do Acordo Verde da UE, esta pesquisa analisa material qualitativo e dados quantitativos em índices cruciais para rastrear o desenvolvimento da sustentabilidade em Portugal e Eslovênia, levando a um modelo de previsão para os anos seguintes (até 2027). Esses países foram escolhidos devido às suas semelhanças em circunstâncias econômicas e estruturas legais ambientalmente amigáveis que permitem a comparação dos dois estudos de caso sem negligenciar variáveis cruciais. Ao focar em 12 dimensões dentro das dimensões EC e ER, o estudo visa

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identificar padrões que contribuem para uma compreensão abrangente das necessidades e estratégias específicas para fortalecer a seleção e implementação de projetos em ambos os países para o Programa de Política de Coesão da UE 2021-2027.

ABSTRACT: The European Union (EU) Cohesion Policy promotes sustainable transitions. It emphasises establishing a solid Circular Economy (CE) plan and a Renewable Energy (RE) transition effort for an environment that matches the United Nations' sustainable development goals. This article compares the impact of the European Cohesion Policy on CE practices and RE in Portugal and Slovenia during the last funding programme from 2014 to 2020. Aligned with the EU Green Deal goals, this research analyses qualitative material and quantitative data in indexes crucial to track sustainability development in Portugal and Slovenia, leading to a forecasting model for the following years (until 2027). These countries were picked due to their similarities in economic circumstances and environmentally friendly legal frameworks that allow comparison of the two case studies without overlooking crucial variables. By focusing on 12 dimensions within the CE and RE dimensions, the study aims to identify patterns contributing to a comprehensive understanding of the specific needs and strategies to strengthen project selection and implementation in both countries for the 2021-2027 EU Cohesion Policy Programme.

INTRODUCTION

Over the last decade, the concern surrounding the shortfall of waste management and growing pollution in large urban settings has contributed to the rediscovery of EU guidelines promoting sustainable development inside and among regions. The technologies working towards more efficient waste management and a smooth transition from fossil fuels to renewable energies are fundamental to reshaping the value chains inside European cities (Wilson, 2023). This transition entails a process of public policy with heavy expenditures to regions, countries, and the EU to bring efficient innovation to these markets, build infrastructures to accommodate such changes, and create a knowledge transfer process that raises awareness of this transition (Medeiros, Zaucha & Ciołek, 2023; Valič, Kolar, Lamut & Jurak, 2023).

The latest results of the EU Cohesion Policy in peripheral European countries (Portugal and Slovenia included) raise two concerns about the cohesion process. On the one hand, it must engage these innovations in the livelihoods of all regions without increasing the disparities between rural and urban settings (European Commission 2023a). On the other hand, it needs to offer the economic, political and social conditions to facilitate the implementation of such innovations (Chalmers,

2013). Hence, these countries were picked based on similar overall performance in policy implementation inside the EU cohesion policy in previous programmes and by the accentuated disparities between its main cities and the more peripheral areas within the countries.

Portugal and Slovenia were chosen as case studies for their similar economic contexts, EU cohesion policy implementation, and distinct historical and socio-economic trajectories in advancing CE and RE transitions. Portugal, located in Southern Europe, has historically faced challenges in waste management and energy dependency. Its diverse economy, heavily reliant on tourism, agriculture, and manufacturing, has provided a fertile ground for testing innovative CE and RE policies, albeit with regional disparities between urban and rural areas. The country's National Action Plan for the Circular Economy (2018-2020) and its early adoption of renewable energy projects underscore a sustained commitment to sustainable development, even amidst infrastructural and funding limitations (Henriques et al., 2021).

Conversely, Slovenia, a Central European country with a robust industrial base, has positioned itself as a front-runner in CE implementation. Initiatives such as the Roadmap towards the Circular Economy (2018) and targeted investments in energy efficiency exemplify the country's strategic orientation towards sustainability (Republic of Slovenia, 2023). Furthermore, Slovenia's smaller geographic size and centralised governance have facilitated cohesive policy implementation, allowing for effective alignment with EU objectives. These historical and structural distinctions between Portugal and Slovenia provide a compelling basis for comparative analysis, enabling insights into how diverse approaches to CE and RE can yield different outcomes under the EU Cohesion Policy.

The main goal of this research is to compare the levels of CE and RE between Portugal and Slovenia before the execution of the last EU cohesion policy programme, during the execution of the 2014-2020 EU Cohesion, and forecast the aftermath of the last EU Cohesion Policy period. This comparative analysis provides insights into sustainability patterns in CE and RE in Portugal and Slovenia evaluates the effectiveness of the EU Cohesion Policy and offers projections for 2020-2027. It explores the theoretical framework of CE and RE within the policy, examines implementation in both countries, identifies structural bottlenecks, and presents a detailed methodology, forecasting model, and results to compare policy impacts on sustainability.

LITERATURE REVIEW

The EU Cohesion Policy has functioned as the principal tool for addressing imbalances in territorial development across the EU (Medeiros et al., 2023). Yet, this policy has substantially changed its investment priorities across various programming periods, broadly aligning with overarching EU development agendas, such as Lisbon and Europa 2020 (Medeiros et al., 2023). As a key redistributor within the Euro-

pean economy (Crescenzi, Fratesi & Monastiriotis, 2020), the EU Cohesion Policy plays significant roles across numerous policy fields (Capello & Perucca, 2018), with a particularly impactful role in developing underdeveloped regions (Crescenzi & Giua, 2020; Di Cataldo & Monastiriotis, 2020; Percoco, 2017).

The EU Cohesion Policy as a catalyst for the transition to a Circular Economy and Renewable Energy

Territorial impact assessment studies conducted in specific EU Member States have demonstrated the instrumental role of the EU Cohesion Policy in accelerating territorial development, predominantly in less developed Member States (Medeiros, Zaucha & Ciołek, 2023). Building on this, Crescenzi & Giua (2020, p. 12) have affirmed that the "Cohesion Policy has contributed positively and substantially to regional economic growth, employment and CE across the EU." According to Fratesi & Wishlade (2017), this was pivotal in lessening disparities among EU regions and countries. Drawing from these insights, it's clear that the EU Cohesion Policy can also be strategically employed to foster the transition towards CE and RE to support the less developed regions in Portugal and Slovenia in moving towards more sustainable economic models. In contrast to recent studies, our primary focus is explicitly directed towards investigating the Cohesion Policy's nuanced and heterogeneous role in influencing two countries' sustainability performance over the long run (Crucitti, Lazarou, Monfort & Salotti, 2023).

For instance, the CE concept is a contested one; hence, the definition used in this article is the result of a systematic analysis by Kirchherr, Reike & Hekkert (2017) that refers to CE as a "combination of reduce, reuse and recycle activities" that has its goal in articulating economic prosperity with improving the environmental quality. Sustained by this definition, the indexes chosen to run the forecasting model applied in this analysis are directly related to achieving waste reduction targets and maximising resource potential in European cities while promoting an endogenous market.

Emerging from the "5R framework" (reduction, remanufacture, recycling, refurbishing, and reuse) (Pearce & Turner, 1991; Prieto-Sandoval, Jaca García & Ormazabal Goenaga, 2016), the concept of CE has not reached scholarly consensus despite nearly three decades of development. As a result, research on CE policies predominantly centres on waste treatment and energy transition, incorporating production process-oriented approaches to eliminate waste (Hartley, Van Santen, & Kirchherr, 2020; Hauschild, Herrmann & Kara, 2017; Reh, 2013; Saavedra, Iritani, Pavan & Ometto, 2018; Zuo & Yang, 2006).

The EU accepted CE as a key part of its previous grand strategy, Europe 2020 (Mazur-Wierzbicka, 2021), which aims to move toward smart, inclusive, and sustainable development (Rodríguez-Antón, Rubio-Andrada, Celemín-Pedroche & Ruíz-Peñalver, 2022). It is an integral part of UN Agenda 2030, a strategic document that, together with its Sustainable Development Goals, was accepted as the

current EU grand strategy, with strong implications on other European, national, regional, and local documents, strategies, and policies (Friant, Vermeulen & Salomone, 2021; Fric et al., 2023).

In 2020, the European Commission approved the European Green Deal (EGD) with the Circular Economy Action Plan (CE Action Plan) as one of its main building blocks, thus cementing it as a strategic priority (European Commission, 2019, 2020a). According to the Ellen MacArthur Foundation (2017), CE represents the EU's way of dealing with the pressures of growing economies and consumption of limited resources and environmental capacity as one of its most thoroughly developed concepts.

While CE policies predominantly target consumer products and construction, the energy sector needs to be more noticed due to the complexity of tracing and quantifying energy as a material. However, significant potential exists in aligning CE solutions with RE transition efforts, emphasising energy and resource efficiency in RE technologies. Unfortunately, on the EU level, policies remain disconnected, with the CE Action Plan primarily addressing energy efficiency in specific sectors. Key legal acts on energy, such as the Renewable Energy Directive and Energy Efficiency Directive (European Commission, 2012, 2020b; Ioana & Andra Tănase, 2023), need an explicit reference to CE solutions.

The recent EU Energy System Integration Strategy under the Green Deal highlights the need for a circular energy system focusing on energy efficiency, waste heat reuse, infrastructure synergies, and biofuel production from agricultural residues (European Commission, 2023b). Advancing CE is essential for RE transitions, maximising raw material utility, promoting reuse and recyclability, reducing waste, and fostering local energy production. This aligns with addressing the global challenge of over 2 billion tonnes of annual municipal waste (Kaza, Yao, Bhada-Tata & Van Woerden, 2018; Klopčič, Rončevič & Valič, 2022).

The impact of the EU Cohesion Policy funds through periods

Cohesion Policy is one of the oldest EU programs, going back to the creation of the European Regional Development Fund (ERDF) in 1975 (although the European Social Fund (ESF) was operating from 1965 onwards). The goal, diversity, complexity, and significant budget of this EU policy have piqued the interest of think tanks, evaluators, auditors, and academics. The EU's Cohesion strategy is one of its most complicated and intriguing programs. For more than three decades, a significant portion of the EU budget – currently €392 billion for 2021-2027 – has been explicitly dedicated to the Treaty goal of strengthening the EU's economic, social, and territorial cohesion by correcting territorial imbalances and promoting 'harmonious development' among countries and regions (Pazos-Vidal, 2019).

The funding available is implemented through a process known as shared management, in which multiannual programs are designed by national and regional authorities but overseen by the European Commission and delivered through proj-

ects that achieve specific strategic objectives and targets (European Union, 2022a, 2022b, 2023). EU funds (currently the ERDF, Cohesion Fund, ESF+ and Just Transition Fund are used to support programs and projects that address political priorities in key areas such as physical and digital infrastructure, business development, research and innovation, employment and training, low carbon and sustainability, and poverty reduction (Fioretti, Proietti & Tintori, 2021).

The policy's reach at the regional and municipal levels is enormous: from 2014 to 2020, the cohesion policy sponsored over 392 operational programs and about 1.5 million projects managed by approximately 500,000 project beneficiaries (European Commission, 2022a, 2022b). New measures for the operational programmes that were applied between 2014-2020 included a greater emphasis on results in program strategies, an obligatory performance reserve to reward achievement of spending targets at the midpoint of the program cycle, and the implementation of ex-ante conditions to improve the institutional, legislative, and strategic conditions for cohesion policy spending. Macroeconomic conditionality was extended to all Structural Funds from the Cohesion Fund (European Commission, 2022a).

Cohesion Policy aligns with Country-Specific Recommendations through investment priorities, emphasising a "place-based" approach supported by integrated territorial investments and community-led development since 2013. Financial instruments like loans and guarantees were introduced to create revolving funds and reduce reliance on donations (European Commission, 2022a). The most recent policy shifts have occurred against three crises that impacted EU circumstances: Brexit, the COVID-19 pandemic, Russia's invasion of Ukraine and, now, the latest war between Israel and Palestine. However, the Cohesion Policy and the *NextGeneration EU* (NGEU) share the crucial goal of inclusion. Since 2000, inclusion has been one of the clear goals of the European Social Funds and is one of the NGEU's pillars.

Many scholars have studied the impact of the Cohesion Policy in the EU and the contextual variables that might condition such effects (Giua, Hoxhaj & Pierucci, 2022). As described by Giua et al. (ibid.), some studies have produced several policy focuses, allowing for the preservation of a direct and exact relationship between policy and intended outcome. When measuring the overall impact of the Cohesion Policy on growth and employment, most of them look at the EU as a whole; other studies have identified interventions aimed at certain categories of territories in specific Member States (e.g., objective, urban areas, convergence). Other scholars have identified particular policy initiatives throughout the European field (Ferrara, McCann, Pellegrini, Stelder & Terribile, 2017) and firm support in assessing their influence on crucial outcomes (Bachtrögler, Fratesi & Perucca, 2020). Similarity also applies to other sectors, such as cultural and creative industries (Besednjak Valič, Čosić & Roth, 2024).

Slovenia's path to circular economy and climate neutrality

Slovenia is located in Central Europe and has a highly industrialised economy focusing on manufacturing, energy, and services. After the Slovenian Development Strategy 2005-2013 concluded, the government adopted the Slovenian Development Strategy 2030 in December 2017. It was built based on national priorities and integrated with the Sustainable Development Goals (OECD, 2018).

The country has also made progress in transitioning towards a CE and RE, with initiatives to reduce waste, promote sustainable production and consumption, and develop green technologies. For example, the Roadmap towards the CE in the Slovenia Field (Republic of Slovenia, 2018) sets the path for Slovenia to become a CE front-runner in the region. It identifies four priority sectors, gives recommendations to the government, and identifies best practices.

One of the most notable examples is the company *Evergreen*, which has developed a new type of biodegradable material made from agricultural waste that degrades in soil fields (Circular Economy Leeds, 2022). *Zero Carbon* has launched a new water hydration station product, and Spark *Inovacije* is working on road and transport optimisation to cut greenhouse emissions. Slovenia's CE evolution is also promoted by the Urban Transformation Initiative, a pivotal aspect of the Deep Demonstration project. This initiative focuses on reshaping urban areas and emphasises cross-community collaboration, systemic change projects, capacity building for city professionals, and business model innovation. Notable successes include transforming former industrial sites into green spaces, supporting circular business ventures like *GreenCycle*, and implementing waste reduction and recycling programs, contributing to decreased landfill waste. Challenges such as community engagement and pandemic adaptations have been addressed, showcasing the adaptability of the initiative.

Concerning the 2014-2020 Cohesion Policy, which made around €0.9 billion in EU funding accessible to the economy, the Slovenian Ministry of the Economy, Tourism, and Sport has already released 97% of these assessments by the end of 2022. The Ministry anticipates the existing cohesion funds from the previous fiscal period will be successfully utilised (Republic of Slovenia, 2023). Municipalities like Ljubljana and Maribor lead by example in Slovenia's energy transition and circular projects (Government Office for Development and European Cohesion Policy, 2022).

Portugal's transition to a circular economy and sustainable society

Portugal has a diverse economy focusing on tourism, agriculture, and manufacturing. The country has made progress in transitioning towards a CE, with initiatives to reduce waste (e.g., Better Plastics), increase recycling (e.g., POSEUR), and promote sustainable production and consumption. However, Portugal faces air pollution and waste management challenges.

In Portugal, the Cohesion Policy has supported the development of green in-

frastructure, such as waste management facilities and water treatment plants. The EU Cohesion Policy has also funded research and innovation in renewable energy, sustainable agriculture, and CE business models. In addition, the policy has supported social inclusion initiatives, such as training programs for disadvantaged groups (the post-COVID Resilience and Recovery Plan is a clear example of the skilling and reskilling efforts made through EU funds in disadvantaged Portuguese regions).

The Cohesion Policy works towards the goals of the National Action Plan for the CE (2018-2020) that was initially approved by the Portuguese government in 2017 and has been through several revision processes to adapt the Portuguese CE to new environmental and health challenges (European Environment Agency, 2021). From the first stage of the National Action Plan for the CE (2018-2020), the results were overall positive for the pillars of sensibilisation established by the Portuguese government to develop CE. Nonetheless, there are issues related to the reduction of waste production, the reduction of natural resource extraction and the introduction of secondary raw materials. These were the three macro actions with a non-satisfactory evaluation during the 2014-2020 EU Cohesion Policy stage.

The option to analyse the spectrum of projects funded by the EU Cohesion Policy to the promotion of the CE and RE can be explained by two main factors – firstly, the lack of efficacy in the implementation of European policy in both countries that can be attested by the low percentage of entirely executed projects in previous cohesion funds operational programmes. Secondly, both countries have been trying to set strategies to establish a long-term CE plan. Those strategies (Henriques et al., 2021) have been responsible for the flourishing of new projects at the national and local levels that look forward to achieving a more sustainable and net-zero economy.

MEASURING NATIONAL COHESION TRENDS

This article employs a quantitative and qualitative comparative study approach to analyse the impact of the EU Cohesion Policy on CE and RE's transition and its transition in Portugal and Slovenia. The research is based on a literature review of relevant studies, reports, policy documents and performance indexes related to the EU Cohesion Policy in the EU and both countries.

The analysis will be based on forecasting thirteen RE development and CE indicators available online at EUROSTAT, Pordata, and INE (Table 1).

Table 1: 13 indicators related to RE development
and CE availability in Portugal and Slovenia

1. Circular Economy	2. Renewable Energy / Energy Transition
% of Circular Material	% Final energy consumption of Fossil Fuels in the industrial sector
Generation of Plastic Packaging Waste per Capita	% Final energy consumption of Renewable Energy in the industrial sector
Recycling % of Municipal Waste	% Final energy consumption of Renewable Energy by product
% of Recycled Electrical Waste	% Final energy consumption of Solar Thermal energy by Household
Amount of Private Investment in CE	% Final energy consumption of Gas oil in transport sector
Consumption Footprint	% Contribution of Renewable Energies to energy consumption

Source: Own elaboration, 2024.

The analysis spans 2013 to 2021, covering the European Cohesion Policy 2014-2020, with 2013 and 2021 data included to track index trends. These trends informed a forecasting model using "Excel" and "R" to guide funding allocation for addressing declining indexes (Shaik et al., 2023). The methodology follows ten steps outlined below order:

1. data collection from indicators on RE and CE from 2013 to 2021.

2. The data collected is divided into three clusters of time – the first stage of implementation from 2013-2015, the middle of the European Cohesion Policy from 2016-2018 and the final stage (fell under the same time spectrum of COVID-19 with possible implications to the final results) from 2019 to 2021.

3. Find the average value for every possible group of three years, i.e., 2013--2015, 2014-2016, and 2015-2017. From now on, it will be denominated μ.

4. The fourth step aims at finding the Cμ values. Cμ results from the average among the groups established in the previous step. F.e: Cμ = μ 2013-2015 and μ 2014-2016 or Cμ = μ 2015-2017 and 2016-2018.

5. This step defines the overall trajectory of the vectors in the analysed indexes, Si. This value is obtained by the following operation Si = Original data/Cμ. A result above 1 would mean an overall growth trajectory in the designated vector, while under 1 means a decrease in that vector.

6. It intends to achieve a clean average of the Si to all the clusters' first, second, and third years established in step 2. An example of how to achieve Qμ: Qμ = μSi (2013; 2016; 2019).

7. The results of the last step are applied in this stage to exclude the seasonality component by applying the following operation: Original data/Qμ. This

step is necessary to elaborate a more accurate forecast of the next EU CP programme towards 2027. The result of this stage explains how much of every year's value can be explained by the effects of seasonality, which is especially important given the inconsistencies of the values that might arise during the COVID-19 period.

8. The amounts obtained in the previous step will work as the Y variable to run a simple linear regression. In this case, the X variable will be a dimension that provides numbers for the years of analysis. In this case, 2013 = 1, 2014=2, 2015=3 and so on until reach 2021=9.

9. Supported by the linear regression, the next column will display the result of the following operation: 'Intercept + t*variable'. Therefore, for 2013, the model applied was Tt = Intercept + t*1, and for the year 2014 was, Tt = Intercept + t*2.

10. The last part of the forecasting process is to run the model Qμ*Tt from 2013 to 2021 and export to the following years to achieve the expected predictions from 2022 to 2027.

This model is not expected to predict the results of the following EU Cohesion Policy with maximum accuracy. However, it draws a compelling portrait of CE trends in RE in Portugal and Slovenia. These trends are the first diagnosis to build policy plans for working on the bottlenecks preventing the implementation of projects in some dimensions and comprehending the relationship between the amount of funding allocated and the indexes' performance.

RESULTS

The analysis provides valuable insights into CE and RE trends in Portugal and Slovenia. While positive developments are evident, the forecasting model emphasises the need for continued efforts to address challenges and optimise funding allocation for sustained progress. These insights are a foundation for informed decision-making and strategic planning for future EU Cohesion Policy programs towards 2027.

As shown in Figures 1 to 6 (own elaboration based on INE, Pordata and EUROSTAT data, (2024), the analysis provides valuable insights into CE and RE trends in Portugal and Slovenia. While positive developments are evident, the forecasting model emphasises the need for continued efforts to address challenges and optimise funding allocation for sustained progress. These insights are a foundation for informed decision-making and strategic planning for future EU Cohesion Policy programs towards 2027.

Circular economy

Valuable understandings and predictions of CE trends for Portugal and Slovenia from 2013-2027:

Figure 1: % of Circular Material flow in Portugal and Slovenia
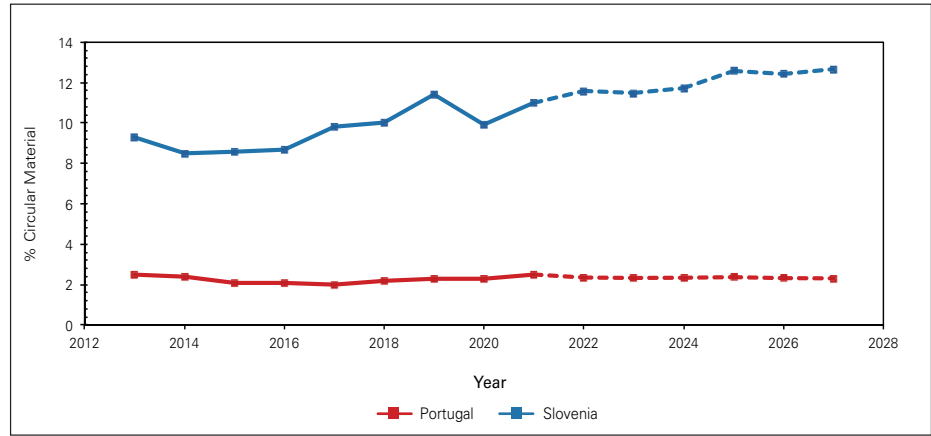(own elaboration based on Eurostat, Pordata and INE data, 2024)

Figure 2: % of Plastic Packaging Waste per capita in Portugal and Slovenia
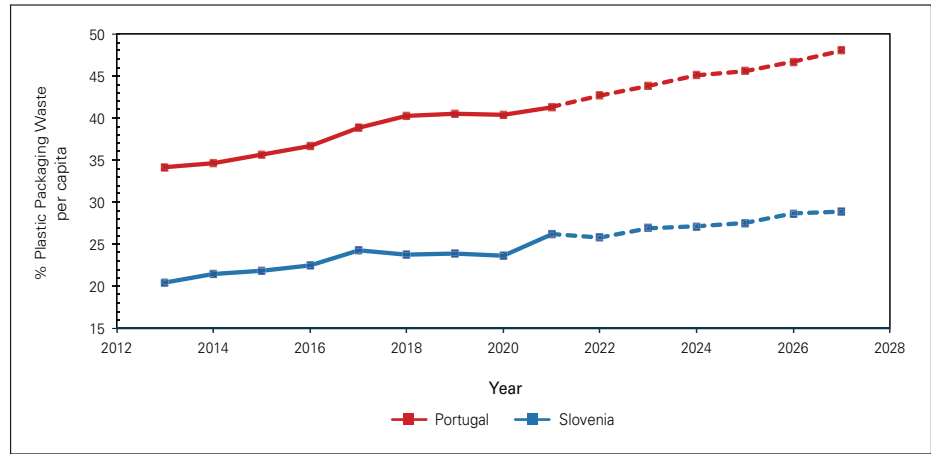(own elaboration based on Eurostat, Pordata and INE data, 2024)

Figure 3: % of Recycled Waste by Municipality in Portugal and Slovenia
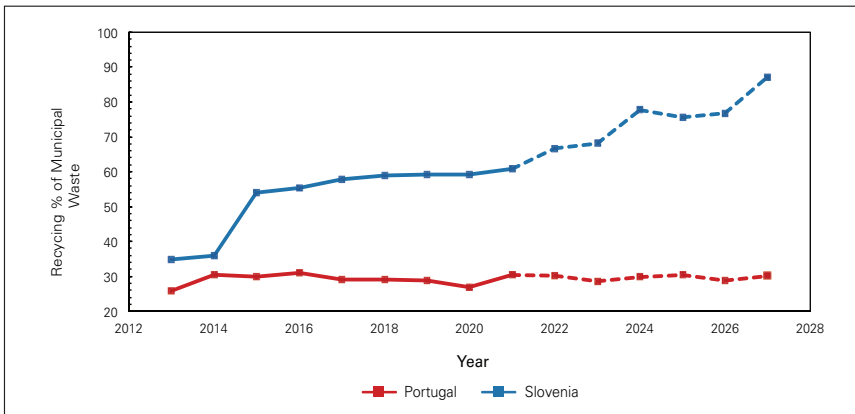(own elaboration based on Eurostat, Pordata and INE data, 2024)

Figure 4: % of Recycled Electrical Waste in Portugal and Slovenia
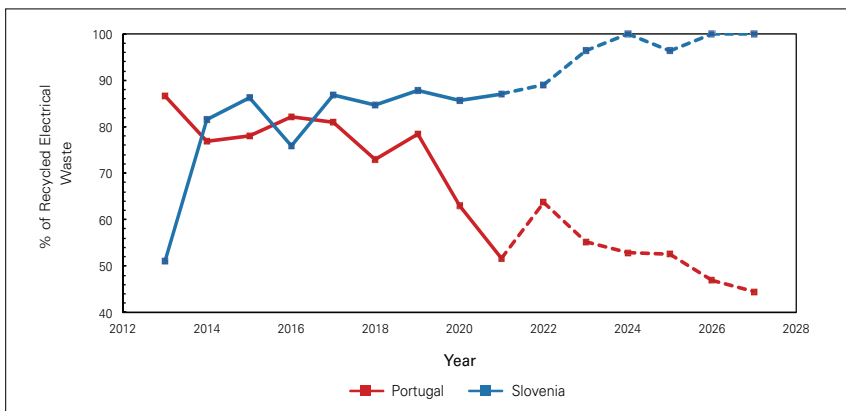(own elaboration based on Eurostat, Pordata and INE data, 2024)

Figure 5: Private Investment in Circular Economy in Portugal and Slovenia
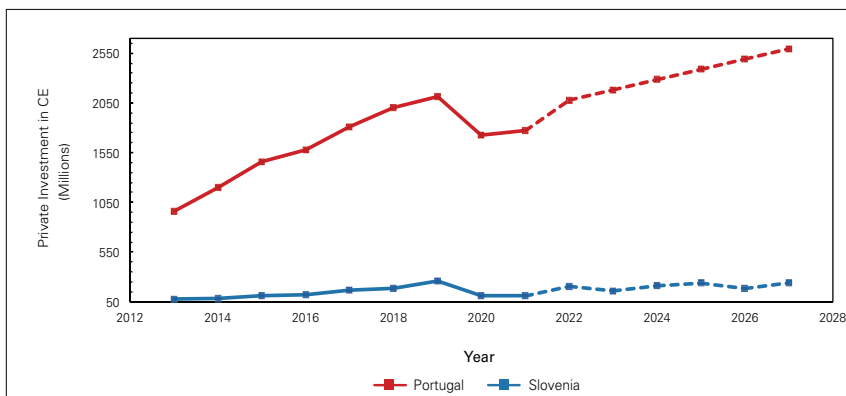in millions of € (own elaboration based on Eurostat, Pordata and INE data, 2024)
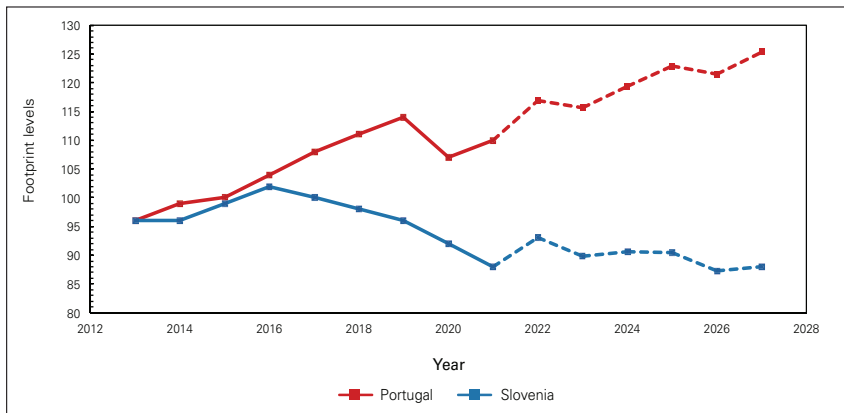
Figure 6: Footprint Levels related to Waste Production in Portugal and Slovenia (own elaboration based on Eurostat, Pordata and INE data, 2024)

The CE dynamics promoted during the 2014-2020 period of the EU Cohesion Policy in Portugal and Slovenia helped both countries improve their overall development in the transition to a better waste and energy management process. Slovenia performs excellently in all the six variables presented in the CE dimension, with more promising results than Portugal in the forecast period. Slovenia's starting point (2013) in all the indexes was already ahead of the Portuguese get-go position, although the differences between both countries increased throughout the 2014-2020 period. Hence, the projections for the programme being implemented in 2021-2027 unravel an intensification of the disparities in almost all the tables displayed above.

Slovenia has a strong case towards achieving an almost 100% rate by 2027 on the recycling levels in the national territory. The solutions for the recycling cycle in Slovenia have been growing in various departments throughout the 2014-2020 program. Therefore, the recycling systems are peaking at the municipal level, with an increment in the efficiency of the infrastructure for electrical waste reuse. When considering the percentage of municipalities with plans for recycling waste, Slovenia is expected to keep steady growth. At the same time, Portugal did not significantly increase its numbers through the European Cohesion Policy Programme 2014-2020, and it is not expected to do so. Under similar execution conditions and similar investment, the municipal rate of recycling waste will be around 30%. At the same time, the Slovenia index shows a solid forecasting trajectory, which will peak by the end of the next EU Cohesion Policy Programme around 2027.

This explains the increase in the % of circular material within the Slovenian economy, which is expected to reach around 13% of reused material flow. This index contributes to the natural reduction of the citizens' footprint in Slovenia, which explains the tendency for the Slovenian footprint to decrease in 2021-2027. Meanwhile, this represents a significant concern in Portugal's sustainable performance.

The slow growth or often degrowth in recycling parameters in Portugal illustrates a problem that must be addressed in future cohesion programmes to close

the gap between Portugal's and the EU's average levels. This phenomenon contributes to the underperformance rate in the footprint dimension, which might be tackled by the willingness of private investment to support the CE in Portugal. As the graphs show, despite the COVID-19 hit in the private sector, Portugal has a growing amount of investment in the CE by non-public organisations; the same cannot be said for the Slovenian economy. However, while the underperformance of the Portuguese economy in the CE opens a gap that the private sector in Portugal can explore, the very positive trajectory of Slovenia's CE is mainly dominated by government programmes, and it is not appealing to the entrance of new private entities in the recycling field.

Energy

As we see in Figures 7 to 12 (own elaboration based on INE, Pordata and EUROSTAT data, 2023), the path towards transforming the energetic sector to become more renewable-based reverses the tendency of the CE. The RE is underway with positive results in Portugal. However, it has been facing challenges to develop its full potential in Slovenia. RE projects had a successful implementation from 2014 to 2020, compared with the starting point 2013. Moreover, these indexes in Portugal are expected to keep improving their results throughout the 2021-2027 programme. The growth of Portugal in the energetic transition is not as exponential as the one observed in Slovenia concerning the adoption of CE practices; however, there is a steady tendency of growth that legitimates the flow of European funding to support RE initiatives in Portugal in the following years. On the other hand, Slovenia is struggling with high levels of fossil fuel utilisation in the transport sector, which are not envisioned to be reduced until 2027.

Valuable understandings and predictions of RE trends for Portugal and Slovenia from 2013-2027:

Figure 7: Industrial consumption of fossil fuel by the manufacturing industry in Portugal and Slovenia in thousands of tonnes of oil)
(own elaboration based on Eurostat, Pordata and INE data 2024)

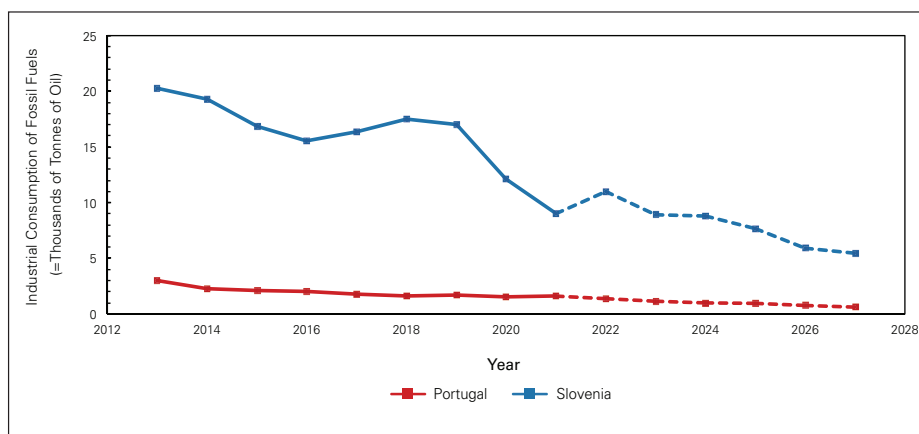in millions of € (own elaboration based on Eurostat, Pordata and INE data, 2024)

Figure 8: Industrial Consumption of RE by the manufacturing industry
in Portugal and Slovenia in thousands of tonnes of oil
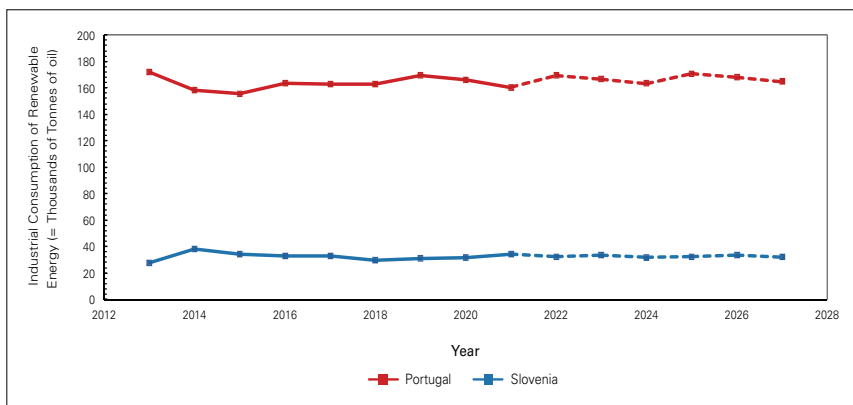(own elaboration based on Eurostat, Pordata and INE data, 2024).

Figure 9: Renewable energy is used in the production process as a by-product of thousands
of tons of oil (own elaboration based on Eurostat, Pordata and INE data, 2024).
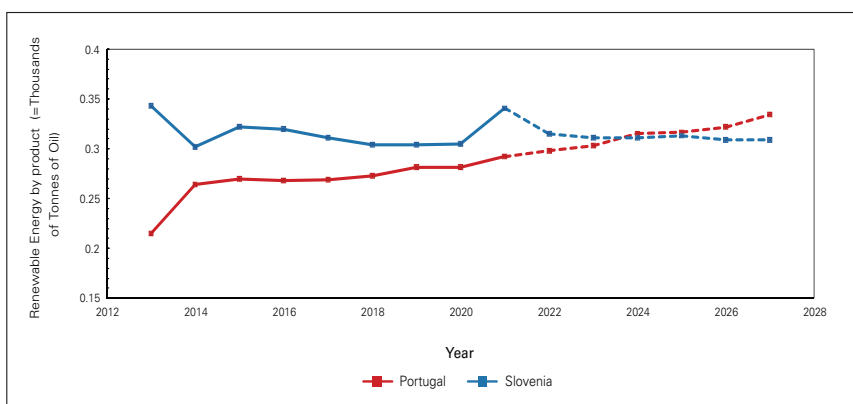

Figure 10: Thermal Energy Consumption by Household in thousands of tonnes of oil
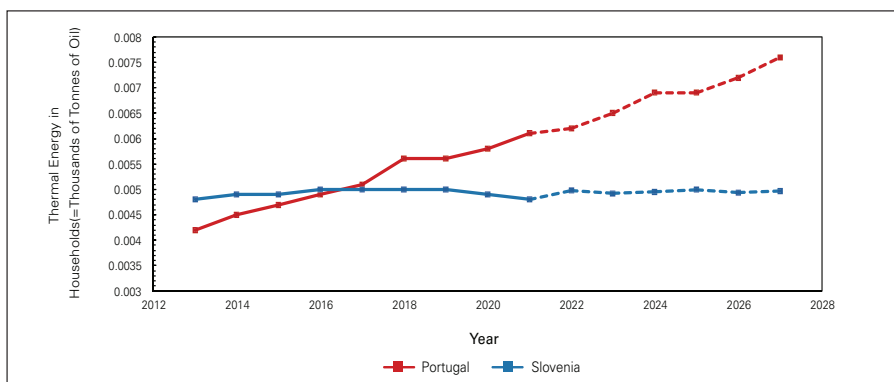(own elaboration based on Eurostat, Pordata and INE data, 2024).

The gas usage % in the transport sector in Slovenia is predicted to go higher in 2027 than before the 2014-2020 period, going above the 80% mark. At the same time, the Portuguese transportation sector will only rely on gas as the main fuel, with strong expectations for the percentage to go down to the 55%/50% mark after 2027. Hence, the need for expected improvement in the dimension of RE to the transport sector deserves more attention from policymakers who are drawing future European cohesion policy programmes. These numbers go against almost all the other indicators that show a slight general improvement in the utilisation levels of renewable energy.

Despite the lack of changes in the transport sector, Portugal has improved its RE consumption. The transition is notorious when comparing the numbers in 2013 and the values expected for 2027. When compared with the low starting points,

Portugal has achieved remarkable performances during the 2014-2020 period, and it is forecasted to grow even more in the % of thermal energy to household consumption, the % of RE used in every product production process and the overall % of RE consumption across all sectors.

These sustainable dynamics are still to be further developed given the mainstream usage of fossil energy sources; however, Portugal is on the right track to apply renewable energies on a large scale in the industry, transport and household domains. Slovenia is still trying to catch the pace, and no remarkable improvements are expected until 2027, with exceptions made to the successful efforts to tackle mass fossil fuel utilisation in the industrial field. The decrease in the number of fossil fuel energy applications in Slovenian industries from around 20% in 2013 to the possibility of reaching numbers close to 5% in 2027 shows the strong impact the EU cohesion policy can have in a short time window.

Nonetheless, following the graph interpretation, the EU cohesion policy and the national authorities in Slovenia must complement the reduction of fossil fuels with a precise investment in RE sources. The possible stagnation of the % of RE applied to industries in Slovenia, very different from the Portuguese numbers, might undermine the industrial growth in the EU context, given the tendency of the EU to fund and support companies which adjust to the RE, leaving the companies based in fossil fuels with a comparative structural disadvantage.

DISCUSSION AND CONCLUSION

The results of this research emphasise two different dynamics within the comparison between Portugal and Slovenia regarding CE and RE policy during the European Cohesion Policy 2014-2020 stage. Slovenia advanced significantly in CE, building on a stronger starting point in 2013, while Portugal outperformed Slovenia in RE but saw a slower pace of progress. Slovenia is expected to maintain steady growth, peaking by 2027, while Portugal's recycling rates stagnated. Both countries reached around 30% municipal recycling rates under similar conditions.

Funding disparities underline the differences in sustainability outcomes, with Slovenia showing stronger growth in RE, including per capita and industrial sectors, though it remains behind Portugal's RE levels. Portugal invested heavily in large green hydrogen projects, which are still in progress, while smaller initiatives, such as public transportation upgrades in Lisbon and Porto, supported steady RE usage.

The EU Cohesion Policy facilitated moderate growth in CE and RE but fell short of expectations. Issues such as outdated infrastructure, limited market capacity, COVID-19 disruptions, and the war in Ukraine hindered progress. Despite these challenges, Slovenia effectively tackled sustainability gaps, achieving notable RE growth, while Portugal's progress in CE was less pronounced, reflecting differing national programme successes.

The analysis of Portugal and Slovenia's transition towards a CE and RE under the EU Cohesion Policy has provided valuable insights into the successes and chal-

lenges faced by both nations. Slovenia is a standout performer in the CE, showcasing steady growth across various indicators. The country's commitment to recycling, municipal waste management, and governmental initiatives positions it as a model for sustainable practices. Contrary to this, Portugal faces hurdles in reaching similar CE milestones, emphasising the need for strategic interventions to bridge the gap. The RE trajectory unfolds differently for these nations. Portugal demonstrates commendable progress, particularly in adopting RE sources across industries, households, and transportation. The positive trajectory in Portugal's energy sector aligns with its commitment to reducing fossil fuel dependence. On the other hand, Slovenia grapples with challenges, especially in the transport sector, where a significant reliance on gas persists. The forecasted increase in gas usage in Slovenia calls for targeted measures to ensure a more balanced and sustainable energy mix.

Divergent funding models shape the CE and RE landscapes in both countries. Portugal's engagement with private investment in the CE underscores the role of non-public entities in driving sustainability initiatives. In contrast, Slovenia's success in CE is primarily steered by governmental programs, signalling different paths to achieving sustainability goals. The COVID-19 pandemic introduces a layer of complexity, disrupting the implementation of projects and requiring adaptive strategies for both nations to recover and refocus on their sustainability agendas.

Looking ahead to 2027, the forecasting model provides a glimpse into the future trends of CE and RE in Portugal and Slovenia. The projections highlight potential disparities, urging policymakers to consider targeted interventions and resource allocation strategies. Lessons learned from these nations can guide other EU member states in navigating their sustainability journeys. The EU Cohesion Policy, while instrumental, must evolve to address emerging challenges and seize opportunities for a more resilient and sustainable future.

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STATEMENT ABOUT DATA AVAILABILITY
Research data is only available upon request to the researcher.